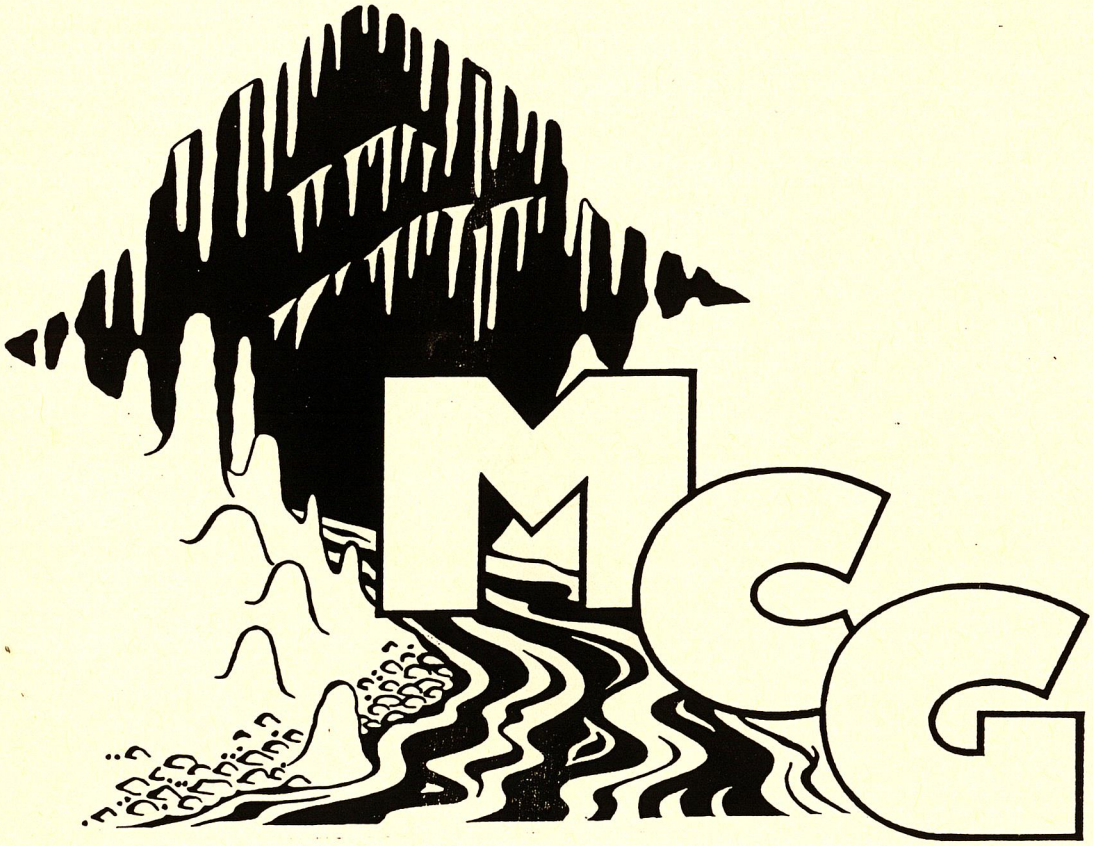
Mendip Caving Group



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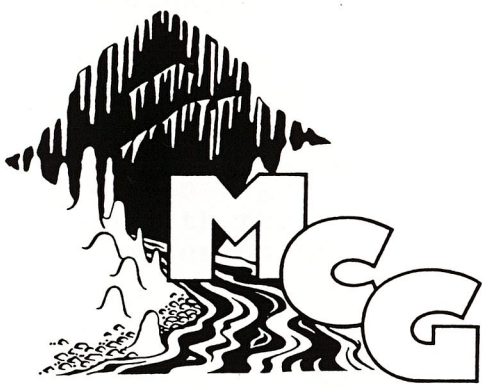

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LOW-VOLTAGE TUNGSTEN HALOGEN BULBS FOR CAVING USE

Over the past few years considerable improvements have been made to the performance of low-voltage (2.5V to 6.0V) bulbs through the introduction of tungsten halogen technology. In addition, the range of bulbs available has considerably expanded, allowing great variation in light intensity and duration to be obtained in conjunction with the increasing range of purpose-designed rechargeable batteries now offered by caving suppliers.

WHAT IS A BULB?

Bulbs are simple things; a tungsten wire filament is held suspended within a glass envelope which is fitted to a metal base for mounting in a suitable lamp in circuit with a battery. The electrical current passing through the filament causes it to glow brightly at about 3000 degrees Centigrade in a vacuum or in an atmosphere of inert gas to avoid oxidisation of the filament.

Vacuum-filling is cheap and not particularly efficient, but the use of an inert gas allows the filament to "burn" at a higher temperature than is possible in a vacuum, with less vaporisation of the tungsten - the cause of internal blackening of the glass envelope. Argon was the most widely used inert gas, but krypton and xenon are now most common in low-voltage bulbs for specialised torches and long-range handlamps where their 20% efficiency gain over vacuum types is desirable and worth paying for.

Comparatively recently, halogen gas filling has been introduced, further increasing light intensity efficiency - expressed as lumens per watt (lm/W) of electrical energy - and producing a notably white light. Halogen bulbs are said to be 20 - 50% more efficient than krypton/xenon bulbs of equivalent wattage, and are rather more expensive.

Halogen bulbs are readily distinguishable from other types by their shape; the glass envelope is a squat cylinder about 8mm in diameter with a flat top, of which the centre is drawn to a blunt point. Krypton and xenon bulb envelopes are either spherical or ovoid in shape.

It is worth noting that these are not the quartz halogen bulbs as used in projection equipment, hence the warning about not finger-marking the quartz envelope does not apply. These bulbs have glass envelopes and may be wiped clean using a cloth.

This article is primarily concerned with placing halogen bulbs in the context of caving use where their markedly greater efficiency over the long-established krypton bulbs brings readily appreciable benefits.

CHOOSING A SUITABLE BULB

A major aspect of bulb selection is the type of bulb base fitting provided in the lamp or headpiece - for either Miniature

Edison Screw (MES) or the pre-focus (PF) variety. Modern Oldham headpieces can be adapted to accept a main bulb with either type of base, but Nife headpieces only accept MES bulbs. A few bulb ratings are available with both types of base, but the widest choice lies in the pre-focus range.

There is no difference between MES or PF bulbs in terms of light output, and there are several instances where bulbs of the same electrical specification are available in both forms.

BULB VOLTAGE RATING

Choosing a bulb for use with a given battery is a matter of getting the right balance. Battery voltage imposes some constraint as the effects of over-running or under-running a bulb can be considerable. Of course, the bulb manufacturers have already set product voltages to match typical power sources.

Battery voltage deteriorates during discharge according to the type of battery and the current drain in amperes (A) imposed by the bulb. Figure 1 shows typical discharge curves for the two most common types of rechargeable battery: nickel-cadmium and lead-acid. It will be seen that each type has its own specific nominal voltage - 1.2V per cell for nickel-cadmium and 2.0V per cell for lead-acid batteries. Bulb voltage rating is normally chosen to conform to the nominal voltage of the battery which, in practice, means that the bulb is slightly over-run initially and under-run at the end point.

BULB CURRENT RATING

The ampere rating of the bulb must be chosen to correspond to the ability of the battery to efficiently supply the current drain imposed. Rechargeable batteries have an energy storage capacity specified in ampere-hours (Ah), which is always related to a recommended current drain. Significant current variations above or below that recommendation will reduce or increase the capacity obtainable.

For example, a battery specified as having a 6Ah capacity at the 20-hour rate (C/20 in manufacturers' terminology - C being capacity in Ah) gives its full rated capacity at the current appropriate to achieving a complete discharge in 20 hours, ie. 6Ah divided by 20h - 0.3A. However, if a 1.0A bulb were used, simply dividing the 6Ah capacity by the 1.0A current to obtain light duration in hours would no longer apply.

Taking a typical commercial 6Ah sealed lead-acid battery as an example, a 1.0A current drain (over three times the C/20 rate specified) would reduce available capacity to 5Ah. A further increase to 2.0A would reduce capacity to only 4Ah. Such a penalty may be quite acceptable in some applications, but this aspect should be borne in mind when choosing a bulb.

Although more expensive, sealed nickel-cadmium batteries are able to cope with higher discharge currents and their capacities are specified at the C/5 rate. Accordingly, a 6Ah version of this type of battery would give its full rated capacity when discharged through a 1.2A bulb.

It should be noted that the Oldham T3 lead-acid mining lamp battery is designed to operate with a 1.0A bulb which indicates that its recommended discharge rate is C/10 or better.

THE EFFECTS OF VOLTAGE VARIATION

The message of Figure 2 is that the application of a voltage higher or lower than that specified for a given bulb will significantly alter its life expectancy and light intensity properties. However, it is often necessary to accept some variation in order to obtain a desired current drain.

There is, for example, a wider choice of 4.0V bulb than 3.6V. Figure 2 shows us what the consequences are of using a 4.0V bulb with a 3.6V battery, ie. at 10% under its design voltage. The expected changes in its performance are:

- four times longer design life (hours)
- 14% less energy consumption (watts)
- 28% less light intensity (lumens).

Conversely, using a 3.6V bulb with a 4.0V battery at 11% above its design voltage gives:

- design life reduced by 75%
- energy consumption increased by almost 20%
- light intensity increased by 40%.

Raising or lowering energy consumption through the bulb will either reduce or increase the light duration obtained from the battery. Increasing light intensity may seem advantageous, but the consequential serious degradation of bulb life, which this entails, easily outweighs the apparent benefits. But what is the life of a bulb?

Looking at most catalogue lists of bulbs, you will find only the basic physical and electrical data - light intensity and design life data are rarities. However, a recent RS Components catalogue (March-August 1993) offers both light intensity and bulb life in hours; but when the bulb which I have been using over a three-year period is attributed only 25 hours life, it is not clear how such data should be interpreted.

The bulb in question is a halogen rated at 4.0V/0.85A and powered by a 3.6V battery - at 10% under its rated voltage, this should increase life by a factor of four. Even so, three-years use is considerably more than 25 hours x the operating factor (100 hours) and it can be reasonably assumed that the stated life refers to a guaranteed minimum burning time at the rated design voltage.

LIGHT INTENSITY

If the available data for all bulbs provided an accurate figure for light intensity, comparison between them would be easy. This is not the case, however, and any discussion of light intensity is liable to become conjectural.

In late 1992 I became aware that three new caving caplamps had been announced - Apex 10, Apex 17 and FX5 - all of them powered by 6.0V rechargeable batteries and fitted with halogen bulbs. Being a user of 3.6V and 4.8V systems, 6.0V battery/bulb combinations were unknown to me, and I decided to compare the light outputs of various bulbs operating with each of these three voltages plus 2.4V to represent the FX2 caplamp.

Two aspects were of particular interest and seemed to merit investigation and quantification:

- halogen were claimed to be more efficient (lm/W) than krypton types, and
- 6.0V halogen bulbs were said to be as much as 50% more efficient than 2.5V versions.

Clearly, if both of these propositions were correct, then the 6.0V Apex and FX systems would represent a quantum jump in the evolution of caving lamps.

Relating to these new lamps, 6.0V halogen bulb intensities of 36, 90 and 190 were mentioned, but since I could neither envisage how these differed nor, through a lack of published data, compare these figures with other more familiar bulbs, I decided to set up a simple experiment to permit direct visual comparison between groups of bulbs in operation.

To verify efficiency claims, three 6.0V halogen bulbs were included in a list with nine other bulbs of lower voltage - both halogen and krypton types. The aim of the experiment was simply to place these twelve assorted bulbs in order of perceived light intensity.

I made a simple open-fronted box from white Melamine-faced chipboard, divided into four identical compartments arranged in line. Each compartment measured 6x6cm in cross-section and was 12.5cm deep. An MES bulbholder was placed 10cm from the back wall of each compartment.

With each compartment illuminated by a different bulb, it was easy to compare filament intensity and reflected light against the white surface 10cm beyond the bulbs, each one adjusted to align the filament axis at 90 degrees to the viewing direction. The subtle colour difference between the slightly yellow krypton light and the whiter halogen was attenuated by placing a pale-blue translucent PVC "window" over the four compartments. This avoided colour differences influencing the observations.

Bulbs were progressively inter-compared in groups of four and the results double-checked until the following order of ranking was reached.

Table 1. Ranking of bulbs by perceived intensity

Rank	Rating	Type	Watts	Points	Published data lm	lm/W
1	2.4V/1.0A	Krypton	2.4	10	22	11.0
2	2.5V/0.8A	Halogen	2.0	10	23	11.5
3	2.4V/1.25A	Krypton	3.0	12	*31.5	*10.5
4	4.0V/0.5A	Halogen	2.0	12	33	16.5
5	3.6V/1.0A	Krypton	3.6	13	*38	*10.5
6	4.0V/1.0A	Krypton	4.0	14	*42	*10.5
7	6.0V/0.4A	Halogen	2.4	14	36	15.0
8	4.0V/0.85A	Halogen	3.4	16	60	17.6
9	4.0V/1.0A	Halogen	4.0	17	*68	*17.0
10	5.2V/0.85A	Halogen	4.4	19	85	19.3
11	6.0V/1.0A	Halogen	6.0	22	90	15.0
12	6.0V/1.7A	Halogen	10.0	30	190	19.0

* Values for these bulbs were obtained by averaging data published in RS Components and Caving Supplies catalogues.

Each bulb was given an empirical 'points' value, arbitrarily commencing at ten - to indicate a degree of perceived difference. In three instances a halogen bulb is seen to be as bright as a krypton bulb of higher wattage, conforming to the assertion that halogen bulbs are more efficient than krypton.

Referring again to those same three instances of visibly equal brightness, an interesting trend can be seen:

- the 2.5V halogen has a 0.4W (16.5%) advantage over its 2.4V krypton equal,
- the 4.0V halogen has a 1.0W (33.3%) advantage over its 3.6V equal, and
- the 6.0V halogen has a 1.6W (40%) advantage over its 4.0V equal.

Give or take a few percentage points either way, it is a reasonable assumption that halogen bulbs become increasingly efficient as their rated voltage rises. This observation may provide the clue as to why 6.0V batteries are in vogue today.

I later discovered some published light intensity data in the 1993 RS Components catalogue and in the 1992-1993 Caving Supplies catalogue. Data from these have been appended to the comparison table above, to give an alternative measure by which the bulbs can be compared, and which tend to substantiate the visual findings.

These same data have provided the basis for constructing Figure 2 which illustrates comparative bulb efficiency in terms of lumens per watt. Although krypton/xenon types show efficiency increasing with voltage, it is the halogen bulbs which most markedly show this trend. The 12.0V halogen bulb is included simply to indicate that this trend does not continue ad infinitum.

CONCLUSIONS

Increasingly up to 6.0V, halogen bulbs are approximately 20 - 50% brighter than their krypton/xenon equivalents.

From the 11.5 lm/W efficiency of the 2.5V halogen bulb, there is an improvement of broadly:

- 50% (to about 17.0 lm/W) for 4.0V bulbs, and
- 65% (to about 19.0 lm/W) for 6.0V bulbs.

So the message would appear to be - choose a halogen bulb of from 4.0-6.0V rating and use it in conjunction with a suitable battery. However, there is a countervailing argument which must taken into account - increasing battery weight with rising voltage.

The following table shows the currently available range of halogen bulbs from 2.5 to 6.0V.

Table 2. Low-voltage halogen bulbs available (1993)

Rating	Watts	Base	lm	lm/W	Source
2.5V/0.8A	2.0	MES,PF	23.0	11.5	BP,CS
2.8V/0.85A	2.38	PF	35.0	14.7	CS,RSC
4.0V/0.5A	2.0	MES	33.0	16.5	BP,CS,RSC
4.0V/0.75A	3.0	MES	51.0*	17.0*	BP
4.0V/0.85A	3.4	MES	60.0	17.6	RSC
4.0V/1.0A	4.0	MES,PF	68.0*	17.0*	BP,CS
4.0V/1.2A	4.8	PF	82.0*	17.0*	CS
4.0V/1.5A	6.0	PF	102.0*	17.0*	BP,CS
4.5V/0.85A	3.8	MES	65.0*	17.0*	Midica**
4.75V/0.5A	2.8	MES,PF	44.0	15.7	BP,CS
5.2V/0.85A	4.42	MES,PF	85.0	19.3	RSC
6.0V/0.4A	2.4	MES,PF	36.0	15.0	BP,CS
6.0V/1.0A	6.0	MES,PF	90.0	15.0	BP,CS,RSC
6.0V/1.7A	10.0	PF	190.0	19.0	BP,CS,RSC
6.5V/0.7A	4.55	PF	90.9	19.8	RSC

* Values obtained by averaging from published data for similar bulbs.

** Only known supplier located in Toulouse (a Mazda product).

PRACTICAL APPLICATIONS

Figures 4a to 4f illustrate nominal light intensities and burning times of halogen bulbs matched to appropriate batteries. As explained earlier, bulbs operated above or below their rated voltage provide a higher or lower level of brightness to that specified. For example, all the 4.0V bulbs shown operating with a 3.6V battery (Figure 4a) are working at 10% below rated voltage and consequently (see Figure 2) give only 72% of their rated intensity. Effects of such variation have been taken into account and lumen values shown in brackets indicate where adjustments have been made.

There can be no such thing as an optimum light intensity for a caving caplamp; people's appreciation of adequate light may differ, and the variation possible in the reflectance properties of limestone can be considerable. However, the judgement of the National Coal Board once held that a 4.0V/1.0A krypton bulb provided an acceptable brightness level for men working underground.

This krypton bulb gives some 40/45 lumens which may represent a sensible light intensity for the caver also. Certainly, users of mining caplamps never seemed short of illumination, and the 68 lumens attributed to the 4.0V halogen equivalent is more than adequate. My own view is that 50 lumens is totally acceptable and 70 lumens is positively dazzling. Beyond this level, one is entering the realm of special effects.

FX2 enthusiasts must forgive the omission of this battery/bulb combination - left out on the basis that its 23 lumen output has been marginalised by current trends in lamp design. Also, the availabilty of only two almost-identical bulbs denies it any real claim to flexibility.

However, the FX2 has been the proving ground for the F-size (33mm diameter x 92mm long) sealed cylindrical nickel-cadmium cell in caving use. It is ideally suited to make up into batteries of two (FX2), three (FX3) and four cells without incurring problems of bulk or weight (240g per cell). The FX5 employs five such cells, which may prove to be too cumbersome for some cavers.

The FX3 has the right physical and electrical properties to challenge that long-accepted yardstick of portable underground lighting - the 4.0V lead-acid mining battery. Without doubt, users of Oldham T3 batteries have the widest choice of bulb ratings available to them, and this same choice reads across to the smaller and lighter FX3 3.6V caplamp but with some loss of brightness and duration.

The Apex 6.0V lead-acid batteries have yet to earn their laurels by withstanding the customary knocks endemic in cave use, and occasional ill-treatment by their owners. In Figure 4e the two most powerful bulbs (1.0A and 1.7A) are not recommended for

continuous use because they seriously degrade the 4Ah capacity to barely usable levels. In Figure 4f the 1.7A bulb has a similar effect. Sensibly, the manufacturer envisages Apex 10 with a 0.4A bulb, and Apex 17 with 0.4A or 1.0A bulbs.

My own choice? Well, I have long-since settled on a home-built, three-cell 3.6V nickel-cadmium system powering a 4.0V/0.85A bulb. But I must admit that more recent experience with four F-size cells in an old Nife battery case combined with a 5.2V/0.85A bulb is giving me second thoughts. Also, I am addicted to using diffuse (matt) reflectors.

Whatever caving battery you prefer, the use of a tungsten halogen bulb will bring real benefits to your enjoyment and safety underground.

Figure 1. Typical discharge curves for nickel-cadmium and lead-acid batteries at the C/10 rate

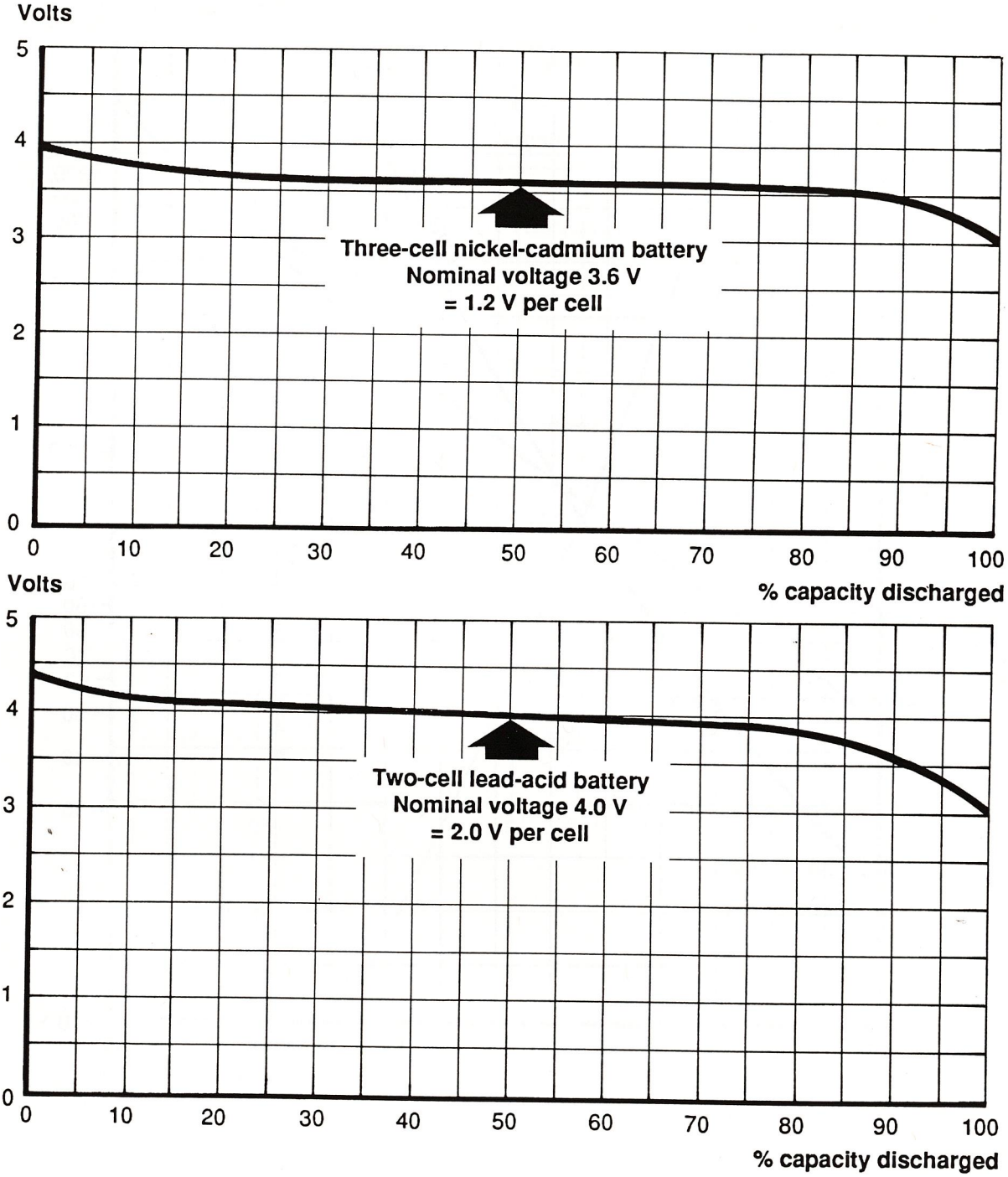


Figure 2. Variations in watts, lumens and life of tungsten filament bulbs, with variations in voltage

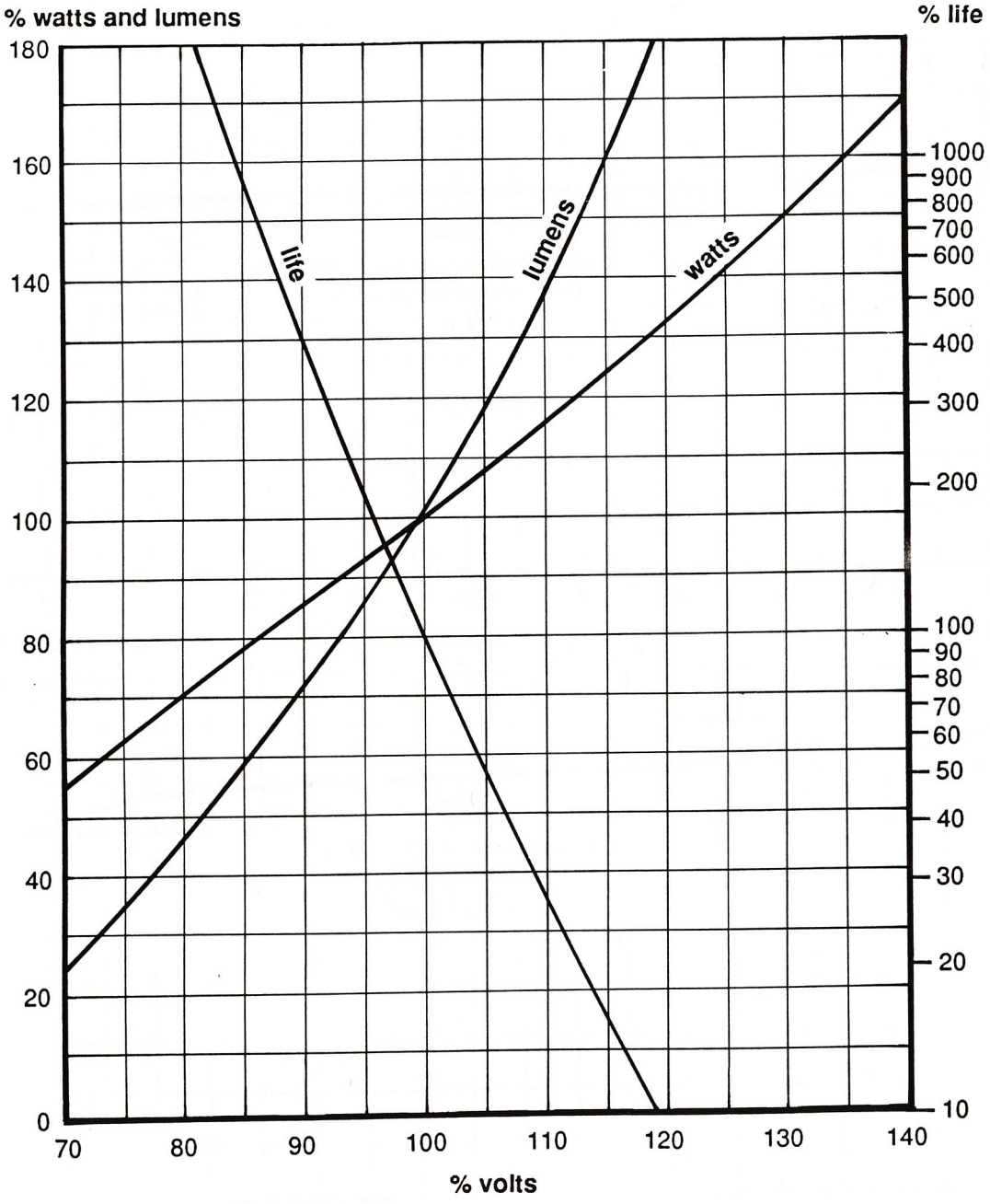


Figure 3. Relative efficiency (lumens per watt) of tungsten halogen and krypton/xenon bulbs

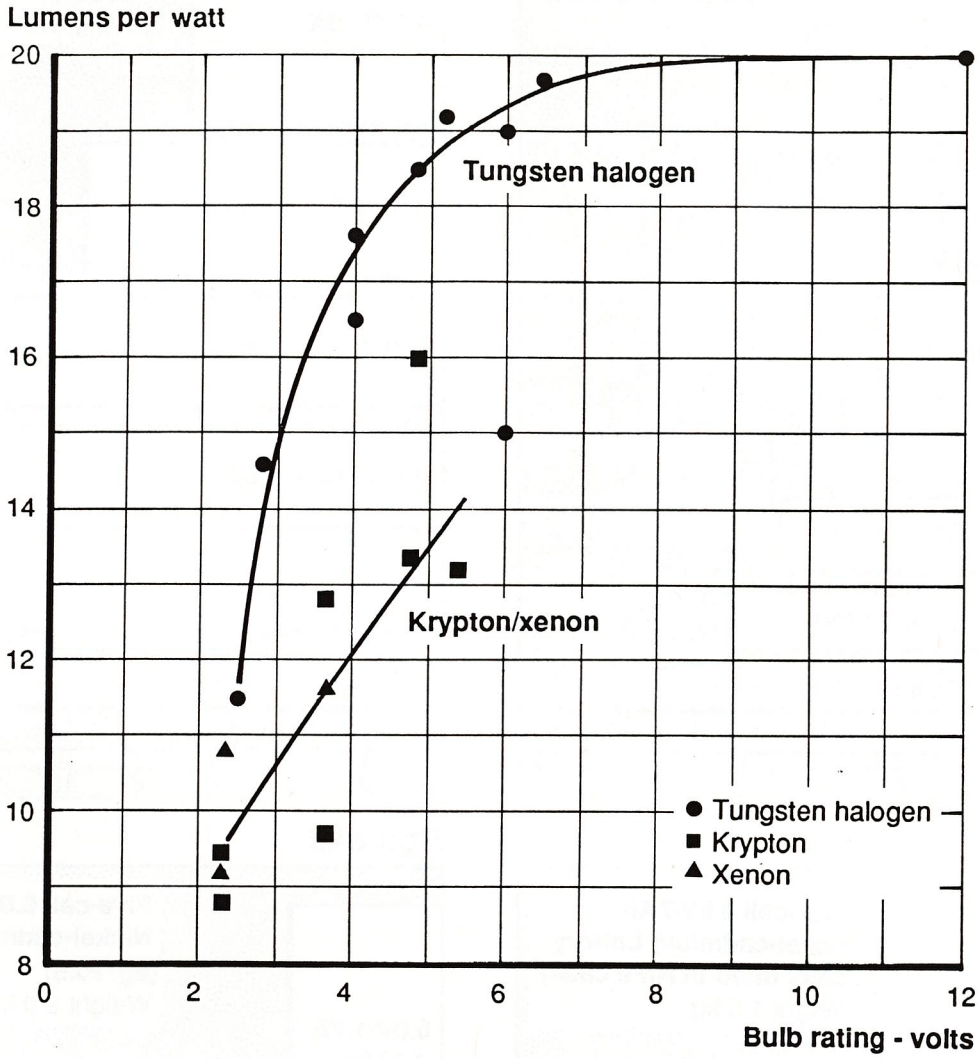
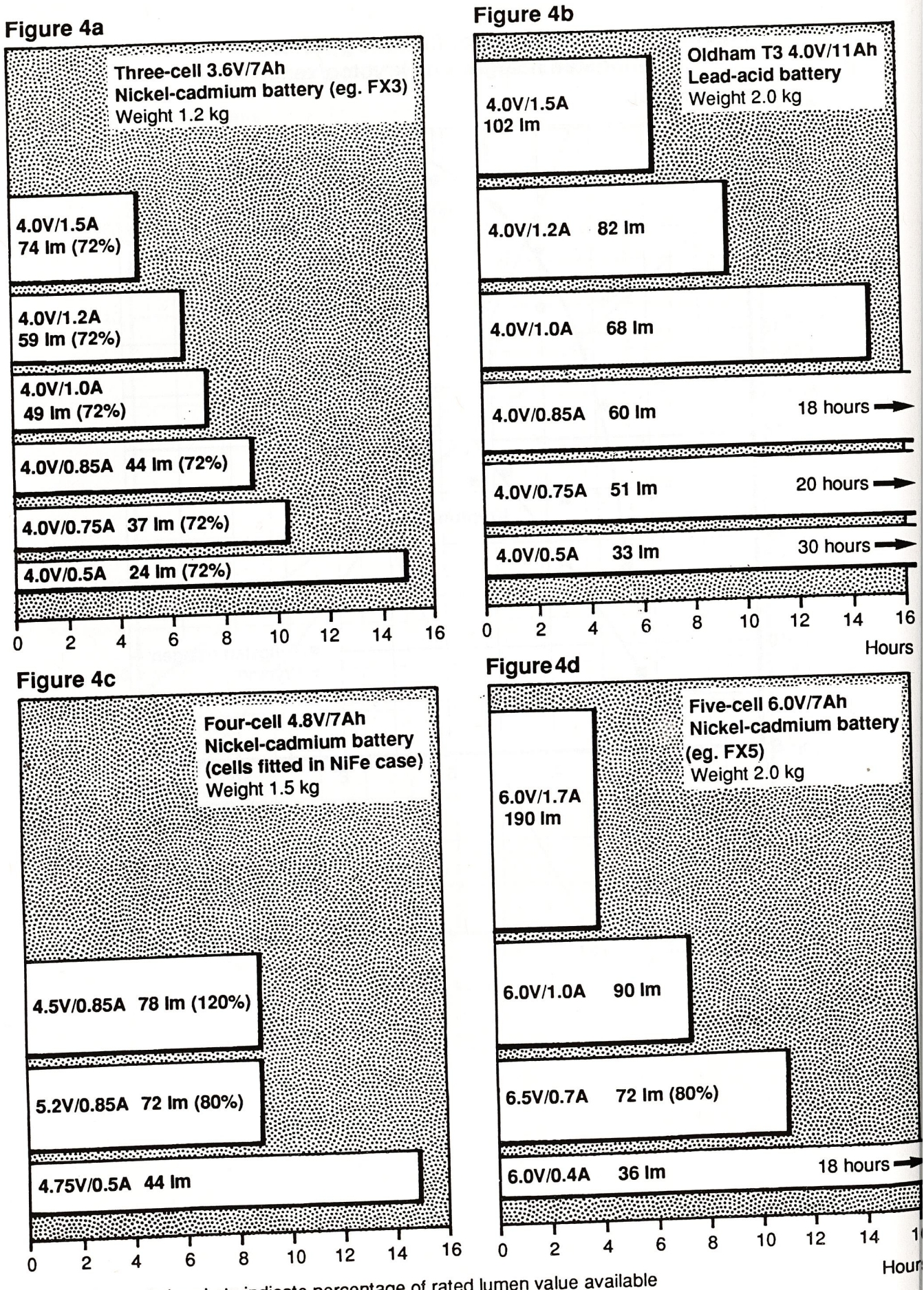


Figure 4. Light output and duration of various halogen bulb/battery combinations



Note : Figures in brackets indicate percentage of rated lumen value available after adjustment for under- or over-voltage operation.

Figure 4e

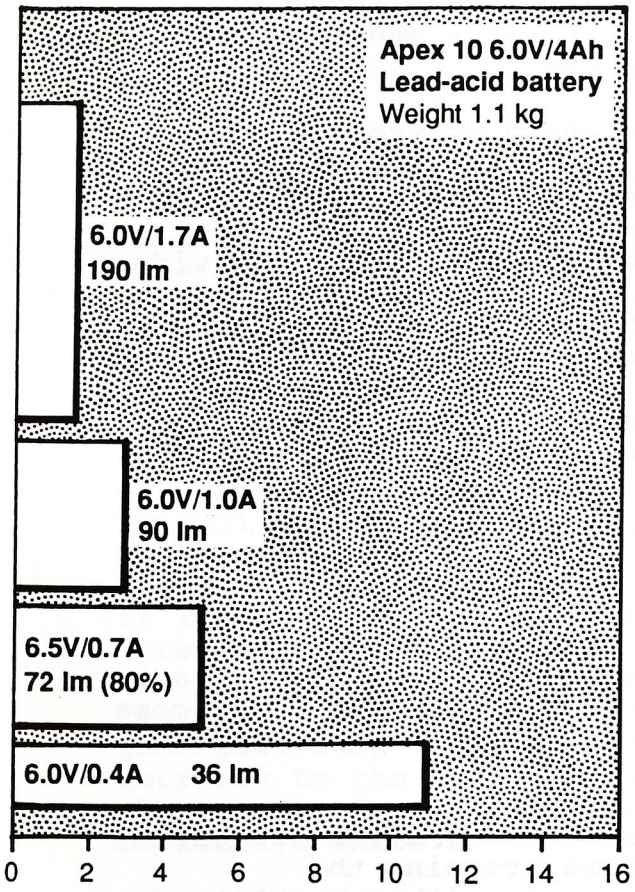
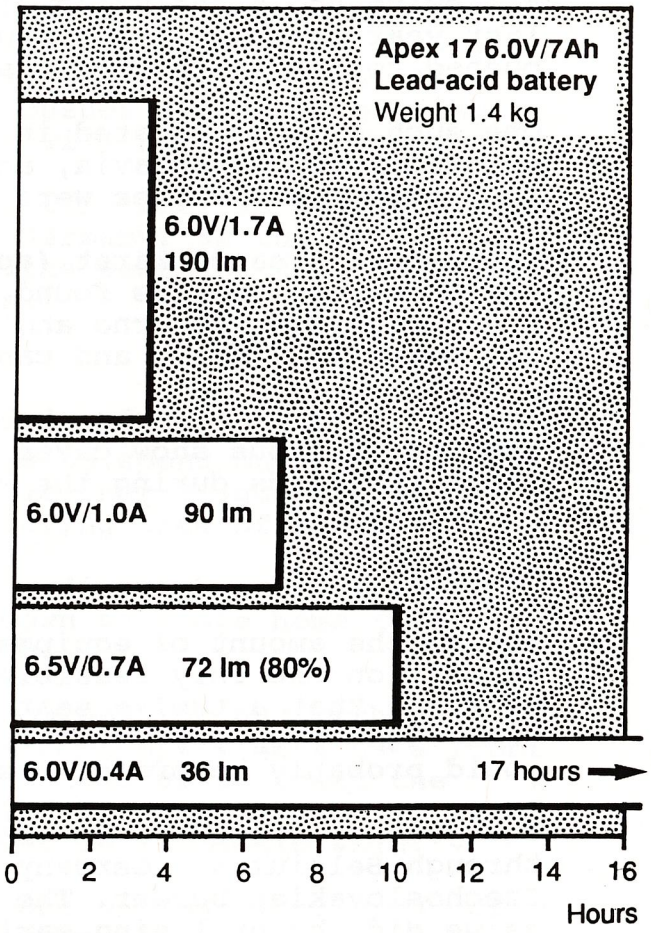


Figure 4f



CZECHOSLOVAKIA EXPEDITION 1991.

Following the dissolution of the eastern block over the last year or so exciting new karst areas have now been opened to the average British caver.

One such area is located in the south of Czechoslovakia, an area known as Moravia, and it was in this area that most of our activities were centred.

This small area of karst (approximately 2 1/2 miles wide and 15 miles long) is found to the north of the large industrial town of Brno and consists of several plateaus dissected by valleys and canyons reaching 450 feet deep.

The whole karst area has been designated a national park and its numerous show caves and gorges attract Czechs in their thousands during the holiday season.

TRAVEL

Due to the amount of equipment needed on a caving expedition the only feasible method of transport is van. We found that a twelve seat minibus would just about cope with eight people plus equipment although seven people would probably be preferable.

The journey itself is in excess of 1,200 miles travelling through Belgium and Germany before crossing the Czechoslovakian border. The drive can either be blitzed, as we did, by utilising early ferry crossings in a day and a half or, if time allows, a more leisurely two day drive is probably beneficial for moral.

Nearly all the journey is along good dual carriageway and motorway with plenty of services and restaurants en route.

Border crossings in Western Europe obviously present no problem but we were expecting a little more trouble from the Eastern frontier. Our fears, however, were unfounded and we were asked for our passports more out of curiosity than concern. A useful ploy for escaping search seems to be for the whole van to feign deep sleep (apart from the driver). This causes such confusion among the customs officers trying to identify everyone that passports are stamped blind and the van is waved through at double speed.

There remains some confusion over the purchase of petrol once in Czechoslovakia. The old communist system insisted that all foreigners bought petrol coupons from the national banks (an extremely long and boring paper wasting exercise) and presented them to a garage in exchange for a certain amount of fuel.

We were later told that this system no longer applies and that anyone (national or foreign) can purchase petrol using local currency. The garages were as confused as our guides and we found that the easiest way was to simply fill the van up and argue very loudly in English. After five minutes, with the petrol queues gradually growing, we found that all garages were willing to accept cash.

We would recommend buying as little fuel as possible when in Czechoslovakia (fill up in Germany) as the petrol is of a much lower grade than in the west and this certainly affected the van's performance.

FOOD AND ACCOMMODATION

We had arranged with our guides to spend our first week exploring the small cave systems near Prague before travelling south to the main caving area of Moravia.

Unfortunately our guide for the first week was stranded in Italy after his car broke down en route home from an international caving convention.

This, however, presented no problems for our rather generous reception committee who promptly gave us a front door key to the empty house and told us to treat the place as home. This was the kind of warm welcome we were to receive wherever we travelled in Czechoslovakia.

The house we stayed in was in one of the nicer areas of Prague but was still incredibly small with three tiny rooms a kitchen and a bathroom. Conditions were cramped enough for the eight of us without our host reappearing with his wife and two children.

Their is no shortage of food in Prague although it is far more expensive than elsewhere in Czechoslovakia. The night before we left for Moravia we ate a five course meal at one of Prague's finest restaurants at a cost of around eight pounds per head, although meals can be bought at any of the local hostelries for between one and two pounds per head.

Once outside Prague the situation changes, with food becoming scarcer but also a lot cheaper. If you are travelling through small villages in a large group expect to split into smaller groups as it appears that most pubs only have enough food for three or four people. If you are lucky enough to get an inn to serve the whole group then be prepared for extremely small portions and a menu change at very short notice.

The staple diet generally consists of meat or fish served with dumplings (knedlik) and pickled vegetables. As noted above the portions are small and the scarcity of food means that it is unlikely you will be able to order a second portion.

On arrival in Moravia we spent the night in the apartments of our hosts in Brno. It was here we were to meet our only real stumbling block. In our letters to and from the Czech Speleological Society we arranged a reciprocal trip with our counterparts travelling to Somerset to cave with us the following year. On arrival in Brno we were to find that the club who were taking us caving did not wish to participate in an exchange trip but were more keen to raise funds for their next expedition to Greece. On learning this we entered into negotiations and, after quite some time, agreed that a donation of two hundred pounds was agreeable all round and that there would be no exchange trip the following year.

This is, apparently, a recurring problem experienced by a few visiting UK clubs. Our only advice is to keep negotiations friendly as any early correspondence is passed through a central contact in Prague and it would appear different promises are made to both parties involved.

CZECH SPELEOLOGICAL SOCIETY

Czechoslovakian caving is split into two geographical areas - the western Czech half which was the area we visited and the Eastern Slovakian half.

All the caves we visited were locked and indications are that the same policy is adopted all over the country. The simple fact is that unless you have an official guide caving in Czechoslovakia is impossible.

Within the C.S.S. there are a number of local clubs which are all allotted an area of land. These clubs are allowed to explore there own patch as much as they like but under no circumstances are they allowed to visit areas belonging to other clubs. Exploration on another club's land is not tolerated and any individuals caught are expelled from the C.S.S. a move which, in effect, means that they can no longer cave.

Because of these jealously guarded boundaries there appears to be very little co-ordination on a national scale and all available time seems to be spent blowing up the countryside to try and find new passageway.

The ridiculous allocation system was highlighted to us when we visited a club which had spent twelve years cheerfully blasting its way into a mountain. Our guide explained that the blasting continued because this particular club had no caves on its territory and, what's more, it did not expect to find any.

It was no surprise to us that when we enquired as to the possibilities of a digging trip the conversation was

rapidly changed to pubs and whether or not would we like another beer (a line we always seemed to be falling for).

On one occasion we were taken to a swallet where a definite waterfall could be heard underneath a small pile of boulders. As soon as we moved to investigate the choke we were physically restrained by our hosts who later explained that we were not on their club's territory and so could not dig.

The fact that Czech caving is so closed was disappointing to all of us. It must be said that the possibilities of exploration or caving as a group without a guide is nil. Even so there are some caves worth seeing and the friendly nature of the local cavers makes it a good destination for an informal visit.

CARLSTEYNE CAVE

The largest cave in Western Bohemia, Carlsteyne Cave lies a few miles outside Prague in a large disused quarry which now doubles as a climbing and abseiling face.

The entrance to the system is a small hole about eight feet up the rock face. This small phreatic tube divides almost immediately, the right hand fork leads into a small chamber with a stemple assisted awkward descent.

On entry into the chamber our guide informed us that this was in fact a dead end and the way on was via the left hand fork. The same man had previously told us we would only need shorts and a tee shirt for this walk through cave - strange sense of humour these Czechs !

The cave continues along phreatic tubes before entering a ten foot flat out squeeze which definitely does not suit the larger caver. The cave then changes dramatically to the sort of sharply inclined rifts that love to eat oversuits and furries.

The rifts occasionally break into large chambers and in one such chamber lies possibly the most unusual sight in Czechoslovakia. A short hands and knees crawl leads to a smaller chamber in the centre of which lies a large rock table which is covered in hundreds of clay statuette figures.

Our guide explained that the hands and knees crawl was once a much tighter squeeze and that it was here in the small chamber that anti-communists met together in relative freedom.

It appears that word was leaked to the local police who entered the cave mob-handed and blew their way into the chamber before smashing everything in sight.

From here the cave carries on much the same as before with lots of inclined rifts interspersed with a few larger chambers and is vaguely reminiscent of Eastwater Cavern.

RUDICKE PROPADANI CAVE

This was to be our first cave in the Moravian area and turned out to be quite an eye opener in more ways than one.
The system was discovered in the early part of the nineteenth century and is now the centre of activity for the Rudice Caving Group.

The old wet entrance, beginning at the swallow hole of the Jedovnikcy potok creek, consists of several extremely wet waterfall steps some 270 feet deep which can freeze in winter making an interesting icy descent.

A newer entrance has , however, been opened and this is impressively lined by thick concrete piping. The descent is a steep one down fixed ladders which are, for the most part, reasonably safe. It was here that we learnt that due to the shortage of funds available for caving all the caves in the area have fixed aids and that these aids are replaced as soon as an accident occurs.

Lifelining is a virtually unheard of practice due to the stability of the ladders (or lack of money) so there was a good deal of trepidation as one by one we started the 300 foot descent to the large cathedral shaped Hugo's Dome where an impressive surge of active water on the left indicated a link up with the alternative wet entrance.

From the dome the stream is followed along its course via an ingenious but totally unnecessary system of wire traverses designed to keep the average Czech caver dry (we were later to be amazed at the lengths gone to achieve totally dry caving).

It was soon found that strolling down the knee deep stream was far easier and more comfortable than daring the rather ominous traverses.

The passage continues with impressive dimensions (in places 480 feet high) and takes in several subterranean tributaries, one of which serves as the main water supply for the nearby village of Rudice.

After a pleasant stroll we encountered what must surely be one of the most unique features in Czechoslovakia. A small tributary enters from the roof forming a huge 20 foot dripstone column of pure white with several very impressive gour pools. Leaning against this column is an old wooden ladder originally used for explorations in the

early twentieth century but which is now encrusted in the same pure white calcite.

It was at this point that we first noticed, with a certain amount of dismay, that little, if any, care or consideration is given to many of the formations throughout the area. The gour pools which most British cavers would circumvent with great care were treated merely as another obstacle by our hosts whose main preoccupation seemed to be exploration (a view which was emphasised more and more with every trip).

After this impressive spectacle the roof drops dramatically and the rest of the cave is mainly a hands and knees crawl in low water (although the water level can rise dramatically) on a gravelly floor along some well formed phreatic passageways.

The system ends for the non diver at the srbsky sump and comprises about 3 1/2 miles of passageway. An interesting through trip is now available via a 500 foot shaft (making it the deepest vertical cave in Bohemia) which has recently been dug out.

BYCI SKALA CAVE

This cave , found at the rising of the Jedovnikcy potok creek, was originally of great archeological interest because it contained the skeletons of some forty people as well as two ritual cremation altars. The fact that most of the skeletons found were women who bore traces of a violent death led local archeologists to believe that they were slaves who were killed and cremated along with their owner.

In the second world war, the large entrance leading to a vast chamber meant that it was an ideal base for the German army, who used it as a munitions factory. Because of the military usage all of the drier parts of the cave are reasonably well lit.

An extremely modified passage (not the last we were to see) takes the caver in a short while to the edge of the streamway where a boat can be taken to the first sump (Driny sump).

Diving of the Driny sump (started at the turn of the century) has eventually led to the discovery of two new dry systems (Prolomena Skala and Proplavana Skala) in 1984.

The initial discovery was quickly followed up in 1985 by the first trip through the downstream end of the Srbsky sump thus connecting the systems to Rudicke Propadani and making the second longest system in Bohemia with passages covering over 7 1/2 miles.

AMATERSKA JESKYNE CAVE

This is by far the largest cave system in Bohemia containing over 15 miles of passageway and its resurgence in the huge Macocha gorge has to be the most breathtaking sight in Moravia.

The entrance to the system lies in a shakehole at the top of a hill which was dug for several years before the final breakthrough in 1969. Finding this entrance proved to be a little difficult as our guide explained that he had not visited the cave for over twenty years.

Having found the entrance the next problem proved to be moving the huge plate steel padlocked cover. There was a strong feeling of deja vu as we scaled the fixed ladders down the entrance pitches which are in excess of 120 feet.

A small hastily erected cat-walk has been laid down across the Hall of Kings. This , unfortunately, has been installed about twenty years too late and all that remains of the once well decorated chamber are half a dozen large columns. Such is the state of disrepair that it was several minutes before we realised that we were all walking over a calcified slope which , when discovered, would have been of the purest white.

A couple more small fixed ladders lead down to the active streamway where , to our delight, we found two small inflated dinghies, and , to our dismay, more of the same ruined formations.

A quick trip through part of the upper series showed some more of the well formed phreatic tubes and then we dropped back down to the dinghies for further exploration of the active river system.

The dinghies are dragged for the first few yards before the water becomes deep enough for them to float. Having successfully got on the boats (two people per boat) one man paddled from the back while the other was able to pull and guide the boat using a very clever line suspended from the roof of the cave and passed through numerous eyebolts.

The boats are completely superfluous to the wetsuited caver as the streamway is very similar to the ducks and creeps in Swildons 2 with a low arched roof and gravelly floor but they do add a new and different dimension to caving as well as being extremely good fun.

After a few hundred yards the canal once again becomes too shallow for the boats and the way on is via a hands and knees crawl which eventually lowers to a flat out crawl in a small stream (although our guide miraculously managed to stay dry). After a short crawl a chamber is

entered and the way on is barred by an armpit deep streamway. It was at this point that our guide tried to tell us that we had arrived at the sump although the passageway could clearly be seen beyond.

The stream can indeed be waded (although our guide managed to find a dry traverse after half an hour) and the passage continues along more low streamway crawls interspersed with small chambers for a considerable amount of time with no end in sight. In one chamber unusual ' Leopard skin ' stalactites (an effect caused by the deposit of dried mud rings all over the surface) can be seen as well as some better preserved formations - presumably due to the isolation of the further reaches of the system.

On the return the only remaining obstacle to be found is the extremely heavy and obstinate lid which requires three men perched on top of each other swearing very loudly before it will finally open.

MACOCHA GORGE AND PUNKVA CAVES

The Macocha gorge is situated on a wooded plateau between the Suchy and Pusty zleb valleys along with several small caves. The gorge, some 530 feet deep, is the remains of a huge chamber whose ceiling collapsed and is, we were told, a popular spot for suicide attempts.

Two observation points, one at the top and the other half way down, would provide any would be abseiler with ideal take off points for a breathtaking descent.

There are two other ways to the bottom of the gorge. One involves a 1,300 foot dive through from the recently connected Amaterska cave while the other easier route is a walk through the Punkva caves which are reputedly the most impressive show caves in Central Europe.

The formations certainly are impressive, particularly the ones taken from several nearby caves which were too small to allow visitors. This formation stealing seems prevalent in all the large show caves of the area and is sad proof of the lack of awareness local cavers show.

The highlight of the trip is definitely the boat trip back from the bottom of the gorge to the entrance via the wonderful Fairytale Dome Chamber. This is beautiful, unspoilt passageway and you can only wonder what other caves in the area may have been like when discovered. Although only a show cave the Punkva system really is a must for any itinerary, a prime example of both the positive and negative aspects of cave conservation for money.

CAVING ON THE MACOCHA PLATEAU

The area surrounding the Macocha Gorge is pitted with small cave systems most of which are fairly vertical although the fitting of fixed ladders means that no SRT equipment is required.

We spent the afternoon exploring three of these smaller systems, the deepest of which is about 1,300 feet, one of the three deepest systems in Moravia. The cave ends in a most impressive 120 foot fixed ladder pitch down into the middle of an immense chamber. The fixed ladder certainly seemed solid but, in hindsight, the lifeline we were told we did not need would probably have been useful.

There is nothing of any great note in these systems except for the architecture around the entrances which shows some ingenuity and the rather suspect state of a lot of fixed ladders, some with rungs missing others with fixings which allow the ladder to tip backwards alarmingly and even one or two completely unfixed.

It was in one of these systems that we experienced our first nylon ladder - a wonderful mixture of laddering and bunjy roping. This particular ladder had a stretch ratio of roughly twenty per cent and even our guide conceded that a lifeline would probably be prudent - the only time we were to use our rope on the trip.

CAVES AROUND THE PUNKVA SYSTEM

A number of small, well decorated, dry systems are to be found in the valley at the bottom of the Gorge around the entrance to the Punkva Show Caves.

These small horizontal systems can provide a days worth of entertainment with no sign of any fixed aids. The first system entered was via a fairly hairy scramble thirty or forty foot up the canyon wall and consisted of a single low crawlway interspersed with two or three very draughty chambers and a reasonably tight squeeze.

Most of the cave is littered with the remains of formations long since removed and taken to local show caves, although the further reaches of the system still have some formations and a camera is definitely worth taking.

One of the other systems visited owes its existence to the old Czech government and some bloody-minded determination. Determined to find a dry route into Amaterska Cave the government started blasting their way into the canyon wall. The passageway was made extremely large, approximately 10 foot by 8 foot, so that the spoil could be removed easily by train. The blasting was abandoned when the miners broke through into a minor cave

system which ended in an extremely well decorated chamber and high aven after only a few hundred yards.

SINGLE ROPE TECHNIQUE

SRT is really in its infancy in Czech as the cost of equipment means the average caver cannot afford it. On our trip we were assured that our rope was unnecessary and that our guide would provide all the rigging aids required.

We were more than a little surprised when he turned up with an apparently lightweight kit bag but he reassured us that all would be okay. On arrival at the cave entrance, typically surrounded by four foot high nettles, the inevitable ten minute unlocking ceremony was eventually completed to unveil a vertical shaft piped for the first ten foot.

The most disturbing sight, however, was that of a rope descending into the darkness with only a single snap gate karabiner for rigging. Our guide promptly proceeded to load up and commence abseiling down the rope with a cheery grin.

After some hasty alterations to the rigging so that we at least had a back up anchor point we proceeded down the rope very cautiously, noting the rather thick coating of mud on the sheath.

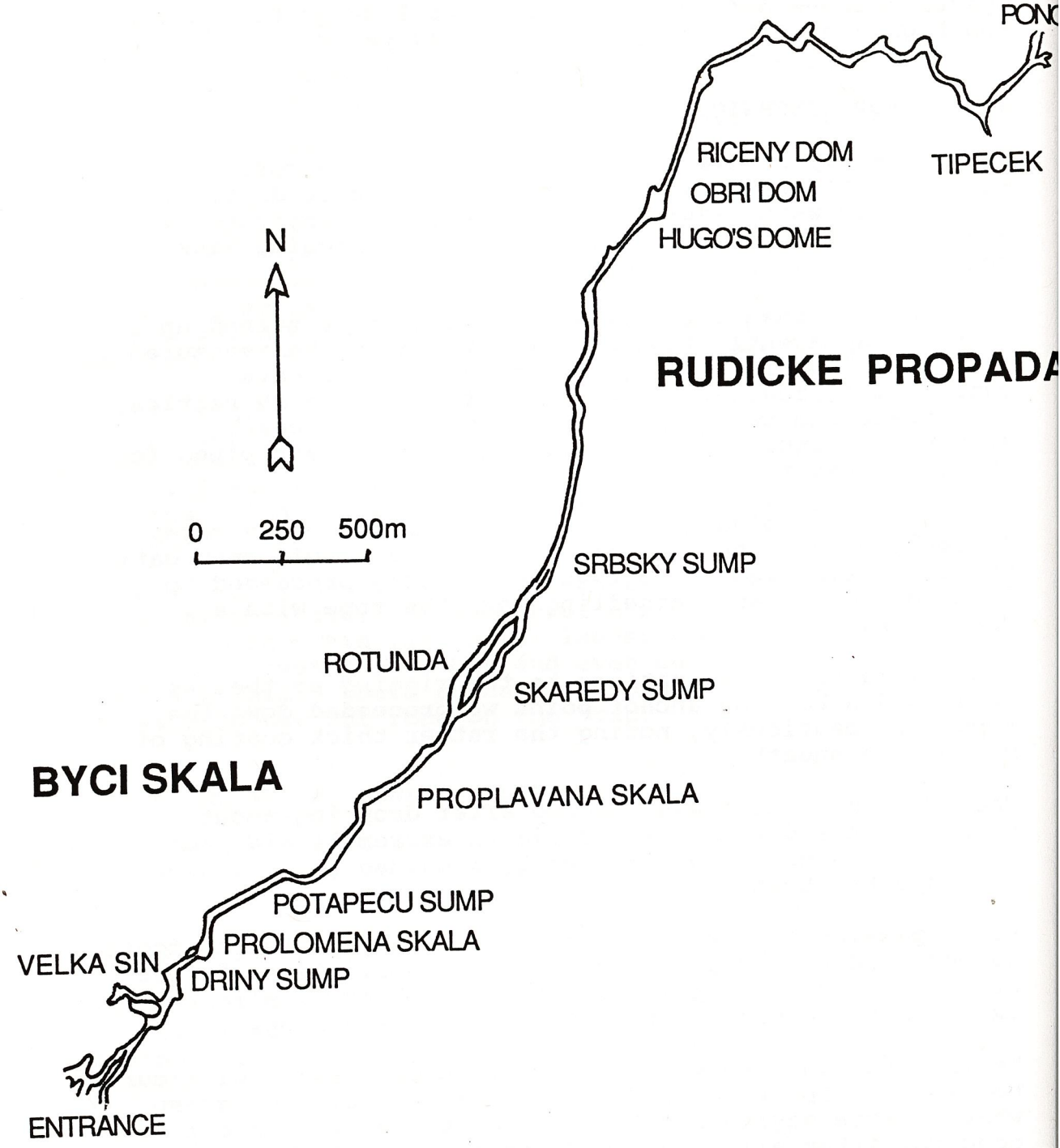
The first deviation was reached after dropping about thirty foot and was attached via an extremely old piece of hemp rope which had presumably remained in situ since the cave had been rigged.

After passing the deviation another twenty or thirty foot descent led to a second, equally dodgy deviation. It was at this point that common sense overtook our desire to explore and we decided that the best move was up.

We then had an interesting ten minute discussion with our non-english speaking guide who at first could not grasp what we were saying and then could not understand our concern. After all, explained his friend later, no one had had an accident on the rope or it would have been replaced.

From these experiences we would obviously recommend that all the caves visited are rigged by the visiting party. Fixed ropes are obviously not a good idea although costs are so high that local clubs simply cannot afford a store.

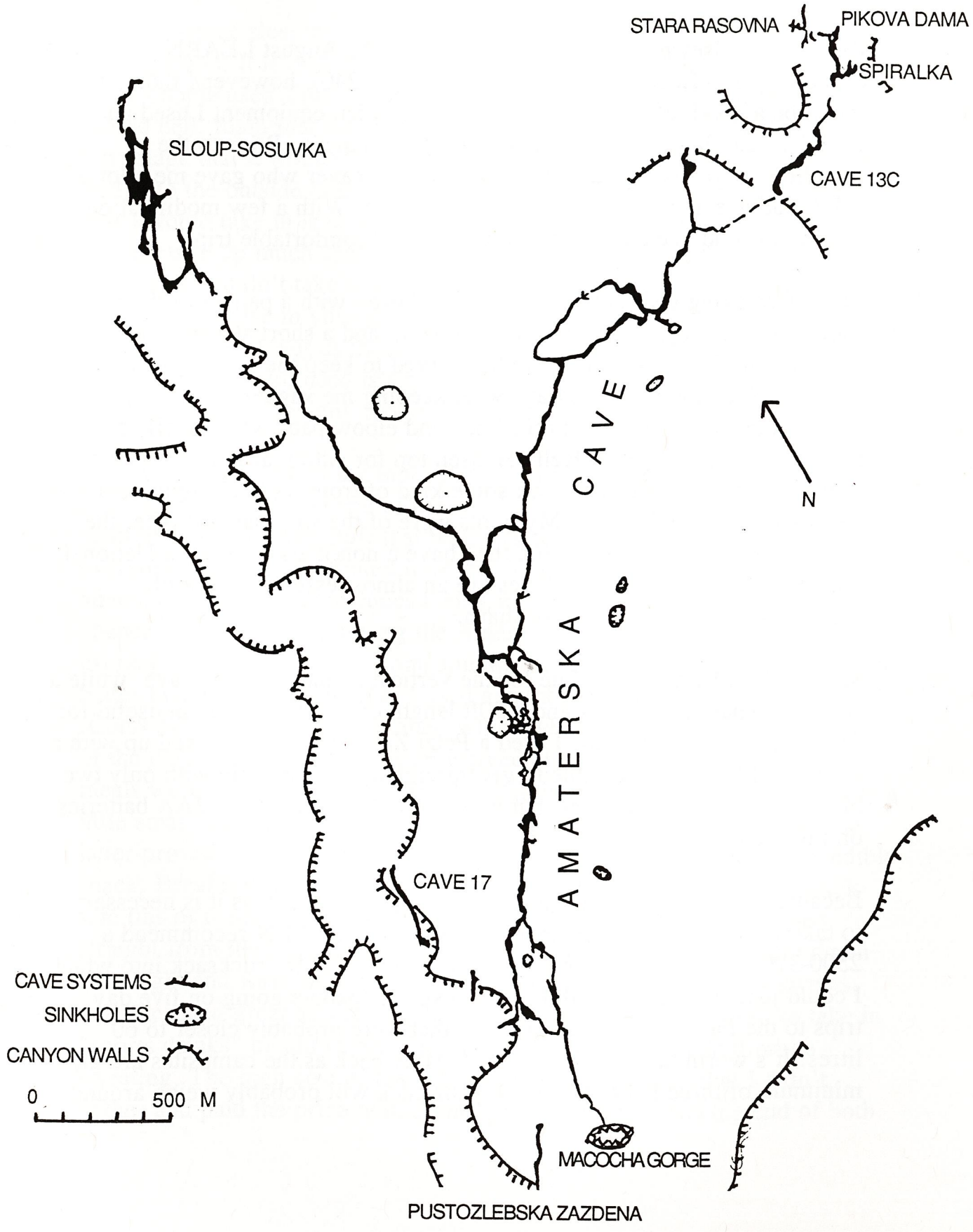
Not only would self rigging be safer but it would also teach the local Czech cavers correct rigging practices and so, in the long term, would prove beneficial to all parties concerned.



JEDOVNICKY POTOK CREEK SYSTE

(after Piskola and Barton)

AMATERSKA JESKYNE CAVE AND OTHER RELATED SYSTEMS



Lechuguilla - Hints and Tips.

Pete Hollings

I've written elsewhere about the activities of the August LEARN expedition into Lechuguilla (MCG News, No. 240), however I thought it might be a good idea to put down in writing what equipment I used and what I would do differently if I was to do it all again. Prior to the expedition I was lucky enough to meet a U.S. caver who gave me a lot of helpful advice about what to take into the cave. With a few modifications I followed his advice and enjoyed a reasonably comfortable trip.

My basic caving gear consisted of lycra shorts, with a pair of ordinary shorts over the top to cut down on abrasion, and a short sleeved Helly Hansen top. The close fitting clothes served to keep the grit out while the polypropylene top wicked away sweat keeping me vaguely dry. To provide some protection I wore neoprene knee and elbow pads which worked fine. I also took a long sleeved Helly Hansen top for sitting around camp in the evenings, some people also took some kind of trousers but if I got cold I just sat in my sleeping bag. My boots were of the soft material type, the only important thing here is that they have a non-marking sole, a National Park Service requirement. Gloves are an almost essential piece of equipment as the cave is pretty sharp.

My standard frog rig was fine for the vertical elements of the cave, while a couple of spare karabiners and a 30ft length of webbing came in useful for checking a couple of leads. I used a Petzl Zoom for light, backed up with a 2AA cell Maglite, I was able to get through a three day trip with only two of the Duracell flat batteries, but used around six sets of the 2AA batteries on my second trip.

Because most trips into Lechuguilla last three or four days it is necessary to take in equipment for an underground camp. LEARN recommend a 2500-3000 cu in pack, for me this equated to a 45 litre rucksack into which I could just about fit everything. However the people going on five day trips to the Far East were taking bags that were probably closer to 60 litres. It's worth taking a fairly comfortable pack as the campsites are all a minimum of three hours away and your pack will probably weigh around

40lbs. The only thing I would do differently is to use a pack with no side pockets as these tend to catch on anything and everything.

I used a fleece sleeping bag liner which proved more than adequate underground. It is also essential to take some form of sleeping mat. While some people used Thermarest mats I took a cheap, three quarter length, closed cell, foam mat which provided just enough comfort. It also had the advantage that it would fit inside my bag which is important as anything tied onto the outside is likely to get ripped off. In hindsight something else that I would take in is an inflatable pillow, this sounds like a luxury but it doesn't take up much space and getting a good nights sleep makes a lot of difference. I didn't take a stove and in general it is fairly safe to assume that someone else in your group will have one. The Park Service prefers the bottled gas stoves as these are thought to pollute the cave the least. The other thing you will need is a 6' x 6' plastic sheet to put under your sleeping mat to catch any food you may drop.

Food is perhaps one of the more important elements of an enjoyable Lechuguilla trip, at the end of the day I often found that I didn't really want to eat, so having stuff that would taste good was vital. Nearly everyone takes in dehydrated food for their main meal (although for some adventurous souls this includes taking in pancake mix !). If you have a chance I'd recommend buying the American made meals, as I spent most evenings drooling over my companion's meals which smelt and tasted a lot better than mine. Saying that, I used a combination of Raven and Peak (Cotswold Camping's home label) which while not great did not have any of the unpleasant effects I'd been warned about. Of the two, the Peak meals were generally the tastier, although in both cases the portions were a little small. For lunch I ate cereal bars and Heinz microwave meals, the latter proved excellent offering a quick, pre-cooked and surprisingly edible snack. Breakfast usually consisted of more cereal bars with small snack-size tins of fruit. All my meals had the advantage of being consumed straight from the packet, so I didn't have to take in a bowl, cutting down on weight and washing up. I also took dried fruit and Dextrosol sweets, which proved great as snacks while surveying. I'd been advised to take in "sports drinks" to add to my water to help replace salts lost through sweating. The high cost of these drinks in the UK meant that I didn't bother and paid the price with cramps in my legs towards the end of both

trips, however these were eased when I added some borrowed Gatorade powder. I'd recommend buying some of this in the U.S.

I started off each trip into Lechuguilla with four one litre water bottles, one of these I drank from on the walk in and then left at the entrance, another I left at the bottom of Boulder Falls for the trip out. The other two were taken to the camp where one became a pee bottle. This meant that I only had a single litre of water for what was often an eight hour day away from camp, which was probably not enough (something you are continually warned about in Lechuguilla is the risk of dehydration and one of my companions made his trip out a lot harder than he needed to when he ran out of water). The technique of drinking a couple of litres before setting out probably helped offset dehydration but it also meant that my pee bottle was usually full to the brim by lunch ! One solution to this would be to take in small collapsible bottles, which wouldn't take up much space in already overloaded packs but would allow for more water at camp (often sited a fair way from the nearest water supply) as well as allowing for extra pee bottles. As an aside because urine is sterile it is only necessary to bleach the pee bottle out before using it again as a water bottle. While I'm discussing bodily functions a brief mention of "burrito" bags is probably in order. The officially recommended version is to use double ziploc bags and then wrap the whole thing in foil to keep the smell in. I dispensed with the foil and put the bags into a small BDH drum, the thought of the bags leaking being too unpleasant to even consider. It is also suggested that adding baking soda to the "burrito" helps cut down the smell. I tried this, but they still stank so I'm not sure it was really worth it.

I wear glasses and made sure I took a spare pair into the cave. I'd been advised to wear contacts as people had had trouble with glasses steaming up due to the high humidity, however I had no problem with this and wore my specs throughout. I have also heard of people having trouble with contacts due to the fact that the cave is very dry and dusty. Make sure you take spare bulbs for your lights, the Americans use such a varied mix of lights that you can't rely on their bulbs fitting your light. A few wet wipes are also useful, allowing you to feel vaguely clean at the end of the day, it is only when you get out and realize that everyone is standing upwind of you that you appreciate how little good they actually did. The other thing that is worth taking is some duct tape, this can be wrapped around water

bottles giving them a little extra protection and comes in very useful for a whole range of minor repairs.

I took a cheap "point and press" camera with a built in flash into the cave as well as a second flash with a slave unit. I managed to get some pretty good pictures with this, but saying that it is almost impossible not to take good pictures in Lechuguilla. I used 400ASA Kodacolour Gold II print film, which worked fine.

Anyone hoping to join or organise an expedition to Lechuguilla should contact the Cave Resource Office, Carlsbad Caverns National Park.

Coahuilla '94
The Cutting Edge Project.

On Monday 13 June 1994, 21 cavers from the USA, Canada and the UK drove down from Texas into the Coahuilla desert of northern Mexico. The trip ha been organised by Peter Sprouse. Who also provided a fair chunk of the transpor the form of a 1954 4-wheel drive Dodge Power Wagon. Unfortunately it had onl just been rebuilt and proved a little unreliable, but it has the potential for being th perfect caving vehicle.

Our target area was a 20 000 hectare cattle ranch in the middle of Mexico' second largest area of limestone. However as we were to find out, low precipitati levels have probably slowed cave development. We approached the Ranch el Nevado via a 90 mile drive from the Del Rio/Cd. Acuna border crossing. The majority of the route was on unpaved roads, which while passable without four wheel drive when dry, had it rained 4-wheel drive would have been essential.

We camped next to a 50,000 gallon water tank, the main source of water f the entire ranch. From the hill top we had stunning views of the volcanic peaks Cerro Nevado and Cerro Colorado. However the most exciting sight was a 15 m square entrance visible in the cliffs on the other side of the valley.

The principal problem with exploration in Coahuilla at this time of year wa the temperatures of 110°F in the shade (of which there was very little). As a resu one of the more popular projects was a draughting dig, especially as it was only a short walk from the road. When first shown to Peter Sprouse the cave consisted 6" crack, however some serious chemical persuasion the previous winter had resulted in some 20 m of crawlway that ended in a low chamber. It was from the that digging continued, with a further 15m of crawl being opened up before more explosive was required. Due to problems with importing explosives into Mexico the time of the Chiapas uprising, we only had a limited supply and so by the end the week the dig was left still blowing and starting to show a downwards trend.

Throughout the week teams headed off to examine a number of canyons where openings had been seen in the cliffs. The majority of these proved to be o shallow rock shelters, but only after long, steep climbs through very sharp vegetation. One cave, Cueva del Ciento Avispes, a small shelter cave with signs prehistoric habitation, proved particularly well guarded by a swarm of wasps. In same canyon Cueva de las Ventanas Groovy (Groovy Windows cave) was also surveyed, with multiple entrances offering spectacular views.

Another group were shown a pit by Benito, the ranch hand. While this pro to be an 80ft blind pit, one of the explorers, wandering around while the pit was being rigged, located Pozo de las Escalera Crystal (Crystal Stairway cave). This proved to be a three pitch cave reaching a depth of 130ft. The cave was well decorated and contained numerous remains both animal and human, including an almost intact deer skeleton.

The Canon de Caballo, was another area investigated by members of the expedition. Among the finds was Cueva Abajo del Castillo (Cave under the Castle), this had a 12m high entrance but was only 20m long. About 2 km down the canyon was Cueva del Oso (it was named Bear Cave because of the bear tracks leading up to the entrance), a 50m cave with numerous archaeological remains including a piece of woven basket protruding from the floor.

On the last day of the trip a few adventurous souls headed off on a mammoth drive to another pit Peter Sprouse knew of. Pozo del Columpio was named after the cable suspension bridge that carries the water pipes over the shakehole. The cave was pushed to a depth of 180ft with no way on at the bottom, but a small draught was noted.

Throughout the expedition much time was spent slogging through canyons and along ridges searching for entrances. At one point a group made a two hour trek to the entrance we could see from camp. Unfortunately this proved to be only a few metres long. As a result of these hikes through lechuguilla and other varieties of cactus, not to mention the acacia like bushes with their one inch long thorns, many evenings were spent removing spines from various appendages. It was during one of these sessions that Marion Smith was heard to remark "this must be one of those Peter Sprouse cutting edge of exploration trips" a voice from the darkness replied, somewhat bitterly "yes, everything has a cutting edge around here". Thus the Cutting Edge Project came into being.

However the viscous vegetation was not our only problem, the fauna also held its terrors, including killer bees, scorpions, black widow spiders, rattlesnakes and bears (they were seen twice during the trip) not to mention the possibility of contracting histoplasmosis or the hanta virus. The roads also proved hard on the vehicles with six tires, a distributor and a rear differential all having to be replaced during the trip.

The area would be well worth a return visit, and I am aware of some of the Cutting Edge team who are planning further trips to ridge walk or continue work on the dig.

Acknowledgments.

I'd like to thank all the members of the Cutting Edge Project (Don and Kay Bittle, Teaka Dearing, Judy Fisher, John Fogarty, Paul Fowler, Mike and Andrea Futrell, Diana Gietl, Peter Grant, Jack Kehoe, Paul Mozal, Ray Nance, Marion Smith, Peter Sprouse, Steve Taylor, Marc Tremblay and Brian Watkins) particularly Jack Kehoe who provided accounts of many of the caves and Steve Taylor for the surveys. I must also apologise for not being able to remember exactly who did what and consequently taking the easy way out by mentioning as few names as possible.

BATTLE OF BRITAIN SERIES
DAN-YR-OGOF

Over the last couple of years, a number of us have been making regular trips into Dan-yr-Ogof with the intention of tying up loose ends and pushing a few new leads. These trips have resulted in the discovery of over 1000m of new, and in some cases, spectacular passage. Although some mention has been made in previous newsletters, here is a full account of our progress so far.

Our main objective has been to push The Battle of Britain Series, discovered by Nick Geh in August 1990 on the 50th anniversary of the event. Other areas pushed in the cave have been Corbel's Chamber, Phyllosan Drive (our wet weather alternative), Mazeways, and Productus Passage.

Phyllosan Drive is a 1m diameter sand and cobble filled phreatic tube just beyond the end of the show cave. It is very easy digging, and so far we have achieved about 60m of passage, ascending north towards Tunnel Cave, but bad air only allows us about 4hrs digging. However, the dig is virtually unaffected by high water conditions in the cave, so makes for a perfect wet weather alternative.

Productus Passage is a high level passage above the Green Canal. It was first discovered by Martyn Farr in the 70's when he explored it to a sump. No one had been back until Nick Geh had the idea of diving the sump (which had not been done). So in April 1991 five of us, Nick Geh, Brian Murlis, Pat Cronin, Tom Chapman and Jo Hall, set off for the Green Canal loaded up with climbing and diving gear. The hardest part of any hauling trip in DYO is The Long Crawl, as Pat (Stumpy) Cronin can verify! To reach Productus Passage requires an 11m bridging climb above the canal - the day's task for Tom and Brian. The climb was not easy, especially as we ended up on a shelf the wrong side of the canal with an 11m drop below and a 1.5m bold step to the other side, but combined tactics got us there. A quick recce was made to confirm the sump's existance, then a bolt was put in and a ladder dropped down for those below. Unfortunately the ladder was hanging a metre above the water, and the water was about a metre deep, which provided some entertainment! When the rest of the party and the diving gear were all up, we were able to have a good look at the passage. There is around 150m of hands and knees passage in total, consisting of a single passage which splits into three, one ending in a choke, another gets smaller and smaller and continues too tight, the third ends in a well decorated chamber with the small sump pool in it. Nick Geh kitted up and in nil visibility entered the sump. Unfortunately, it only went about 6m and was completely choked.

Mazeways was our next objective. Again, in the 70's, Martyn Farr had dug open a sandy crawl in Mazeways and discovered about 300m of passage ending at a sump (Mazeways Extension Sump). He dived the sump to 50m, had problems, so ditched the line reel and turned back to base. Since then it appears that no one else had been back there. Nick Geh, Digger Hastilow, and Brian Murlis visited Mazeways with the intention of re-opening the sandy crawl and inspecting the sump with a view to diving it. The sandy crawl was completely blocked but after 2hrs hot digging we had excavated 8m of tight crawl. The passage beyond was not what

we were expecting, it was all hands and knees crawling for over 300m, mostly on jagged rock. We eventually found the sump, with Martyn's diving line still in place, and crystal clear visibility inviting us to return with diving gear. On the return journey from Wales we called in on Martyn and asked him why he had not told us about the uncomfortable nature of the passage, to which he replied: "You never asked!"

On 17th August 1991, after a couple of failed attempts to return with diving gear (one when The Mazeways duck was sumped, and another when a bag of diving gear was lost in Lake Three by a nameless person), four of us (Dig Hastilow, Brian Murlis, Trebor McDonald, and Andy Dennis) eventually returned, hauling loads of gear through the long crawl (again) and all the way to The Mazeways, then all the way over the 300m or so of jagged crawl to the sump. Digger kitted up and disappeared into the, by now, murky pool. After what seemed like an eternity, Digger returned. He had found Martyn's line reel about 45m in, then continued for a further 50m or so to surface in a short section of passage, which ended in another completely blocked sump (Descent 102). The reward for Dig's discovery was, unfortunately, a burst ear drum which put him out of diving for a few weeks.

The Battle of Britain Series has been our main objective throughout the last year or so, since its discovery (Descent 96). There are two ways into this section of the cave, the first, and easiest, is a 15m long sump (not free divable), in the river entrance to the cave. The second is a 120m sump just beyond the end of the showcave. Nick Geh found the series by diving the 15m sump to an airbell (this airbell was found by others in the early 70's who described it as going nowhere). On surfacing in the airbell Nick could hear the roar of a streamway, but as he was on his own, he went back for help, then returned to climb the 5m to the top of the airbell, where a passage led to a climb down to a fine section of streamway. The series consisted of a streamway with a long section of deep canal (which sumps in slightly wetter than normal conditions), several streamlets leading to sumps, two well decorated chambers, and the impressive Gwynne Saunders Hall containing a small lake fed by a waterfall entering from a tantalising hole 15m up in the roof; all originally surveyed to 450m of passage.

Since the discovery we have been making regular trips to the series to push the various leads. The main attention has been to a large choked passage heading north at one end of Gwynne Saunders Hall. This passage is about 8m high and 6m wide with a loose slope of sand and boulders leading up to its roof. We have been digging a tunnel into the choke, following the roof and one wall of the passage, it is easy going, pulling out mainly sand and the odd boulder. So far we have gone about 5m into the choke, but it is a long term project.

Another project we had in mind was to climb the waterfall to see if there was a person size passage up there. Brian Murlis had a go, unaided, on one of our earlier trips but was forced to give up due to very loose and slippery rock. To this end we recruited Tom Chapman to the digging team. Hence, on 1st September 1991, Tom, Brian, Nick and Trebor McDonald dived through the sump loaded up with climbing gear and ladders. On arrival at the waterfall Tom and Brian set about tackling the climb whilst Trebor and Nick continued the dig. Tom, amidst crashing boulders, managed to get two thirds of the way up the climb

where he put some protection in, then came back down. Brian then climbed to the same spot, and whilst trying to find a way on, spotted another passage 2m lower and 3m across from the waterfall one, so earmarked it for the next visit. Tom then took over again and this time managed to reach the waterfall passage via a side inlet into it. Brian soon joined him and subsequently over 200m of meandering, clean washed stream passage (The Doodlebug) was explored to an easy looking choke with the stream issuing from it. The well decorated passage varies from 2m high and 1m wide to flat out crawling in a canal; there is one small chamber and a pretty oxbow.

Wet weather denied us access until 13th October 1991 when four of us, Dig Hastilow, Brian Murlis, Tom Chapman and Trebor McDonald, returned to gain access to the passage that Brian had noticed on the previous visit, and also survey The Doodlebug. Brian ascended the rope that we had left in place, then traversed across to the new passage, disappeared into it for a quick recce then returned to haul up a ladder for the others. The passage was a discoverers dream. A pure white calcite floor with amazing crystal pools led to a beautiful cascade, at the top of which a metre diameter passage continued over calcite floors and passed columns and straws to a low section with a superb crystal pool in the middle of it. We had surveyed 23m to this point and beyond the low bit the passage could be seen to continue, but at what cost to the formations if we went any further! After much discussion it was decided that Brian should take his wetsuit, boots, lamp and helmet off and carefully continue with just a diving torch! He managed to pass through the 6m of low section with no damage to the crystal pool, but had to sacrifice a couple of straws to get through. Beyond the low bit the passage briefly became walking height then back to metre diameter tube which meandered past plenty of excellent formations to eventually end at a long, deep (and cold without a wetsuit on!) canal which sumped. For obvious reasons we were unable to survey this part of the passage but it was estimated to be at least 60m, making the passage around 100m in total. We named it Wellington Passage as Trebor was not able to climb the ladder due to the fact that he was not wearing any boots. Our new discoveries now totalled 300m, making The Battle of Britain Series over 750m long.

On the 27th October 1991, Dig Hastilow and Brian Murlis returned to have a look at a stal blocked passage below the choke at the end of The Doodlebug. The stal dam was soon removed and Dig squeezed into a body sized passage, the size of the smaller parts of the Long Crawl but half full of mud and water, and under protest proceeded to explore it. He went about 15m to a further restriction where the passage could be seen to continue, but with no sign of anywhere to turn around, he backed all the way out. Brian also had a look, and both decided that it was a cavers nightmare so it was named Elm Street!

The choke at the end of The Doodlebug was also attacked on 24th November 1991 by Nick Geh and Trebor McDonald whilst Dig Hastilow and Brian Murlis were taking photos of Doodlebug's formations. Unfortunately, after removing a few boulders, it was obvious that the stream was issuing from a very tight, loose rift. Having decided that it was not worth persuing, and also with the possibility of winter floods on the way, we removed the rope and ladder on the climb to Doodlebug.