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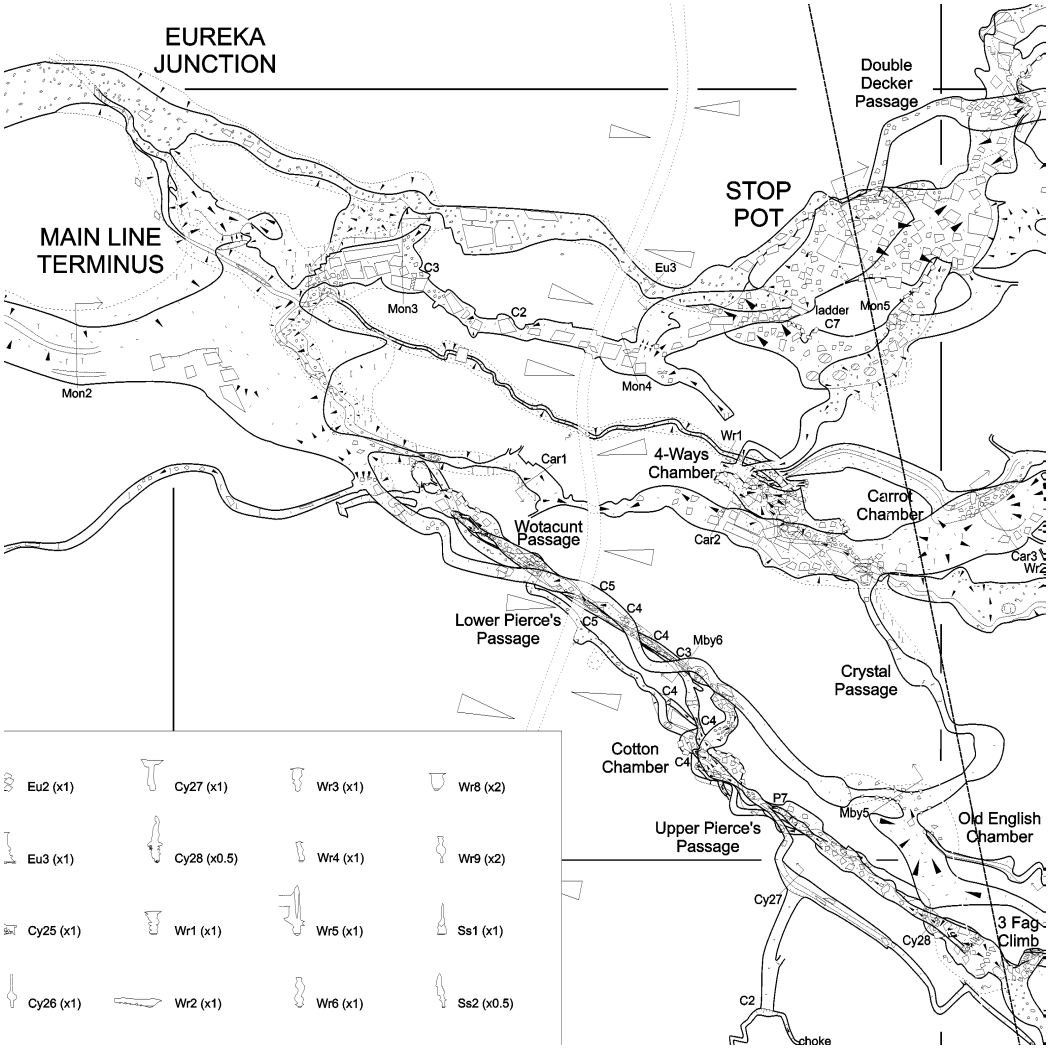
Issue 36

# Compass Points

November 2006

BCRA




## Spring field meet report

## Speleoliti cave mapping software

## Denis Warburton, 1925-2006

The Journal of the BCRA Cave Surveying Group

## COMPASS POINTS INFORMATION

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**NOTES FOR CONTRIBUTORS**

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The group aims, by means of a regular Journal, other publications and meetings, to disseminate information about, and develop new techniques for, cave surveying.

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**COMPASS POINTS LOGO**

courtesy of Doug Dotson, Speleotechnologies.

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The CSG runs an e-mail list for cave surveyors around the world. To join send a message containing the word 'subscribe' in the body text to cave-surveying-request@survex.com

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The journal of the BCRA Cave Surveying Group



*Cover image: Excerpt from sheet 3 of the Easegill survey, which won the Arthur Butcher award this year. Courtesy of Red Rose Cave and Pothole Club.*

# Editorial

This issue contains a report on the Spring field meet, which was primarily billed as a training meet. The event was judged a success, and it is hoped that similar training meets can be arranged in the future as a service to the wider caving community. The next field meet is timed to coincide with the BCRA Cave Technology Symposium, which will be a one-day event with lectures, posters and practical sessions covering all aspects of caving technology – surveying included. This sounds like an excellent initiative to raise the profile of technical projects within BCRA – full details can be found on page 4.

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# *CSG Admin*

## AGM report

***Wookey***

The Annual General Meeting of the CSG was held at the Hidden Earth conference in Leek, 24th September 2006.

Present: Andrew Atkinson, Julia Bradshaw, Anthony Day, Sam Lieberman, Arthur Millet, Allan Richardson, John Stevens, John Wilcock, Wookey.

### Chairman's Report

Despite our determinedly laid-back approach we did achieve various things during the year.

- There was a field meet in March, which was very successful, attracting some new people to get cave-surveying training. That is something we should repeat in the future.
- An issue of Compass Points was produced and disseminated - Issue 35, March 2006. Thanks to Anthony for that.
- Members have continued to be involved with Therion and Tunnel development with the Austria and Mulu projects respectively pushing development forward.
- Members have continued to be involved in large survey projects such as the Easegill and OFD resurveys.

### Treasurer's Report

We still have a fair amount of money - enough for at least a couple more CPs even if no-one paid any more memberships.

### Editor's Report

I am very happy for a new editor to step forward as increased work responsibilities mean it is getting harder to do a CP, and being stuck over in Norway makes it harder to know what is going on, and who to hassle for articles of interest. In the absence of volunteers I will continue, endeavouring to do 2 issues a year rather than one, but no promises.

### Open Meeting

Various things were discussed and the following agreed. The current to-do list is:

- Update the website (it's really embarrassing), probably move onto BCRA site. Check with Dave Gibson best way to proceed (Wookey) (Status: started)
- Set up mailing list for members, so chivvying about subs and updates of CP can be done easily (Wookey)
- Some CSG publicty would be good. A general article in the caving press to show we exist and aren't too tedious. An article on choosing instruments was suggested (Wookey)
- Hold another Spring field meet, in Derbyshire. Based at Orpheus.
- Have newbie training. Electronic instruments session – comparing Mike McCombe, Phil Underwood and Dave Edwards instruments.
- A BCRA technology meet has been arranged, so we will have our meet that weekend, effectively only having one day for our exclusive part (Allan) (Status: underway)
- Possibly ask BCRA for a grant to cover the costs of acquiring/developing a batch of electronic instruments. Wookey to check whether Phil U felt this was useful or not. (He later said he had enough money to DIY it so this was probably just extra faff). CSG may wish to apply for a grant to acquire instruments for itself.
- CP will now be published online at the same time as on paper. We will start sending out subscription reminders and announcements on the mailing list. (Wookey/Anthony)
- Agreed to reimburse Wookey for CUCC Silva clino broken at the field meet, which he has replaced with his personal brand new one. Wookey observes that the SWCC stone floor is remarkably unforgiving.
- Wookey will continue to supply instruments to cavers at preferential rates, but this is now a personal rather than CSG activity (largely because he doesn't want to have to account for the money well enough to go in the CSG accounts).

The existing officers were re-volunteered:

Chairman: Wookey

Editor: Anthony Day

Treasurer/Secretary: Andrew Atkinson

Meets Organiser: Allan Richardson

# Forthcoming Events

## Field meet

The CSG Spring field meet has been timed to coincide with the BCRA Cave Technology Symposium on the weekend 14-15 April 2007. The current plan is to hold presentations on Saturday covering electronic instruments and computer drawing. Sunday will be set aside for practical work, particularly practice with electronic instruments and comparison with conventional instruments. It is possible to arrange training in general surveying or computer drawing if there is sufficient demand – please contact the meet organiser in good time if you are interested. Accommodation will be arranged at the Orpheus Caving Club headquarters. If you would like to attend or need further information, please contact Allan Richardson (csg-meetings@bcra.org.uk).

## BCRA Cave Technology Symposium

***David Gibson***

Members of BCRA's Cave Surveying Group and Cave Radio and Electronics Group are joining forces to organise a one-day "classroom" symposium to be held on Saturday 14 April 2007 near Ashbourne in Derbyshire. This event will coincide with the Cave Surveying Group's weekend field meeting. Contributions are invited on any aspect of caving technology – including (but not limited to) cave surveying, electronics, computing, lighting, photography, cave radio, radio-location - in the form of short lectures, poster papers, or more informal practical sessions. Cave survey posters and cave photographs are particularly welcome for display. Digital projection facilities will be available, but please bring your own computer. (If OHP or 25mm projection is required, please let us know in advance).

Whatever type of contribution you are offering, a publishable abstract of around 100-300 words is requested, so that we can publish a programme in advance. In addition it is hoped that papers based on the lectures will be available for publication by BCRA or one of its SIGs. In other words, this event has a slightly more formal basis than a mere "field meeting" and is aiming to be similar to BCRA's Science Symposium in concept. Lectures will probably fall into three categories - a) theoretical, b) practical reports of work done and c) practical demonstrations.

The idea is to provide a forum for discussion of cave technology topics, with a particular emphasis on cave surveying, computing and electronics. However, the event could be extended to include discussions on other Special Interest Group topics, and so members of BCRA's EUG and the UK Cave Photography Group are welcome to contribute, or even to organise their own weekend field meetings to coincide with this classroom session.

The Location is the Millennium village hall at Hulland Ward near Ashbourne in Derbyshire. The start time will be 9:00am, to finish at 4:00pm. Admission charges will be £2 in advance or £3 on the door, and this charge will provide light refreshments, though the cost of lunch is not included.

Those wishing to contribute should contact the lecture secretary, David Gibson (d.gibson@bcra.org.uk). Abstracts are required by 1 March 2007. Further details, including directions to the venue, can be found on the BCRA website at http://bcra.org.uk/detail/tech2006.html We encourage all potential delegates and speakers to subscribe to the "meetings" mailing list (http://caves.org.uk/lists/meetings.html) so that they can be kept up to date with arrangements.

# Snippets

## Auriga 1.0 released

***Luc Le Blanc***

Auriga is cave survey freeware for PDAs running PalmOS, an early beta version of which was described in issue 32 of Compass Points[1]. Since its first public inception in December 2003, then as beta software, 35 versions have been published until version 1.0 was released last July. Over this time period, the software was thoroughly debugged and much improved, while being extensively tested in numerous caving trips and expeditions worldwide, the latest taking place in Mexico, where the author - Luc Le Blanc - and a dozen cavers from Canada, France, Mexico and USA, used Auriga both underground and at camp to input and plot their maps on millimetric paper. This three-week field test definitely proved, if doubt remained, that Auriga was a viable and often superior alternative to the classic paper notebook for the input and handling of numerical data.

Beyond the mere input and storage of survey data, Auriga offers a heap of compelling features:

- the immediate rendition of cave map in graphical mode, with top and profile views, several display options (station names, passage fill and colour, walls, landmarks, etc.), a user-defined grid and various query tools (distance, angle, station locations, geographic or XYZ coordinates, etc.);
- the graphical display of cave networks based on geo-references or common survey stations;
- aids for sketching to scale showing the survey shot projected length and station and passage dimension co-ordinates in sketching paper grid units
- the real-time detection of hanging (orphan) cave legs and survey loops along with the display of closure errors;
- sortable and customizable list displays of survey shots and station coordinates, to scale with paper plot;
- a Bluetooth or serial link with Disto rangefinders, GPSes and other electronic data acquisition devices, some still in prototype stage;
- the ability to backup the cave data on a memory card, share it with other Palm OS devices through IR beaming, export it into more manageable (smaller) cave subsets or sync it with cave survey software on the PC;
- a pit sounder that evaluates the depth of a pit based on the fall time of a rock, measured by the Palm acting as a stopwatch;
- various navigation and search tools to quickly locate survey data;
- cave statistics.

The software regularly benefits from new additions to satisfy the needs of cave surveyors, while offering a wealth of customizable options to suit everyone's taste. Currently under development are a display tool to help sketching cross-sections and an input interface for supplemental data (e.g. bat inventory, temperature measurements, mineral sampling, etc.) according to a user-defined dictionary.

Web site: http://www.speleo.qc.ca/Auriga

Contact: lleblanc@cam.org

[1] Le Blanc, L. (2003). Auriga, or trading your survey notebook for a PDA, *Compass Points*, 32, 8-11.

## Surveying software updates

Here is a round-up of some recent developments in the world of cave surveying software.

A new version of **TopoRobot** [1] (v.9.1,7) was released in June – the first release for over three years. This version contains no new features, but has many internal changes brought about by the termination of support for the development environment previously used to create the software. Rather than port the outdated user interface, the author intends to completely overhaul it. Users should not expect to see immediate results, but the author assures you that he is actively working on the software.

The latest **Walls** [2] build (dated 2nd June 2006) includes improvements to the SVG export module, including correct Unicode support, enhancements to the project management features, and numerous bug fixes.

Finally, the **Therion** [3] drawing package has reached version 0.4.0. The most significant recent addition is loch – a new 3D viewer. There have also been numerous bug fixes and minor enhancements.

[1] TopoRobot: `http://www.geo.unizh.ch/~heller/toporobot/news.html`
[2] Walls: `http://www.utexas.edu/tmm/sponsored_sites/tss/Walls/index.html`
[3] Therion: `http://therion.speleo.sk/`

## Arthur Butcher award

Each year, BCRA presents an award for, broadly speaking "excellence in cave surveying". The winner receives a cash prize of £100, a trophy that they keep for a year. The Award is judged and announced at the National Caving Conference.

The 2006 winners were Ray Duffy and the Red Rose Cave and Pothole Club's resurveying team for sheet 3 of the Easegill survey (Oxbow Corner to Holbeck Junction). The award was made for exemplary survey draughtsmanship, production and publication with accompanying notes and for carrying through a long-term project, with commitment over a decade.

An excerpt from the award-winning survey is shown on the cover of this issue. Copies of the survey and accompanying booklet are available from the Red Rose Cave and Pothole Club for £7.50 (plus £1 postage and packing if folded, or £2 in a rocket tube). Send cheques payable to RRCPC to Mel Wilkinson, 7 Broadacre, Caton, Lancaster, LA6 9NF. Sheets 1 and 2 are also still available, at a cost of £5 each.

# *Press Round-up*

## Hydrolevelling of very deep caves, with an example from Voronja (Krubera) Cave

*This article – by Alexander Degtarev, Eugene Snetkov and Alexey Gurjanov – was printed in the October 2006 issue of Compass and Tape (vol. 17, no.3, issue 59). The original version appeared in Svet, magazine of the Ukrainian Speleological Association. The Compass and Tape version is based on an English translation in AMCS Activities Newsletter, no. 29.*

The authors describe a method for measuring the depth of a deep cave with high accuracy. A hydrolevel device is made from a 50m long transparent tube filled with water. Tough tubes with an internal diameter of 4-5mm are recommended. A rubber glove is placed on one end, which acts as a reservoir, and a metal box with a transparent window is placed on the other, in which a depth gauge is submerged. In the example from the article, the depth gauge on a Casio watch was used, which works from 1 to 30m depth in sea water. When the glove is placed on the higher station and the depth gauge on the lower point, the hydrostatic pressure difference between the two points as measured by the depth gauge depends only on the height difference between them, i.e. it is independent of the routing of the tube. Thus, by adding readings from consecutive pairs of stations, the depth of the cave can be measured. With care and appropriate calibration, an accuracy of 0.2% can be achieved.

Since depth gauges are calibrated for sea water whilst the hydrolevel is filled with fresh water, it must be calibrated before use. This is achieved by hanging a measuring tape on a free drop and taking readings at regular intervals in height difference. Measurements should be taken over the full range of height differences that could be encountered to ensure that the depth gauge has a linear response over this range. A reading for zero height difference should also be taken since this will not necessarily be zero due to air pressure. It is suggested that a barometer is used to independently measure any changes in air pressure during the course of the survey. It is important that the calibration parameters are calculated as accurately and reliably as possible if the best possible accuracy is to be achieved.

Potential sources of random and systematic errors are discussed at length. As with conventional surveying, station position errors and quantisation errors are potential sources of random error. There might also be some random error intrinsic to the operation of the depth gauge. The magnitude of these errors can be estimated from closure errors. However, systematic errors will not be identified from closure errors, so care must be taken to minimise them. Large bubbles that fill the diameter of the tube can cause systematic errors and should be avoided and expelled if observed. Also, in addition to weather-induced changes, atmospheric pressure also changes with depth. At the altitude of Voronja Cave, this error is the equivalent of 10cm per 100m of depth, so this effect must be corrected.

The method was used during an expedition to Voronja Cave in October 2005 that was organised by the Ukrainian Speleological Association with the participation of cavers from the Russian Geographical Society and the Bulgarian Speleological Federation. This cave, in the Arabica Massif in the Caucasus, has previously been hydrolevelled to a depth of 2080m making it the world's deepest known cave. However, there were significant discrepancies between the downward and return levellings and some errors were discovered. The October 2005 expedition set out to re-level part of the cave. They levelled downwards and upwards between the entrance and 916m depth, and downwards only from 916 to 1195m depth.

# Field meet report

***Wookey***

*The CSG held a successful field meet in South Wales in Spring 2006. The main focus was on training, though the participants also found time play with an electronic instrument and computer drawing packages.*

The CSG held its annual field meet at SWCC this Spring, on March 18th/19th. The weather was crisp and sunny, if extremely windy, plenty of people turned up, including 3 new faces in search of some training.

The primary task for the weekend was to provide surveying training. This took the form of an initial theory session on Saturday morning, followed by some actual surveying in OFD I, then data entry and an explanation of software use in the evening. On Sunday morning the teams drew up their surveys by hand. This format worked well, and will be used again at future meets where the focus is on training.

The three trainees were Henry Dawson, Brendan Marris, and Paul Hartwright. Paul had done some surveying many years before, but felt in need of a refresher. He showed us the instruments he had previously used - a mining compass and a DIY-clinometer he had made from a standard plastic protractor attached to a bit of wood for sighting, with a plumbob for readings. Despite being about 20 years old, and having clearly cost all of 80p to make it actually worked quite well, giving readings to within about 2-3degrees of the Suunto/Silva devices, the main limitation being the accuracy with which one could read the protractor scale. Henry and Brendan had essentially no previous surveying experience.

The trainers were Brian Clipstone, Wookey, Andrew Atkinson, Martin Green, and the Dobsons. Becka Lawson, Julian Todd and Allan Richardson helped out for the surface work, but had other things to do (caving and SWCC committee meeting respectively) during the actual surveying.

## Theory and real-world practice

We started with about 1hr of theory covering surveying fundamentals, instrument use, note-taking, and various other bits of practical advice on station placement and common mistakes to try and avoid. Then we got changed, arranged ourselves into three teams each equipped with full survey kit (thanks to Cambridge UCC and SWCC for loan of survey kit), and headed down to OFD I to survey a couple of bits of convenient cave near the entrance - Skeleton Chamber, and The Font to Pluto's Bath. The object was for the trainees to experience representative conditions and to survey each bit at least twice, for comparison purposes, so there was no need to go any further than necessary. OFD I is ideal for this being varied enough to provide a good case study and also big and warm enough to be pleasant and not get stuck behind each other too much.

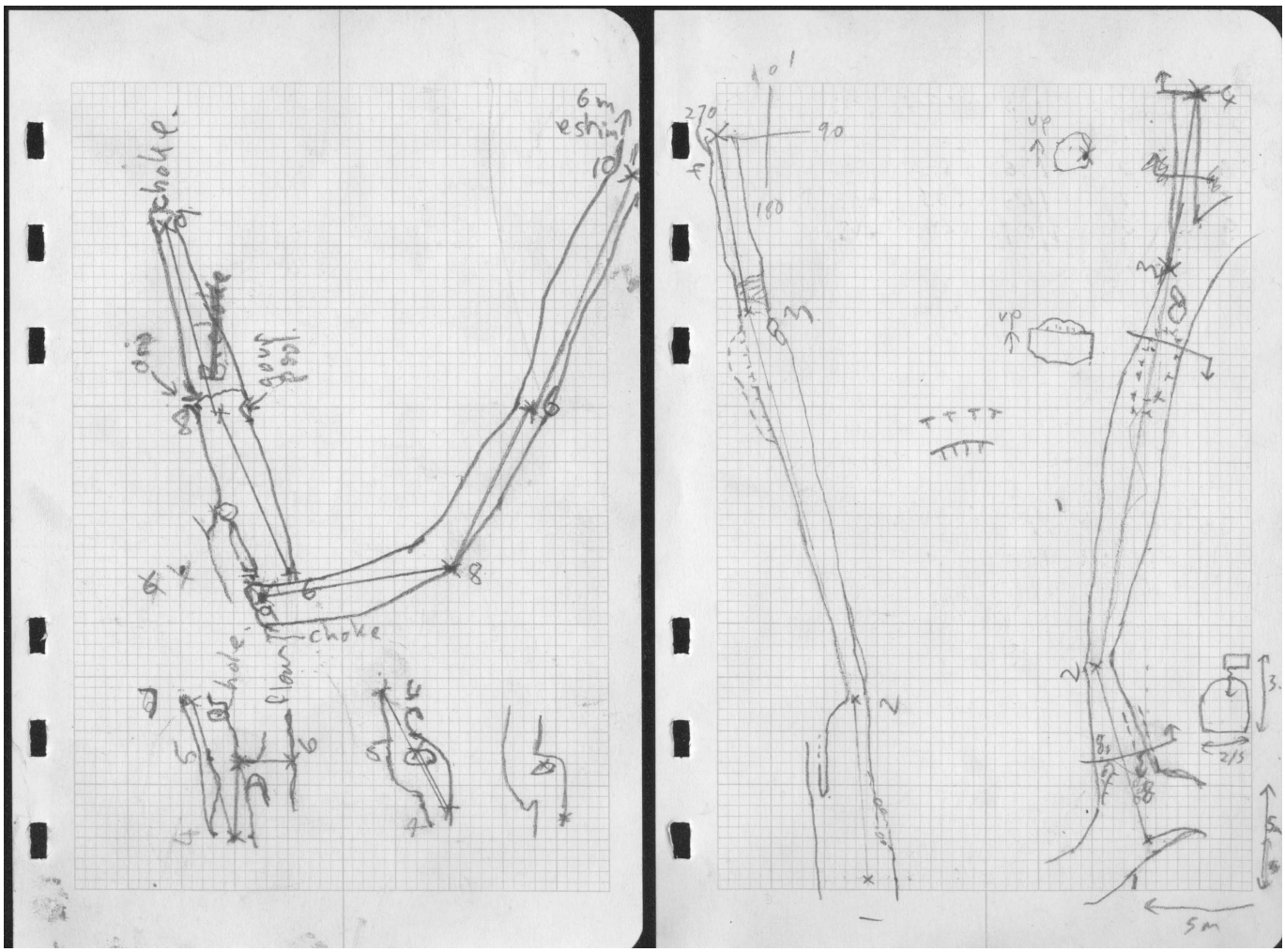


***Figure 1: In-cave sketches for part of the Skeleton survey.***

In the end there wasn't time for all the teams to survey everything but we had the main drag in Skeleton done twice and parts of the font/pluto survey done twice as well. This is ideal for showing beginners where they cocked-up, because both blunders and inaccurate readings are obvious when the two surveys don't line up.

After a few hours surveying we had about 300m of survey and 58 stations between the teams, and everyone had a reasonable idea of how it works in practice. Tippex was used for station marking and we made sure that teams re-used at least a few of each other's stations so that we could cross-check the surveys. Example in-cave sketches for part of the Skeleton survey are shown in Figure 1.

We also got to see the Dave Edwards electronic clino in action, which is a nice bit of kit that seems to work well. It lives in a plexiglass box with neoprene transport wrapper and has a laser pointer and fire button with a small display to read the reading from. Readings are very quick to take, and the last reading stays on the display so you can take the reading, then relax, calling the number out to the note-taker when he is ready.

## Data entry

Back in the SWCC Library after some food, we gathered to put the data in. Survex was used for this. Wookey showed how the data was put in, processed, displayed and checked. There was a fairly typical array of errors for beginners - all the from/tos being backwards in one survey, significant variations between one survey and another on legs steeper than 13 degrees, legs recorded as going to stations they didn't really go to, and a couple of plain blunders. Nevertheless, as you can see from Figure 2, once the cock-ups were fixed there was good correspondence between the surveys.

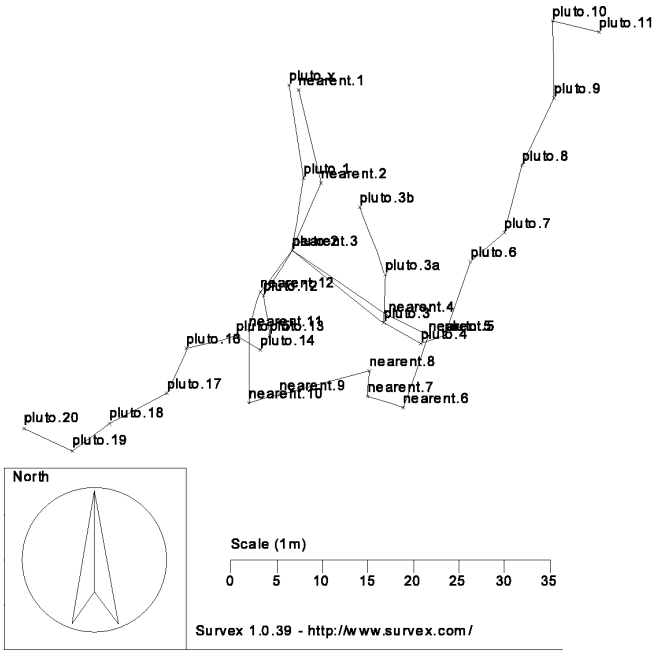


***Figure 2: Centreline for The Font area of OFD1, surveyed by two different teams ("nearent" and "pluto" surveys).***

Next we had a short session on drawing with Therion and Tunnel just to give the students an idea of what was possible, but left them to do good old-fashioned manual drawing-up for this session as it's a lot simpler to learn. We printed out their centrelines and people sloped off to bed or beer whilst Wookey and AndrewA scratched their heads some more about merging two different data-recording styles of Mulu data in Therion, which turns out to be a remarkably complicated issue (still ongoing as I write this, some 8 months later).

## Drawing up

Our nascent surveyors spend a happy couple of hours drawing up their surveys on Sunday morning, thereby getting a good understanding of what they should have drawn/written down underground but forgot. The drawn-up surveys weren't at all bad, with the overlapping sections recognisably the same caves, and our new surveyors left the event very pleased with their education. The Skeleton survey was later drawn up using Therion (see Figure 3). We hope this sort of surveying training will remain popular at CSG meets in the future.

Thanks to Allan Richardson, Meets Organiser, for meet organising, and to all who came along and helped out.

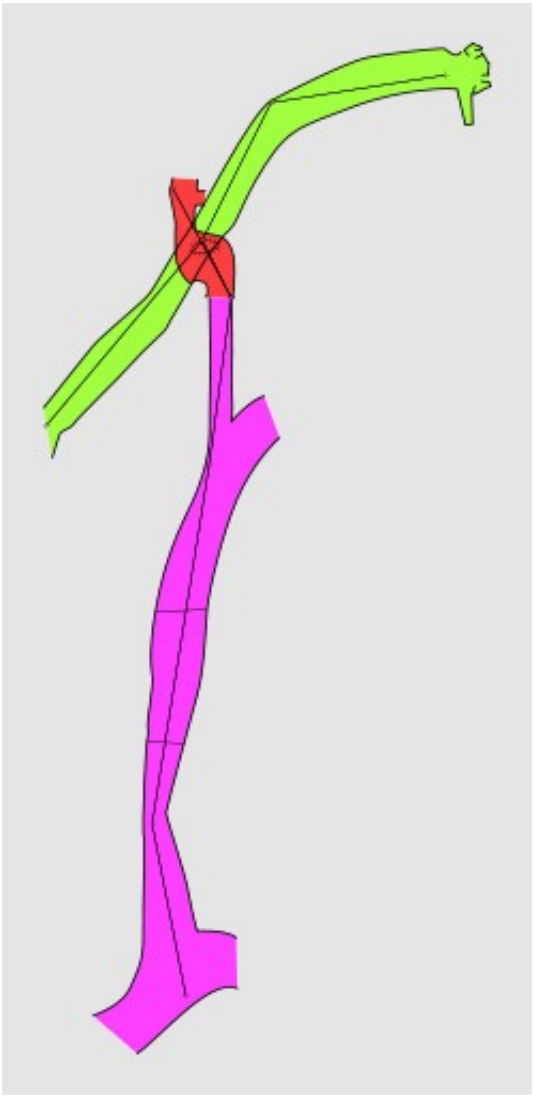

***Figure 3: Final version of the Skeleton survey from Figure 1 drawn using Therion.***

# A short introduction to Speleoliti mapping software

***Matej Dular***

*Speleoliti is a relatively new piece of cave mapping software written by Matej Dular of Caving Club Ljubljana, Slovenia. In this article, he gives an overview of the features and capabilities of the software.*

I felt very honoured when the Compass Points editor asked me to write a short presentation of the Speleoliti software this Spring. Of course software like this cannot be described in detail in only a few pages, but at least I can point out the most interesting features to Compass Points readers.

## Speleoliti background

I started writing the program at the end of 2002. I didn't have much experience in programming then, but I was trying to get some, and writing some simple mapping software seemed to be a great learning project at that time. Later I just couldn't give it up and constantly came back to the project. The latest changes were made in July 2006 and version 4.1 seems to be stable and finished now for a while.

This is to point out: the whole Speleoliti project emerged from a learning experiment and this is still evident today. There was plenty of improvisation and the program is not one of the fastest. Nevertheless it became a useful tool that offers some interesting features that are quite unique in the world of cave mapping software. It can be useful on occasions when other powerful software doesn't offer similar features. Speleoliti is provisionally translated into English.

## First impressions

Speleoliti is supposed to be a little all-in-one package that includes editing, drawing, extended-profile construction, error manipulation and basic GIS features. It is a multi-window application. Some people may not like chasing multiple windows around the desktop, but it makes it possible to access and manipulate all the different program modules at the same time.

The software is very easy to use: one click to start editing data and another one to display the drawing. You can load multiple objects, but they are all of the same rank - there is no hierarchy. However, it is possible to link one object to another. Units of measure and axis names in the program can be freely adjusted and renamed. Motion and zoom are seamless and the drawing settings are fully adjustable.

Speleoliti uses its own data file format CSP. It can also read and write On-station and Compass files (after importing you may have to join imported subfiles back into one single file to get the correct linkage of object's subparts) and data can be exported to some useful standard file formats, such as SHP, DXF and XML. It can produce interactive SVG or Java files, but this is quite an obscure option, I think.

## Interesting features

Survey data is entered into a standard data table with the possibility to copy and paste. Besides survey shots, data can also be entered or edited as 3-D Cartesian co-ordinates of survey stations (see Figure 1). Dive shots can also be entered. Both survey shots or 3-D survey co-ordinates can be printed. The "Marionette" option enables real time object drawing, so you can type your data and watch the object being drawn as you type.

As previously mentioned, plan, profile and extended profile run in different windows so it is possible to watch them all at the same time. If you enable the "Marionette" option, you can also move and rotate them synchronously. Drawings can be printed with crossmarks or millimeter grid, or they can be exported to PDF, SVG or BMP files.

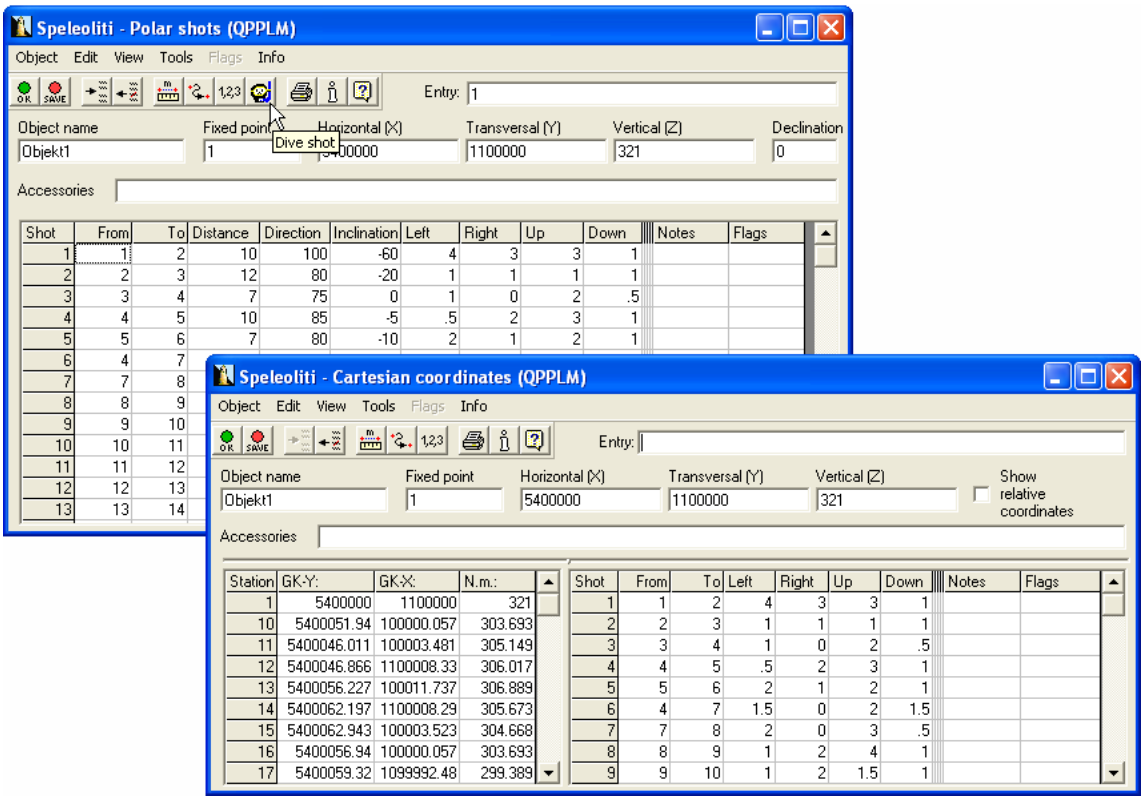


***Figure 1: Survey shots and survey station co-ordinates can both being edited.***

Speleoliti's speciality is the construction of extended profiles. With arrow keys you move a selection between shots and switch a shot (left/right with combinations with Ctrl and Shift), a polygon branch or a whole object. You can extend a whole object and there are still some other options to switch shots depending on their direction or to set it by a flag while entering the data. The extended section configuration is saved with the object so next time you open it it is as you left it last time. If you load a surface grid, a surface section can be displayed above the cave, as shown in Figure 2.

Error correction is a bit complicated, but gives you the option to decide precisely how an error should be distributed between the shots of a loop. Correction takes place in its own window, where you can select shots or stations with your mouse (or the program can find a loop for you) and then distributes the error on one of many possible ways. You are allowed to select only some parts of a loop if they are more likely to be wrong than other parts (for example if one part of the loop was measured with theodolite and the other part wasn't). You can also stretch an object (or its part) to a selected station of other object, although the program doesn't recognize this as a loop. One thing that is still missing is a one-click bicubic correction of the whole object, but it will be included in the near future. There is another interesting possibility about loops – you don't necessarily want to correct an error, but maybe you just want it to appear somewhere else in the loop. No problem - simply transfer it to the station where you want it to be. These options are illustrated in Figure 3.

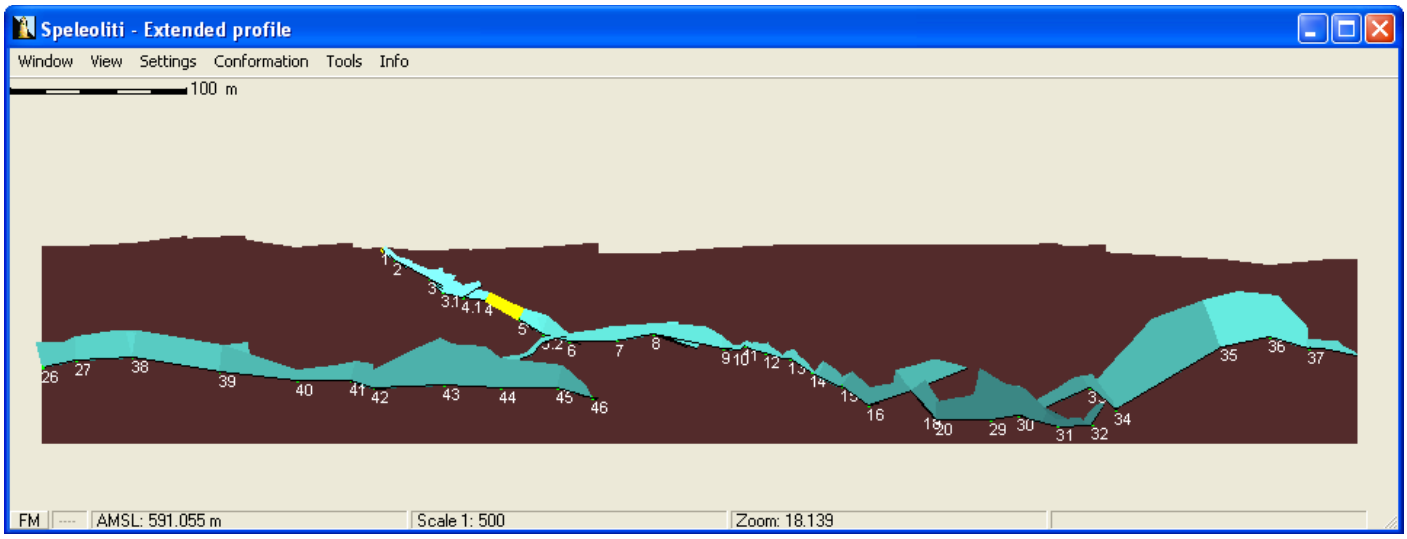


***Figure 2: Extended profile of the entrance part of Najdena cave. If a surface grid is loaded, then a surface section is also displayed above the cave.***

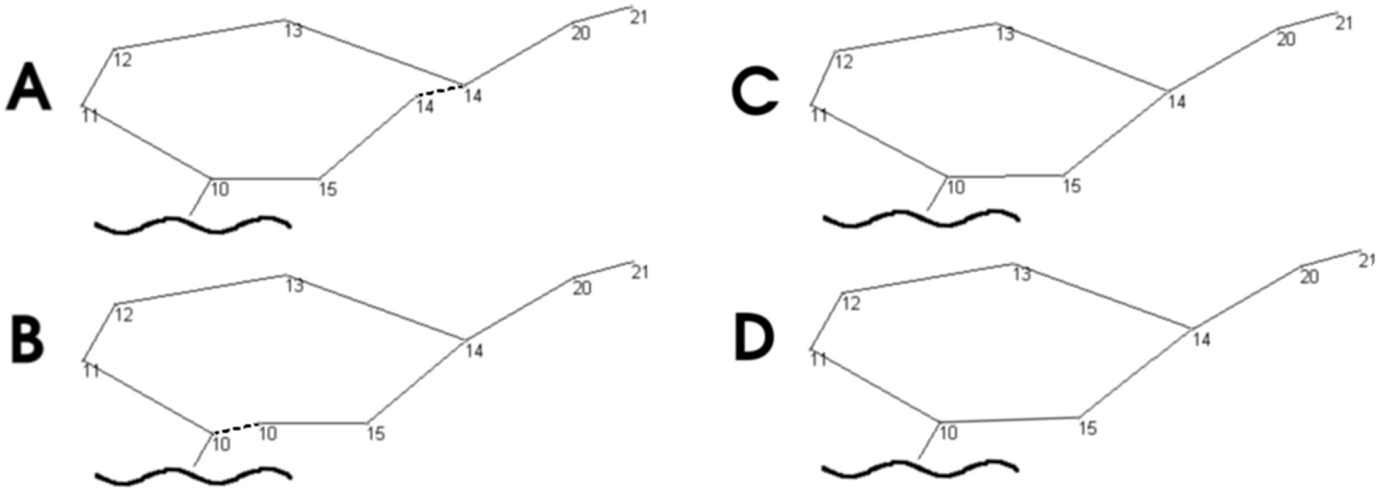


***Figure 3: Some possible correction results: A - uncorrected loop; B - the error is transferred to station 10; C – equally distributed error (there are other distribution options too); D – in this case the error is only distributed between shots 14-15 and 15-10, so the polygon part 10-11-12-13-14 stays unchanged.***

Speleoliti includes basic GIS features such as image backgrounds, point layers and surface grids. Many data file formats are supported and the data can also be edited. This allows you to put image backgrounds even under profile views in case you want to put some vertical graphic schema behind a profile view. These features are shown in Figure 4.

The next interesting feature is the possibility to shade some areas (for example chambers) that can not be described by LRUD parameters. If you have measured shots around the edge of a chamber or taken radial shots from the centre of the chamber, you can shade the hall as Figure 5 shows. You only have to specify the stations of the chamber circumference in the "Accessories" field in the data editing window.

The last feature I will mention here is about tunnel passages. By default, Speleoliti interprets LRUD parameters as normal vectors to the shot axes (though this behaviour can be changed). This means it won't flatten the tunnel in a vertical shot. Besides LRUD Speleoliti also has parameters L'R'U'D' which can be a bit confusing. They describe the tunnel dimensions in the second part of a shot and can be used to modify the tunnel dimensions along the shot (for example at a sudden ceiling jump where you don't want the software to smooth the tunnel with the following shot's tunnel automatically). Figure 6 shows an example of this procedure. However, if you don't want to mess with the L'R'U'D' parameters, you can hide them and ignore them completely.

## Conclusion

Speleoliti used to be an experiment only, but has evolved into a useful cave modelling application. It has some non-standard approaches, but also offers some original solutions. The most powerful and noteworthy options are 3-D co-ordinate editing, construction of extended profiles and exporting to professional file formats such as SHP, PDF, DXF, SVG and GRD. Speleoliti remains a classical box-type cave mapping software and does not have any ambition to become "CorelDraw-type" software, so editing of contours like there is in Walls or Therion is not possible. The main drawback of Speleoliti is its non-object data model. The data model is based on arrays and there is a default limit of 255 shots per object. This limit can easily be increased, but only when no data is loaded. Yes, I know, mea culpa. This was an early decision, but now I would have to rewrite the whole program to solve this problem.

*To download the software or obtain further information, visit the Speleoliti web page at:*
`http://www.speleo.net/speleoliti/`*, or contact the author:*

*Matej Dular,*
*Caving club Ljubljana*
*Ulica Luize pesjakove 11, 1000 Ljubljana, Slovenia*
`matej@speleo.net`

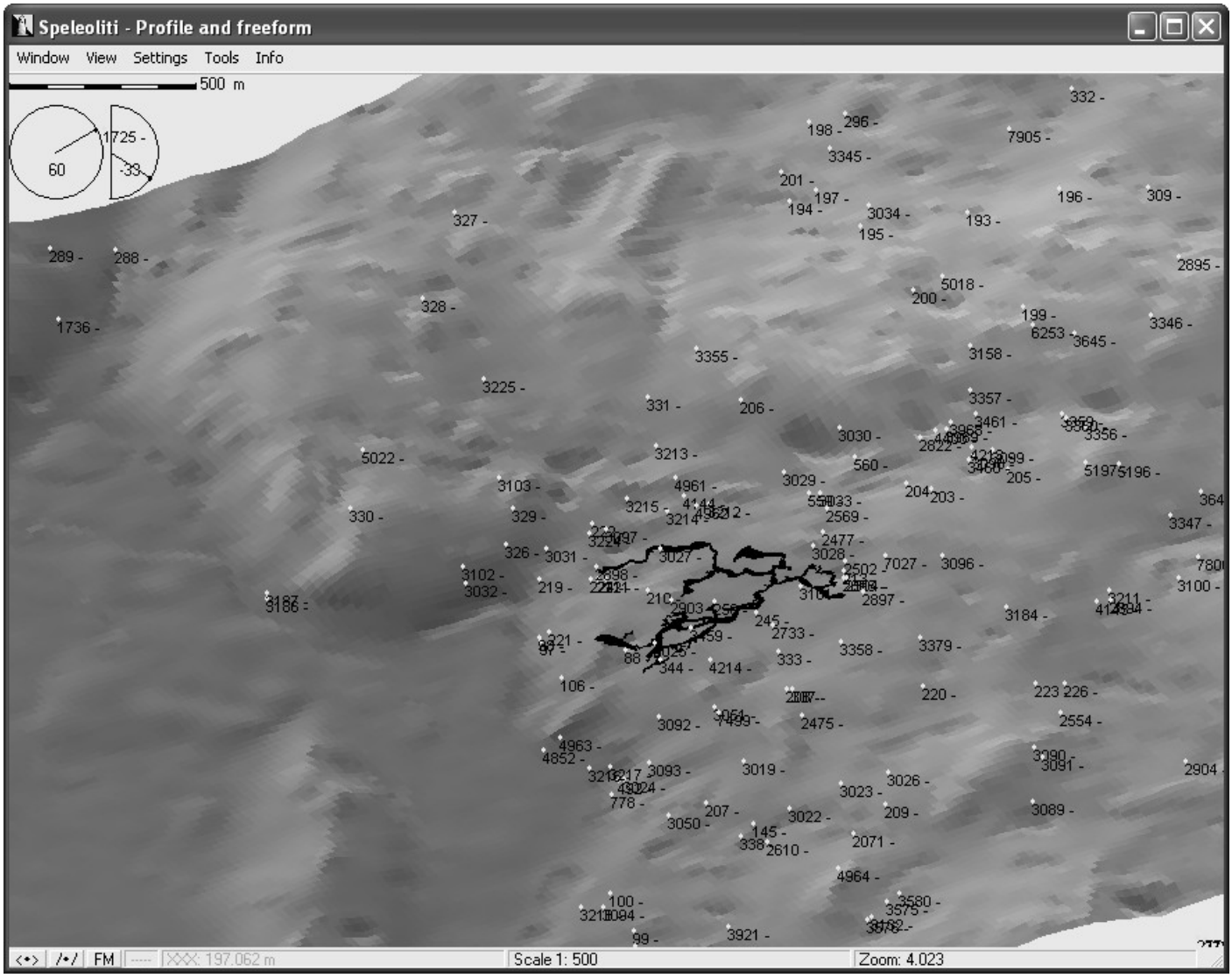


***Figure 4: Najdena cave (coloured by distance), a point layer from a cave database and a surface grid of the northern part of Planinsko polje.***

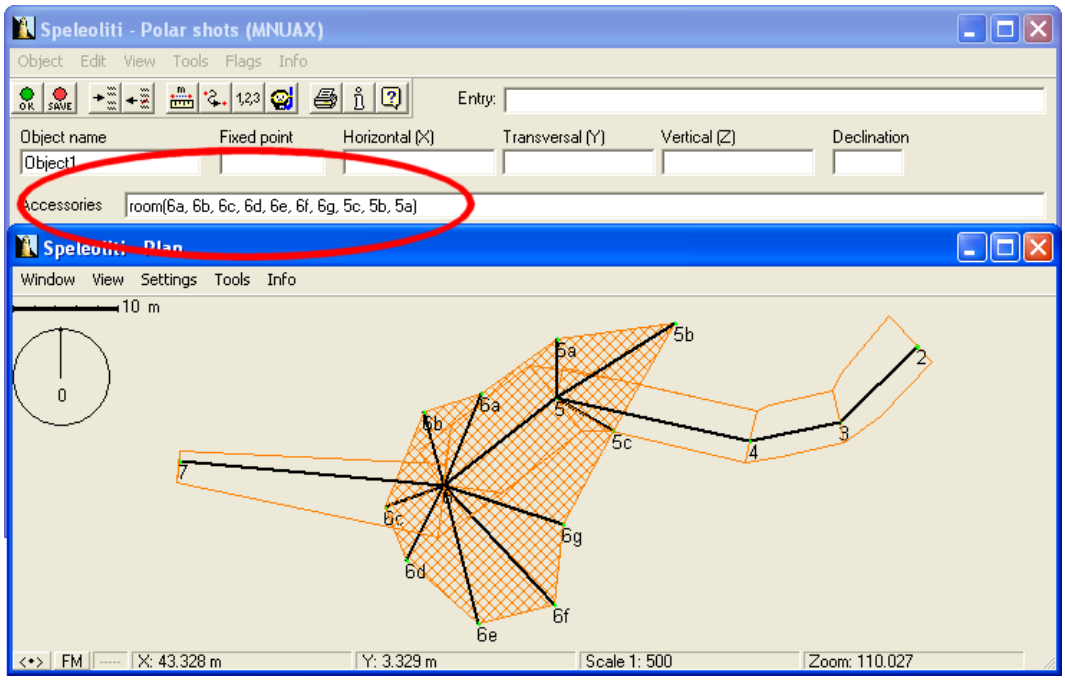


***Figure 5: Examples of chamber and cavern shading by the Accessories keyword "room". The string in this example is: "room(6a,6b,6c,6d,6e,6f,6g,5c,5b,5a)"***

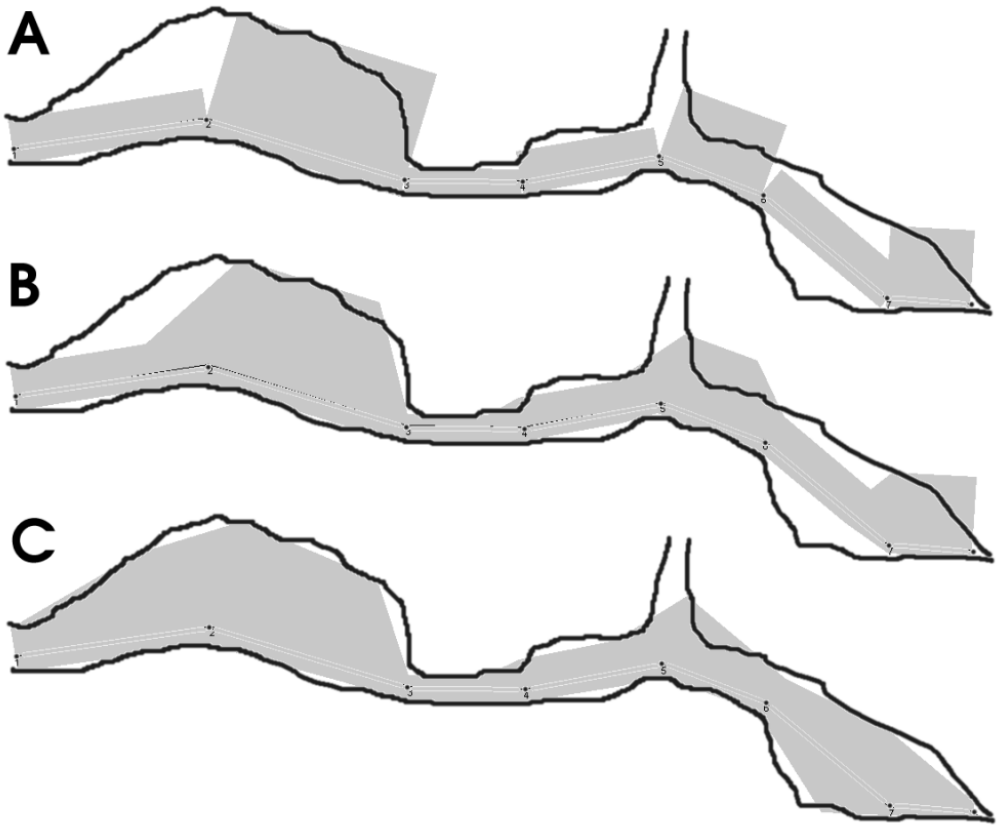


***Figure 6: Examples of tunnel walls interpretation: A – unconnected bricks; B – partially connected tunnels; C – modification of tunnel walls by parameters L'R'U'D'. It is obvious that example C can describe the cave most accurately.***

| Shot | From | To | Distanc | Directio | Inclina | Left | Right | Up | Down | Left' | Right' | Up' | Down' |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 2 | 10.8 | 90 | 9 | | | 1.6 | 0.8 | | | 5.5 | 1.0 |
| 2 | 2 | 3 | 11.4 | 90 | -17 | | | 6.0 | 1.0 | | | 1.2 | 0.7 |
| 3 | 3 | 4 | 6.4 | 90 | -1 | | | 0.6 | 0.8 | | | 0.9 | 0.7 |
| 4 | 4 | 5 | 7.7 | 90 | 10 | | | 1.6 | 0.7 | | | 2.5 | 0.8 |
| 5 | 5 | 6 | 6.0 | 90 | -20 | | | 4.0 | 0.6 | | | 1.8 | 0.6 |
| 6 | 6 | 7 | 9.0 | 90 | -40 | | | 1.7 | 0.6 | | | 3.8 | 1.0 |
| 7 | 7 | 8 | 4.6 | 90 | -3 | | | 4.0 | 0.4 | | | 0.5 | 0.3 |

# Denis Warburton, 1925 – 2006

***Pete Cousins***

Denis Warburton, who was by profession a Chemist, started caving in the early 1950's, regularly travelling down to Mendip with Alan Surrall and others from Birmingham. He soon put his analytical skills to work underground, rapidly becoming one of Mendip's foremost cave surveyors.

Denis is recorded, jointly with Alan Surrall and Phil Davies, as surveying Eastwater in 1952-54 and this work was published as a CRG grade V survey on two sheets with Plan, Elevation and Passage Cross Sections. This was one of the earliest surveys to be published in conformity with the new CRG standards [1] - and the Wessex team could hardly have chosen a more difficult subject! It is clear from this work that in addition to being a meticulous surveyor, Denis was also a fine draughtsman - for it is his signature that appears on this survey.

Denis worked on many of the smaller Wessex survey projects at this time; surveys of Cookoo Cleaves, Hillier's Cave, Withybrook Slocker and even in a cave on Steep Holme - surveys which appeared at regular intervals in the Journal.

In 1956/57 Denis is reported helping Derek Ford (also Jim Hanwell and others) with the Grade V survey of Stoke Lane II, published 1959. In 1960, also on East Mendip, Denis is recorded as working with Phil Davies on the survey of Fairy Cave.

In 1962 Denis, again working with Alan Surrall and Phil Davies, completed the single sheet (Plan and Elevation) Grade V survey of Lamb Leer. This must have been a busy year for the Wessex surveyors as, also in 1962, Denis Warburton, Alan Surrall and Jim Hanwell produced the two sheet (Plan and Passage Cross Sections) Grade VI survey of Balch's Hole.

Around this time several Mendip surveyors met to discuss survey practice, problems and standards. The resulting report "The Mendip Survey Colloquium" [2] was published privately and is often quoted - but rarely read. However thanks to the tolerance of the Wessex Editor at the time Denis' own 15 page theoretical paper had already been published in the Journal [3] and has been quoted in virtually ever paper or book on Cave Surveying since.

What is often forgotten is that at this time all the vital survey calculations would have been done manually, using Log, Log Sine and Log Cosine tables; always a time consuming and error prone task. Chunky desktop calculators with a simple Polar to Rectangular function key only became available in the mid/late 1960s. Indeed, we know that around 1968 the Chemistry lab at Wolverhampton Metals kindly provided Denis with an early model Olivetti calculator that could actually be programmed - using a magnetic strip - to do some of the survey number crunching.

Using Log tables remained a necessary surveying skill for several more years; and it is interesting to note that as late as 1976 Bryan Ellis still thought it appropriate to include four pages of 4-figure Log tables in his classic book "Surveying Caves".

As well as working enthusiastically on many of the Mendip digs of the period - including Cow Hole and later Fairmans folly - Denis also travelled to Yorkshire and Wales with the club. He even did some surveying in Yorkshire. But his casual suggestion one Sunday morning in Horton-in-Ribblesdale that we should rise early "to do Pen-y-Ghent before breakfast" was greeted with some trepidation by many hardened cavers; particularly when they realised that a walk up Ingleborough was on the menu to follow breakfast!

In 1968 Denis switched to working in Agen Allwedd (the task that I took over two years later). Now we were working to a genuine Grade 6 with new versions of the Survey Unit and a tape measure conveniently marked in feet and tenths. We arrived one weekend in May 1968 and, closely following the recommendations of his 1963 paper, took no less than 6 calibration bearings on our way to the cave entrance - and a similar number on every trip thereafter. The vagaries of Magnetic Declination were not going to spoil this survey.

Denis Warburton passed away quietly on February 26th, 2006. Just eight members (or former members) of the Wessex Cave Club attended his funeral in Stourbridge on 7th March. They were outnumbered by his family, former work colleagues, and many friends from the village where he had lived with Brenda for the past 30 years. It had rained heavily that morning and continued to rain during the service, somehow we felt that Denis would have approved.

## References

[1] Butcher, A.L. (1950). Cave Survey, Cave Research Group publication no. 3 [Cave Research Group of Great Britain] 40pp.

[2] Anon. (1963). The Mendip Survey Colloquium, *Journal of Wessex Cave Club*, No. 92, 276 - 277.

[3] Warburton D. (1963). The Accuracy of a Cave Survey, *Journal of Wessex Cave Club*, Vol. 7 (89), 166 – 181.