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EDITORIAL

There are several things which I feel need mentioning concerning this particular 20 page issue. Owing to the splendid response in regard to material and the fact that we have a bit of money to spare (believe it or not!), we have managed to publish this giant-size edition. However, this particular issue is an exception as far as size is concerned. In keeping with our budget, we find that in most cases, a 16 page issue suffices. I must apologise to those people who have sent me material only to find that it has not been published in this issue. Owing to the size of Ken Grimes' particularly interesting feature, space has been at a premium and only the more urgent articles have been included.

I was also somewhat astonished to learn that there are a large number of non-member clubs existing throughout the Mainland states which for reasons unknown are either unaware of ASF's existence or are simply not interested in ASF. In my opinion, it is essential that steps are taken to ensure that these clubs are affiliated with ASF in some way or another. I was also surprised to learn that one club in WA was completely unaware that the ASF Newsletter existed until two of its members saw one for sale in an outdoors shop in Melbourne! It is therefore imperative that ASF members or representatives take steps to contact these 'rebel' clubs and inform them of ASF's functions. I personally feel that this is a matter of utmost importance and be acted upon immediately!

Lastly, I would like to take this opportunity of offering our condolences to the family of Phillip Coburn who died in the Granville Rail Disaster in mid-January. Unfortunately, I never met Phillip but judging by the esteem in which he was held by fellow members of BMSC, the caving world will be the poorer with his loss. A resume of his caving contributions written by his close friend Greg Powell appears below.

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Phillip Coburn (obituary)

Phillip began his caving activities as a Senior Scout in the Blue Mountains. He gained his Queen's Scout Award and progressed into Rovers. He joined the Blue Mountains Speleo Club in 1973 and soon became a full member. Phillip held the office of librarian in 1975 and 1976. This is not the easiest job in any club but Phil treated the task with the dedication that it deserved. During the time that he was in the club, the trip programme would be very scant indeed if the trips that he led were removed. Phil was a very dedicated caver in all fields, as well as being a keen outdoorsman, quite proficient at li-loing, hiking, ski-touring, rock climbing and abseiling, four-wheel driving and SRT work. However, caving was his major interest. When the Cave Rescue Group was formed, Phil quickly joined and represented BMSC at its functions. He was well known to many societies and many people will miss him and his dedication to caving. Phil lived with his parents, brother and sisters at Blaxland. He had studied hard to become a Bank of NSW Officer with the Chief Accountants Department in Sydney. It was while on his way to work that he died in the Granville Rail Disaster on the 18th. January, 1977. He was only 23 years of age but had led a rich and rewarding life, yet it is sad to reflect on how much good work he had yet to do and that which will never be done. The BMSC attended the large and moving funeral in force as did his Scouting friends, Leo Club, Tennis Club and many more including some from other Speleo Societies and the Cave Rescue group. Cards and flowers from many other societies and individuals attested to the high regard in which he was held. His death deeply saddened and shocked many people yet it is comforting to think that Phillip had lived such an inspiring way of life that his passing has affected so many people; people will miss him and the work that he did, very, very much.

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REDUCING CAVE SURVEY DATA WITH A HAND CALCULATOR

by Ken Grimes
U.Q.S.S.

ABSTRACT

The recent advent of a wide range of small electronic calculators greatly facilitates the mathematical reduction of survey data into X, Y and Z co-ordinates for plotting on a grid. Presented here are the formulae and methods used for reducing traverse data, closing networks and simple loops, and triangulating inaccessible points. An appendix lists a series of programs for use with the Texas Instruments SR-52 programmable calculator.

INTRODUCTION

There are two main methods of producing a cave map. The first method is the graphical one in which the first point of the traverse is marked on a sheet of paper and the next obtained by using a protractor and ruler to lay off the bearing and distance (at the scale chosen) to the next point, and so on. The only mathematics used is in converting inclined distances to horizontal distances, though even this can be done graphically if necessary. Misclosures are adjusted by eye. The method is described in Ellis (1976, Ch. 5) and is fairly satisfactory for small low grade surveys. The main disadvantage is that an error in plotting any point will affect all following points.

The second method is a mathematical one which converts the original data into X, Y and Z co-ordinates (Eastings, Northings, and Elevations respectively) of a grid system. This method has the advantages of greater accuracy (bearing in mind the accuracy of the original data), a permanent record in the form of co-ordinates which can be used for plotting at any scale, and the ability to distribute misclosures mathematically and generally apply all sorts of other mathematical treatments if desired. The method has the disadvantage that the repetitive calculations can be tiring and are a possible source of error. The use of electronic calculators, or computers if available, removes much of this problem.

FEATURES OF ELECTRONIC CALCULATORS

There are a variety of pocket calculators on the market at present. The only really essential requirement beyond the basic arithmetic functions is the provision of trigonometrical functions. However, in selecting a calculator a number of other features should be kept in mind. Calculators operate by one of two basic modes: the Algebraic mode and the Reverse Polish Notation (RPN). The difference can be told at a glance: Algebraic machines have an '=' key while those using RPN have an 'Enter' key instead. The RPN system is the more versatile of the two as it allows easier manipulation of the data and therefore reduces the number of memory registers and memory operations needed, however an algebraic calculator with parenthesis keys will overcome many of these shortcomings. Another very useful function to have, is a 'Polar to Rectangular Co-ordinate (P/R) conversion' which reduces to a single step the conversion of a bearing and a distance to the changes in X and Y co-ordinates. Also useful is a summation key which (among other things) simultaneously sums both the X and Y contents of the RPN operating stack into separate memory registers. This allows the changes in X and Y for each leg of the survey (obtained from the P/R conversion) to be added to the X and Y co-ordinates of the previous station to give the co-ordinates of the next station. In order to avoid having to re-enter data unnecessarily, it is advantageous to have several memory registers. From my own experience I would suggest at least 7 registers for an Algebraic calculator (or 5 if it has Polar to Rectangular conversion) and 6 (or 4) for RPN calculators. In practice, I use many more than these in order to store additional data (e.g. to retain the co-ordinates of the original point for later misclosure calculations, and to sum the total length of the traverse). To satisfy all these requirements the choice is limited to less than a dozen models on the present market and the price will probably exceed \$100.

PROGRAMMABLE CALCULATORS

A simple reduction of a CRG grade 5 traverse leg takes between 20 and 40 keystrokes (depending on the machine. 'Programs' of keystrokes for some non-programmable calculators have been listed by Pavey (1974), King (1974) and King (1975). As each keystroke is a possible error (especially in the wee hours of the morning after reducing a long survey) the programmable calculators offer a distinct advantage both in reducing errors and in speeding up the calculation. With these machines, the sequence of keystrokes is entered at the start of the session, along with any special instructions such as 'halts' to allow the insertion of data or the read out of results. The calculator stores this sequence in a special program memory. All one has to do then is enter the data in the correct order and the machine does the rest. For simple programs such as those listed by the above authors, a 50 step program memory is sufficient. However longer program memories are an advantage as these allow additional calculations such as the summing up of traverse distance, automatic conversion of backsights, conversion of bearings to true north etc. Program-

REDUCING CAVE SURVEY DATA Cont;

mable calculators generally also include special functions such as branching of the program based on the nature of the previous result or according to 'flags' which can be set by the operator. Flags are particularly useful for 'telling' the calculator to convert backsights before proceeding with the main calculation.

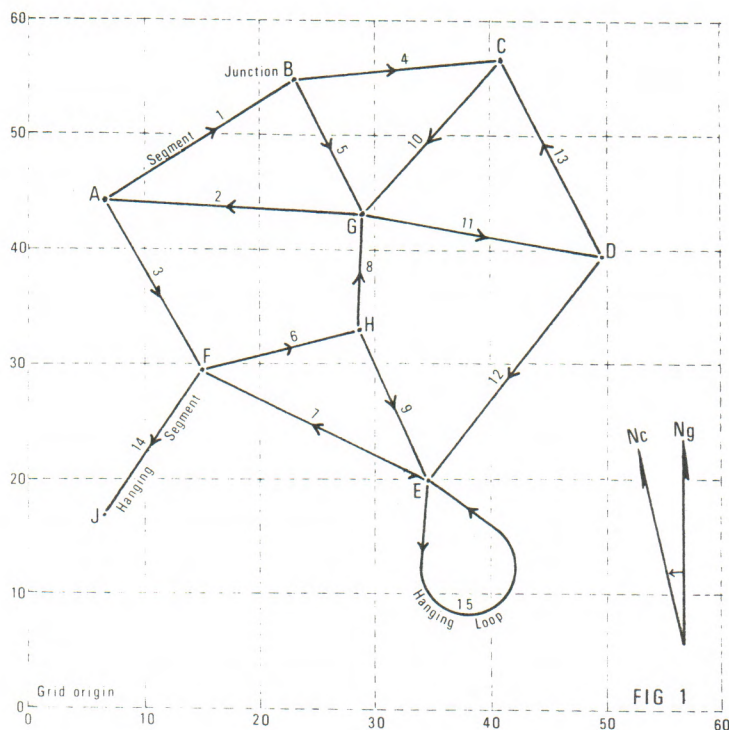
In comparing calculators the efficiency of the program memory must also be kept in mind: some machines merge steps (e.g. prefix keys, or memory operations) and therefore reduce the number steps which have been stored.

Computers are even more efficient, especially for large and complicated surveys. They are also expensive to use and are beyond the reach of many cavers. They will not be discussed here. Summaries of computer applications in cave surveying have been given by Wilcock (1970 a & b), Luckwill (1970), Schmidt & Schelleng (1970), Rutherford & Amundson (1974).

SELECTION OF ORIENTATION AND ORIGIN OF CO-ORDINATES

The aim is to reduce the measurements made in the cave to a set of three orthogonal co-ordinates for each survey station. The first step is the selection of a suitable orientation and origin for the grid. The easiest orientation to use is magnetic north, or more precisely compass north if the compass used has not been calibrated. Compass calibration is something which does not appear to be done much in Australia. The need for calibration before each surveying session, and the method for doing so are discussed in Ellis (1976, Ch. 8) and Irwin & Stenner (1975). If the compass has been calibrated then the grid can be oriented to true north or to the National Map Grid, and the relevant correction is made to each bearing as it is fed into the calculator (a programmable calculator will do this for you). The orientation of the grid must be stated on the final map (i.e. compass north, magnetic north, or true north). The origin of the grid could be the start of the survey but this will generally result in negative co-ordinates for some stations and this can be confusing and makes it difficult to give grid references. It is better therefore to locate the grid origin a sufficient distance to the southwest so that all co-ordinates will be positive (cf. Fig 1). In the vertical direction the origin could be placed at sea level if the entrance elevation is known or at some arbitrary level otherwise. For a group of caves, if the entrances have been linked by a surface survey then a single common grid could be used for all the caves: this will facilitate the search for possible connections.

Figure 1.



A network survey: terms used in the text.

A, B, C,...H are JUNCTIONS of the network. 1, 2, 3,...13 are SEGMENTS of the network, e.g. segment 4 joins junction B to junction C. The arrows indicate the direction in which each segment was surveyed and its co-ordinate changes calculated. Each segment is composed of a number of LEGS (see Fig. 2). Segment 14 (F-J) is a HANGING SEGMENT which is attached to the network at one point only (junction F). Segment 15 (E-E) is a HANGING LOOP. A ROUTE consists of several segments. e.g. 'route 1,5,-10,-13.' travels from A to D via G and C. A negative sign on a segment number in a route (e.g. -13) indicates that the route follows that segment in the opposite direction (C-D) to that in which the route was surveyed (D-C). A GRID is superimposed on the network plan. The GRID ORIGIN is located to the south west of the network so that all survey stations will have positive co-ordinates. The X and Y co-ordinates of the junction A are about 6.5m and 44.3m respectively. The deviation of COMPASS NORTH from GRID NORTH is shown in the bottom right hand corner and is about -13° in this case. This value is added to all compass bearings to convert them to grid north. For components of a segment see Fig. 2.

REDUCING CAVE SURVEY DATA Cont;METHODOLOGY

The calculation of a complex survey is done in a number of stages (see Figs. 1 & 2 for the descriptive terminology used here).

(1) Preliminaries: A rough sketch of the traverse lines and stations is made and used to identify junctions, segments, legs, radiations, etc. (see Figs. 1 & 2).

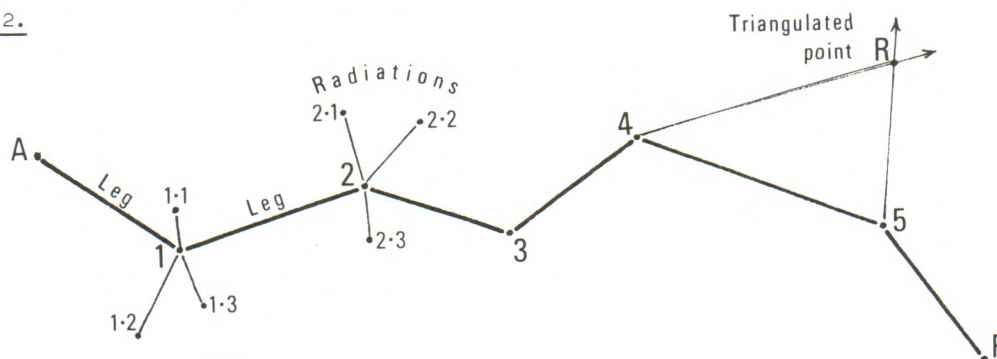
(2) Calculation of station co-ordinates: (a) Unclosed survey; If there are no closures involved then the co-ordinates of all stations (be they on legs, radiations, or triangulations) can be calculated together using programs of the type listed by Pavey (1974), King (1974), King & Pavey (1974) and King (1975) or the TAPE TRAVERSE program listed in the appendix of this paper. As there are no closure corrections to be made these are the final co-ordinates and are used for plotting the map. (b) Closed traverses; If there are closures in the survey then tentative co-ordinates are only calculated for stations within closed segments and the junctions between segments. Radiations, triangulations and any hanging (unclosed) segments or loops are left until step 5 below.

(3) Network closure corrections: The junctions of the network are adjusted for misclosure and their corrected co-ordinates calculated.

(4) Segment closure corrections: Using the corrected co-ordinates for the junctions the stations of the closed segments are corrected for misclosures.

(5) Remaining (unclosed) stations: Co-ordinates for stations in hanging segments and loops, and in radiations and triangulations within segments, can now be calculated using the corrected co-ordinates of their starting points. Isolated (hanging) loops are corrected for misclosure.

Figure 2.



Components of a segment: terms used in the text.

A-F is a SEGMENT of the network in Fig. 1. It is composed of seven stations (A, 1, 2 ..., F) and six LEGS: A-1, 1-2, 2-3, 3-4, 4-5, & 5-F. Several RADIATIONS have been measured: 1.1, 1.2, 1.3 from station 1, and 2.1, 2.2, 2.3 from station 2. Point R is an inaccessible point which is located by TRIANGULATION using the intersection of bearings from stations 4 and 5 (see Fig. 3).

Calculation of Station Co-ordinates

The mathematics involved in these calculations is a simple application of basic trigonometry (see Ellis, 1976). The horizontal and vertical distances (S and v, respectively) of an inclined leg are given by:

$$S = d \cos VA \dots \dots \dots (1)$$

$$v = d \sin VA \dots \dots \dots (2)$$

Where 'd' is the inclined distance (tape measurement) and VA is the vertical angle (clinometer reading) with appropriate sign (positive for an upward sight and negative for a downward sight). For a backsight the sign of the vertical angle is changed.

The co-ordinates of the next station 'i' can then be calculated using the horizontal distance (S_i) from equation 1 and the bearing (A_z), expressed in degrees from north (for a backsight add 180°). The formulae are:

$$X_i = X_{i-1} + S_i \sin A_z \dots \dots \dots (3)$$

$$Y_i = Y_{i-1} + S_i \cos A_z \dots \dots \dots (4)$$

Where X_i and Y_i are the east and north co-ordinates of the station 'i' and X_{i-1} are the co-ordinates of the previous station 'i-1'. The Z co-ordinate (elevation) is given by :

REDUCING CAVE SURVEY DATA Cont;

$$Z_i = Z_{i-1} + v_i \dots \dots \dots (5)$$

where Z_i and Z_{i-1} are the co-ordinates of points 'i' and 'i-1', and v_i is the change in elevation from equation 2.

In the case of a leg (see Fig. 2) the new co-ordinates replace the previous co-ordinates in the relevant data registers of the calculator. For a radiation the previous co-ordinates are retained for use in further radiation calculations or for calculating the next leg. In some programmable calculators a 'flag' can be set to indicate the course of action to the calculator (see the program in the appendix).

If the calculator has a Polar to Rectangular conversion then the procedure is much simplified. The vertical angle and inclined distance are fed in and a single keystroke gives S_i and v_i , using S and the bearing the same key gives the change in X and Y which, together with v , are added to the previous point's co-ordinates to obtain the co-ordinates of the next point. Note that Polar co-ordinates use a different convention to magnetic bearings: the angle is expressed anticlockwise from the x axis while magnetic bearings are read clockwise from the north (Y) axis. Therefore what the calculator hand-book calls x and y are Y (north) and X (east) respectively in the nomenclature used here.

The equations given above assume that the bearings are from grid north. If this is not compass north then the difference should be added to the bearing before calculation.

This is the basic maths, and is the basis of the previously published programs (cited above) for the HP 35, HP 45, HP 65, and HP 21 calculators. However it is also advantageous to sum the inclined distance of each leg for use in closure corrections, and to give the total traverse length of the cave survey. Also if the calculator has sufficient data registers the co-ordinates of the start of any segment can be retained for use in calculation of the overall co-ordinate change of the segment, which is also used in closure corrections. Both these provisions are included in the TAPE TRAVERSE program for the SR 52 listed in the appendix, and the HP 65 would probably have sufficient steps left in its program memory for these options to be added to the program listed by King & Pavey (1974).

Closure of Networks (Fig.1)

The 'approved' method for correcting a network for misclosures is the 'least squares' adjustment, such as is discussed by Schmidt & Schelleng (1970) and Luckwill (1970). This is too complicated for easy use with a hand calculator and a computer is generally required (or plenty of spare time). The procedure described here and used in the NETWORK CLOSURE program in the appendix is based on that of Irwin & Stenner (1975) to which the reader is referred for a much more comprehensive treatment. The corrected co-ordinate of each junction is obtained by taking the mean of a series of values obtained by a number of different routes through the network. The procedure described here differs from Irwin & Stenner in that I have used a weighted mean, i.e. the value from each route is weighed inversely according to its length; the rationale being that longer routes are likely to have greater total errors (cf. Breed 1971, p 102). The formula used is:

$$\bar{X}_j = \frac{\sum_m \left(\frac{X_0 + \sum_n \Delta X_s}{\sum_n D_s} \right)}{\sum_m \left(\frac{1}{\sum_n D_s} \right)} \dots \dots \dots (6)$$

where \bar{X}_j is the weighted mean X co-ordinate of junction j ,

X_0 is the correct co-ordinate for the start of each route,

ΔX_s is the co-ordinate change for each segment of a route,

$X_0 + \sum \Delta X_s$ is the calculated co-ordinate for junction j by any route,

D_s is the length of each segment of a route, and

$\sum_n D_s$ is the total length of a route.

n is the number of segments in a route

m is the number of routes

X , Y & Z co-ordinates are adjusted separately

REDUCING CAVE SURVEY DATA Cont;

Although simpler than 'least squares' the procedure is still time consuming, even with the SR 52 program listed in the appendix, which can only handle nets with up to 26 segments (and that only by using split memories to store the segment data).

A slightly easier method (and one more feasible for most small calculators) is to do a series of simple loop closures, starting with the most accurate loops and working through to those with the greatest misclosures. While this method is a little easier it has the disadvantage of propagating errors through the network to a greater degree than the mean co-ordinate or least squares method. The mathematics of a simple loop closure are discussed later.

Adjustment of a network closure is made in a number of steps:

Step One: It is first necessary to sketch the network on paper (cf. Fig.1) and assign numbers to each segment and indicate the direction in which the overall co-ordinate change (X, Y, Z) of that segment was calculated. The X, Y & Z co-ordinates of the junctions have to be adjusted in separate stages. For simplicity only the adjustment of the X co-ordinates will be discussed here. Procedures for Y & Z co-ordinates are similar.

The second step is to check for gross errors in any segments. This is done by calculating a series of values for the X co-ordinate of some junction at the opposite end of the network to the starting point (which has known, or assigned co-ordinates) taking a variety of routes through the network so that each segment is included in at least one route. Details for the selection of routes are given in Irwin and Stenner (op. cit.). As an example, in Fig.1 one might select junction D as being more or less the furthest point from the starting point 'A' for the survey. A series of routes from A to D are selected (e.g. 1, 4 - 13; 1, 5, 11; -2, -10, -13; -2, -8, 9, -12; 3, 6, 8, 11; 3, -7, -12; see Fig.1). For each route the co-ordinate changes for each of the segments are summed and added to the co-ordinate of the starting point to give a tentative co-ordinate (X_D) for the point D. For any segment followed in the reverse direction the sign of the co-ordinate change is changed before summing. Each value of X_D is weighted inversely by the total length of that route and the weighted values are summed and then divided by the sum of the weights to give the mean value (\bar{X}_D) of the X co-ordinate of point D (see equation 6). This is a preliminary estimate only.

Step Three: The co-ordinates of D obtained via each route are then compared with this preliminary mean. Any which show a strong deviation from the mean must contain gross errors. Irwin & Stenner (op. cit.) present a series of graphs giving expected errors for different grades of survey and different average leg lengths. Use of these graphs allows a more logical assessment of the significance of any deviation. By comparing routes and a process of elimination it should be possible to find the actual segment(s) containing gross error(s). The Y and Z co-ordinates should also be calculated and checked for errors as some mistakes (e.g. in the length of a due north sight) will only effect one co-ordinate and may not have been detected in the examination of the X co-ordinates.

Step Four: If possible the segments with gross errors should be resurveyed. If this cannot be done (e.g. the cave is in New Guinea, or has been flooded by the Glenlyon Dam) then those segments are eliminated from further consideration and the remaining segments are used to calculate a final mean value for \bar{X}_D by repeating the above procedure.

Step Five: The mean co-ordinate of a third point is then calculated by repeating step four using A and D as starting points for routes and so on for all the junctions, with the length of routes becoming progressively shorter as the number of starting points increases.

The whole procedure is then repeated for the Y and Z co-ordinates.

Closure of Segments and Loops

When the corrected co-ordinates of all the junctions have been found, the uncorrected co-ordinates of the stations within each segment can be adjusted for misclosure, as can the stations within any hanging loops. The principals of a segment closure are basically the same as for a simple loop. The main difference is that the segment closure calculation has to allow for variations at both ends of the traverse line. The procedure is to distribute the overall misclosure between all the legs of the loop or segment in proportion to the length (inclined distance d) of each leg.* In addition any adjustment in the start of the segment is made equally to all points within the segment. The formula used is:

$$X_{ic} = X_{i'} - (X_{0'} - X_{0c}) + \left[\frac{\sum_D^i d_i}{D} \left\{ (X_{0'} - X_{0c}) - (X_{n'} - X_{nc}) \right\} \right] \dots (7)$$

* Lex Brown (pers. comm) suggests that it might be more accurate to record the changes in X, Y and Z co-ordinates for each leg together with the total (absolute) X, Y and Z co-ordinate change for each segment. Misclosures in X, Y and Z would be distributed in proportion to the X, Y and Z change (respectively) in each leg. This would of course require additional memory space for summing the absolute changes in X, Y and Z, and would make the programs a little more complex.

REDUCING CAVE SURVEY DATA Cont;

and similarly for Y_{ic} and Z_{ic} , where:

X_{ic} is the corrected X co-ordinate of station 'i'

X_i is the uncorrected X co-ordinate of station 'i'

X_{oc} is the corrected X co-ordinate of the start of the segment

X_o is the uncorrected X co-ordinate of the start of the segment

X_{nc} is the corrected X co-ordinate of the end of the segment

X_n is the uncorrected X co-ordinate of the end of the segment

$D = \sum_{i=1}^n d_i$ is the total length of the segment (sum of leg distances)

$\sum_{i=1}^i d_i$ is the length from the start of the segment to station 'i'

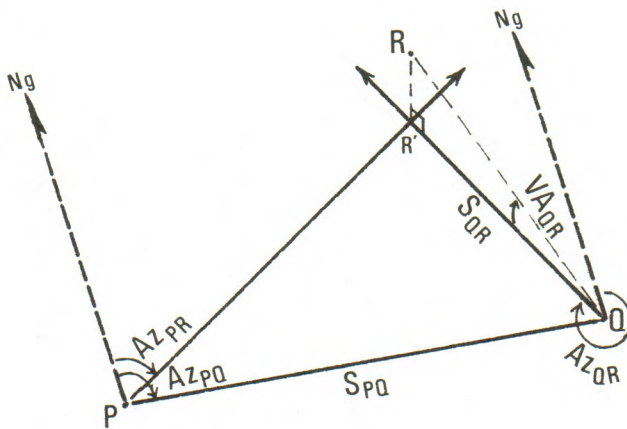
The values; $\frac{1}{D} \{ (X_o - X_{oc}) - (X_n - X_{nc}) \}$, and $(X_o - X_{oc})$ are constant for any segment and can be stored in the memories at the start of a series of corrections. The value $\sum_{i=1}^i d_i$ is incremented for each leg progressively through the loop. The value $(X_o - X_{oc})$ is zero for a simple loop. A flow diagram for the SR 52 program is given in the appendix.

Calculations of Triangulations

Triangulation is the procedure for locating an inaccessible point (e.g. a roof feature) using bearings from the ends of a known baseline (see Fig. 3). The sine rule for solution of triangles is used. In its modified form for use with compass bearings this formula is:

$$S_{QR} = S_{PQ} \frac{\sin (Az_{PQ} - Az_{PR})}{\sin (Az_{PR} - Az_{QR})} \dots \dots \dots (8)$$

Figure 3.



Triangulation of an inaccessible point.

P and Q are the two base stations and R is the remote point.

R' is the vertical projection of the point R onto the horizontal plane.

Az_{PR} is the bearing of line PR.

Az_{PQ} is the bearing of the baseline PQ.

Az_{QR} is the bearing of the line QR.

VA_{QR} is the vertical angle from Q to R.

S_{PQ} is the horizontal distance of the base line PQ.

S_{QR} is the horizontal component of line QR.

N_g is the direction of grid north.

and from this the co-ordinates of the distance point R can be found:

$$X_R = X_Q + S_{QR} \sin Az_{QR} \dots \dots \dots (9)$$

$$Y_R = Y_Q + S_{QR} \cos Az_{QR} \dots \dots \dots (10)$$

$$Z_R = Z_Q + S_{QR} \tan VA_{QR} \dots \dots \dots (11)$$

where Az_{PR} is the bearing from P to R (Fig.3)

Az_{PQ} is the bearing from P to Q (Fig.3)

Az_{QR} is the bearing from Q to R.

VA_{QR} is the Vertical Angle from Q to R

S_{PQ} is the horizontal distance of the base line PQ

S_{QR} is the calculated horizontal distance between Q and R

and X_Q , Y_Q & Z_Q are the co-ordinates of the point Q.

REDUCING CAVE SURVEY DATA Cont;

This ends the calculations and the points can now be plotted on paper using their co-ordinates. Ellis (1976, Ch. 5) describes the methods of plotting from co-ordinates and this will not be described here.

I am indebted to Lex Brown for criticising the original draft of this paper.

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- ELLIS, B.; 1976 - SURVEYING CAVES. British Cave Resear. Assoc., Somerset.
- IRWIN, D.J., & STENNER, R.D.; 1975 - Accuracy and closure of traverses in cave surveying. Trans. British Cave Resear. Assoc., 2 (4), 151 - 165.
- KING, D.; 1974 - A program for the reduction of survey traverses on a Hewlett Packard model 45 pocket calculator. Spar, 32, 3: & 42, 6.
- KING, D., & PAVEY, A.; 1974 - A program for the reduction of survey traverses on a Hewlett Packard model 65 programmable pocket calculator. Spar, 34, 3.

APPENDIX

SUMMARY OF PROGRAMS FOR THE SR 52 CALCULATOR

The Texas Instruments SR 52 calculator has a 224 step program memory and programs can be recorded permanently on small magnetic cards. It uses algebraic notation, with nine levels of parenthesis; has 20 addressable memory registers (and additional 'unofficial' registers which can often be used for data storage); has indirect addressing of registers, a variety of branching and decision making functions and the usual range of mathematical functions found in advanced scientific calculators. Programs can be exchanged without destroying data in the memory registers. An optional printout attachment is available.

At a price of about \$270 the SR 52 is considerably cheaper than the HP 65 and the HP 67 which are the only comparable machines currently available. One major disadvantage however, is that although the SR 52 operates off a rechargeable battery pack, there is no indication given of an impending flat battery which means that one is likely to lose both program and memory contents without warning. As some registers may have been accumulating data for a considerable time, this considerably reduces its value for field use. At home, it can be run off the mains and there is no problem.

The following programs were written specifically for the SR 52, but should be adaptable to other calculators provided they have sufficient memory registers and a long enough program memory (c.f. table 1). As the specific sequence of key steps would tend to vary from one calculator to another, only generalised flow charts are presented here. Detailed listings of key sequences for the SR 52 can be obtained from the author.

Each program has been broken up into a number of separate routines which are called into operation by pressing the appropriate keys. Such 'user definable' keys are available only on the SR 52, HP 65 and HP 67. For other calculators the program would have to be written as a single routine. Splitting up the program in this manner is particularly advantageous for the data input stages as it makes it easier to correct any errors made in keying in the numbers. The routines are further broken up by HALT instructions which allow intermediate results to be displayed or additional data to be entered. After each HALT the routine is continued by pressing the RUN key. If the optional printer is used, some halts can be placed by 'print' instructions which do not interrupt the run of the calculation.

In the flow diagrams in this appendix, the following symbols are used:

TABLE 1A. Data and program registers used by some of the SR 52 programs

	TAPE TRAVERSE	STADIA TRAVERSE	SEGMENT AND LOOP CLOSURE	TRIANGULATION
Number of steps in program	205	224	211	133
Data Registers				
R 00	used for P/R calc.	used for P/R calc.	-	-
01	X_i	X_i	$X_n, \Delta X_n / X_i, / X_{ic}$	X_Q
02	Y_i	Y_i	$Y_n, \Delta Y_n / Y_i, / Y_{ic}$	Y_Q
03	Z_i	Z_i	$Z_n, \Delta Z_n / Z_i, / Z_{ic}$	Z_Q
04	Az	Az	Address (R 1-2-3)	Az _{PQ}
05	VA	VA	" (R 11-12-13)	Az _{PR}
06	d	d	" (R 15-16-17)	Az _{QR}
07	-	staff intercept	-	VA _{QR}
08	-	stadia interval	-	S _{QR}
09	-	instr. height	-	-
10	S_i	S_i	$\sum d_i$	S _{PQ}
11	X_o	X_o	X_o'	-
12	Y_o	Y_o	Y_o'	-
13	Z_o	Z_o	Z_o'	-
14	$\sum d$	$\sum d$	$D_s (= \sum d)$	-
15	Z	Z	X_o' / X_o	-
16	-	-	Y_o' / Y_o	-
17	-	-	Z_o' / Z_o	-
18	-	-	-	-
19	D_c	D_c	-	D_c

TABLE 1B. Data and program registers used by the NETWORK CLOSURE program

Number of steps used in program: 186

Data Registers used:

Normal data registers, R 00 - 19, and } ~ [Segment data; D_s & X_s stored
 unused program registers, R 94 - 99. } in split registers. Up to
 26 segments can be stored.]

Unused parentheses 'stack' registers, R 64 -69:

R 64, segment address (n)

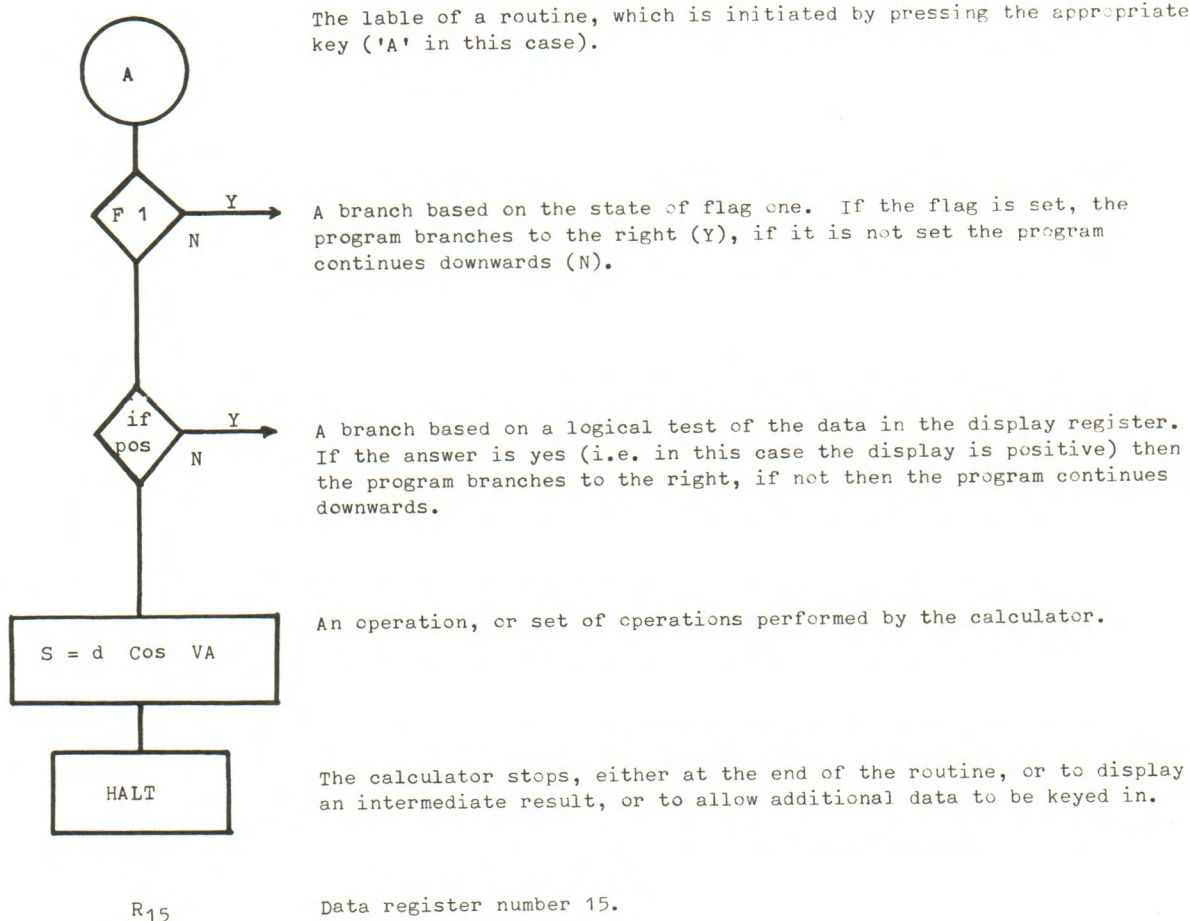
R 65, route origin (X_o)

$$R 66, \sum \left(\frac{1}{D_r} \right)$$

$$R 67, \sum \left(\frac{X_r}{D_r} \right)$$

$$R 68, \sum_r D_n = D_r$$

$$R 69, \left(X_o + \sum_r \Delta X_n \right) = X_r$$

APPENDIX Cont;

As much as possible the assignment of data register numbers has been made so that data obtained in one program can be used in other programs without being re-entered, and to allow one program (e.g. TAPE SURVEY) to be temporarily exchanged with another (e.g. TRIANGULATION) and then resumed without data loss. This is only possible if there are a large number of data registers available (see table 1).

THE PROGRAMS

The TAPE TRAVERSE program. At the start of a segment (or loop) the co-ordinates of the starting point are entered into R11, 12 & 13 (key in X₀, press key E', key in Y₀, press the RUN key, key in Z₀, press RUN. See flow diagrams). The compass correction (if any) is entered into R19 via routine D'. For each set of observations the flags are first set to indicate whether this is a leg or radiation, and a foresight or backsight (routines A' and B'). The bearing (azimuth), vertical angle, and tape distance are entered into R04, 05 & 06 by other routines. The calculator converts for backsights if required and adds the compass deviation to the azimuth, and in the case of a leg, sums the inclined distance into a data register (R14) for eventual use in misclosure calculations.

The co-ordinates of the next point can now be calculated with routine E. The calculator displays (or prints out) in sequence the X, Y and Z co-ordinates and the horizontal distance. For a leg, the flag causes branches which replaces the stored co-ordinates of the previous point (in R01, 02 & 03) with those of the new point, so as to supply a starting point for the next set of observations (see flow diagrams). In the case of a radiation, the co-ordinates of the previous point are retained.

At the end of a segment, routine D is used to calculate the co-ordinate changes from the origin of the segment (which are also the misclosures in the case of a loop) and recalls the total distance which has been summed in R14 during the leg calculations.

The NETWORK CLOSURE program uses the storage capacity of the SR 52 to its limit. Only one set of co-ordinates is treated at a time (see main text). The program stores data for up to 26 segments at a time by using split memories to store both the co-ordinate change (7 digits) and the length (5 digits) of each segment in a single data register. This is made possible by a subroutine which truncates either the fractional or integer part of the register contents and shifts the decimal place back and forth to

APPENDIX Cont;

allow storage and restoration of the two parts. Data is stored and recalled by indirect addressing of the data registers using the segment number (n) stored in a separate address register (R64). In addition to the 20 'official' data registers the program uses 11 'illegal' registers (basically the unused part of the program memory and the upper levels of the parenthesis stack). I am indebted to Alan Fowler of Scientific Calculator Sales, Brisbane, for drawing my attention to the existence and use of these registers which are not disclosed in the SR 52 handbook. The program is rather more complicated than the accompanying flow diagram would suggest, as the various subroutines used for storing and recalling data in the split memories have not been shown.

To use the program the segment data is first entered with routine E. The segment label (n) is entered first and then used for indirect addressing of the later data: the co-ordinate change (X_n) and the length (D_n) of the segment. The former is taken to the nearest centimetre and the latter to the nearest metre. This data will have been obtained from routine D of the TAPE TRAVERSE program. For each set of routes, the co-ordinate of the starting point (X_0) is stored in R 65 by routine D. Before calculating for each route, this value is transferred to R 69. Each route is indicated by entering the segment labels with routine A. For segments traversed by the route in the opposite direction to that in which they were originally calculated, the label is given a negative sign: this sets a flag which later changes the sign of the co-ordinate change of that segment (see flow diagram). The co-ordinate change (X_n) and length (D_n) of each segment of the route are recalled and summed into separate registers (R69 & R68). Routine B displays the end co-ordinate and length of that route and does some preliminary summations and calculations for the final routine C, which calculates the weighted mean co-ordinate for the end point of all the routes.

The SEGMENT or LOOP CLOSURE program. For a segment of a network, the original (uncorrected) values of the first and last stations and the total length are entered by routines A, B, and C. This data is derived from the TAPE TRAVERSE program. The corrected values derived from the NETWORK CLOSURE program are entered by routines A' and B'. For a simple loop closure following on from the TAPE TRAVERSE programs, the necessary data will already be stored and one can go straight to the misclosure calculation: routine C'.

Routine C' calculates the misclosures in X, Y, and Z, and the adjustments per unit length ($\Delta X / D$ etc.) for use in routine E. The use of indirect addressing of the three sets of X, Y, and Z data, allows the same subroutine to be used three times and saves considerably on program length (see flow diagram).

For each leg within the segment, the uncorrected co-ordinates (X_i , Y_i , & Z_i) are entered together with the length (d_i) of that leg, which is summed to the total of the previous legs to give a basis for distribution of the misclosures (routine D). Routine E does the actual calculation (see main text) and again indirect addressing allows the same subroutine to be used three times for adjustment of the X, Y, & Z co-ordinates in turn (see flow diagram). Previously calculated radiations and triangulated points can also be corrected by entering their co-ordinates with a zero length immediately after calculating the corrected co-ordinates for their base station.

The TRIANGULATION program computes the co-ordinates of an inaccessible point. If the program is inserted at the appropriate point during a sequence of TAPE or STADIA TRAVERSE calculations (i.e. immediately after calculation of its base line) the baseline data will already be stored in R01, 02, 03, 04 & 10. If not, this data is entered by routines A, B, and C. The bearings to the distant point are entered, and corrected for compass deviation if relevant before storing in R05, 06 and 07. The calculation is done by routine E, which displays the co-ordinates of the distant point together with the horizontal distance (S_{QR}) from one of the base stations.

* * * * *

These programs should be usable in similar or simplified form in a number of other programmable hand calculators. They could also be used (and expanded) with programmable desk-top calculators.

For use with calculators with shorter program memories, the first step in reducing the length of the program would be to combine the data entry and calculation routines into a single sequence with the data fed in as required during the calculation. This eliminates the need for labels (which many smaller calculators don't have anyway) and reduces the amount of data storing and recalling, and therefore the number of memory registers needed. If flags are not available, these can be replaced by an $x = 0 ?$ test on the contents of a data register, in which an 0 or 1 has earlier been stored. This assumes sufficient program memory; if not, a halt instruction can be used and the branch made manually. Conversion of back-sights, and compass adjustments can be made manually while entering the data.

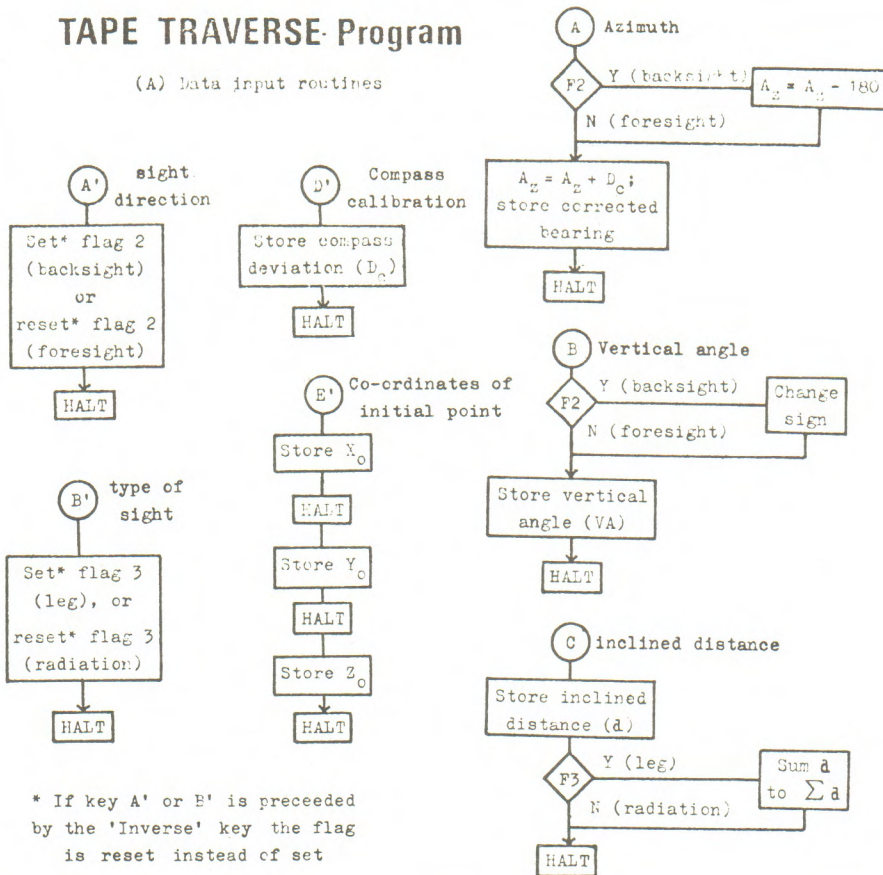
ROSIE MURPHY - WHERE ARE YOU?

Wrote you care of The Union, Uni. of Qld. in early December. My letter was returned - Address Unknown - end of February, 1977. Could you please advise me of your correct address. Editor ASF.

* * * * *

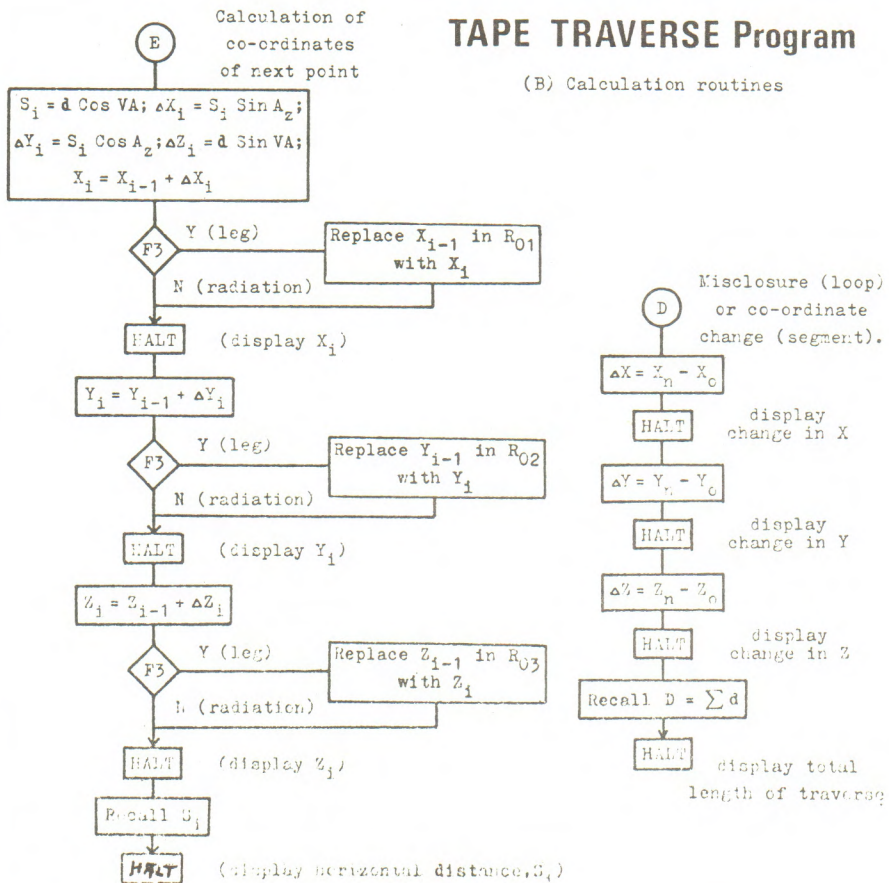
TAPE TRAVERSE Program

(A) Data input routines



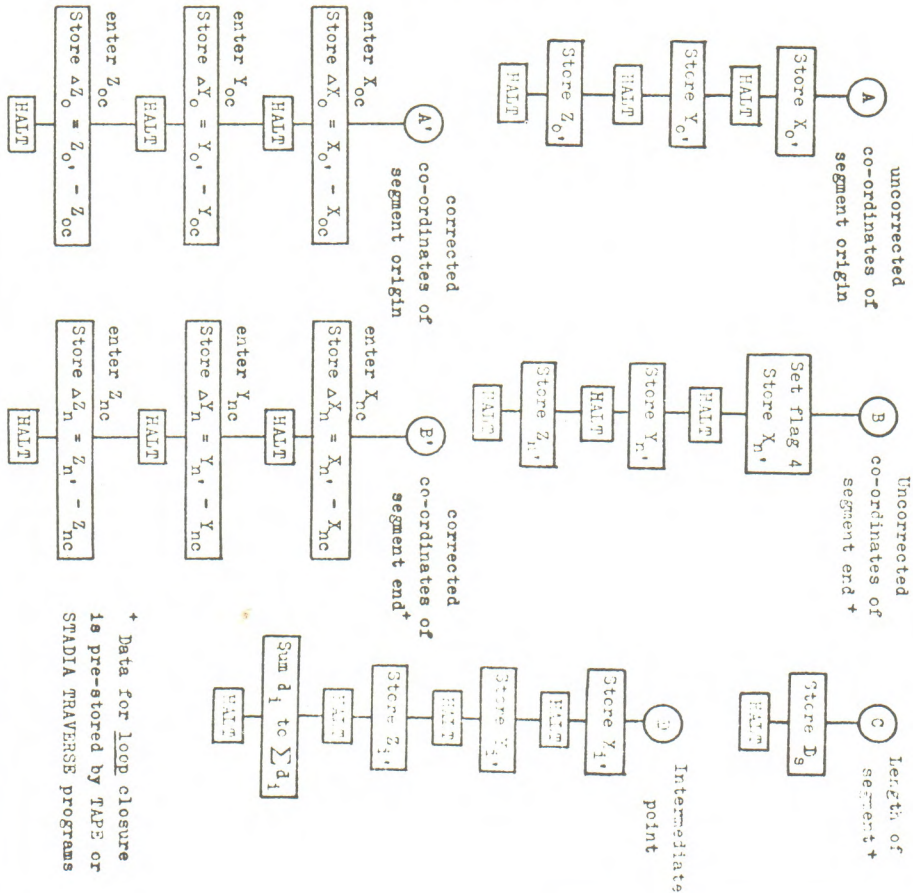
TAPE TRAVERSE Program

(B) Calculation routines



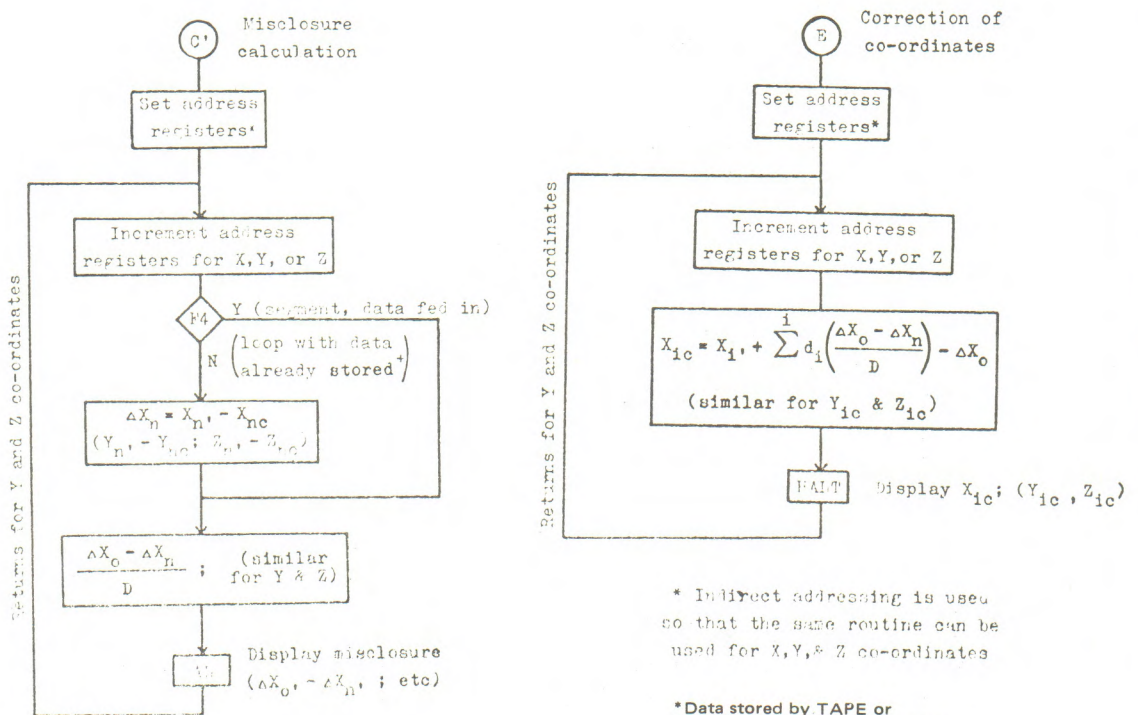
SEGMENT & LOOP CLOSURE Program

(A) Data input routines



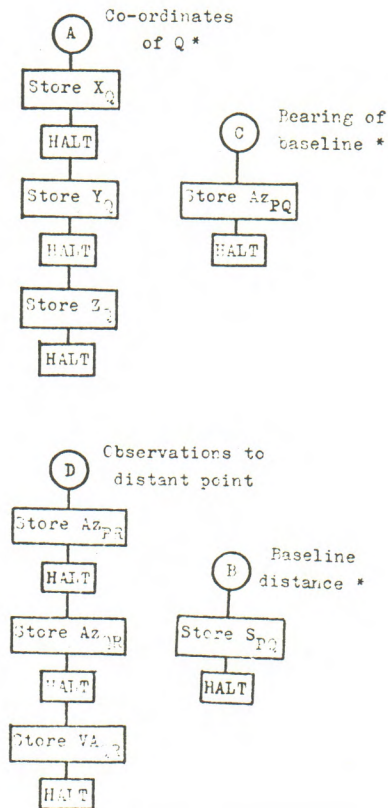
SEGMENT or LOOP CLOSURE Program

(B) Calculation routines

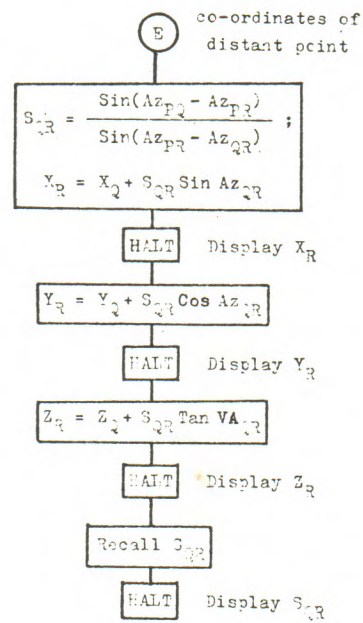


TRIANGULATION Program

(A) Data input routines



(B) Calculation Routine

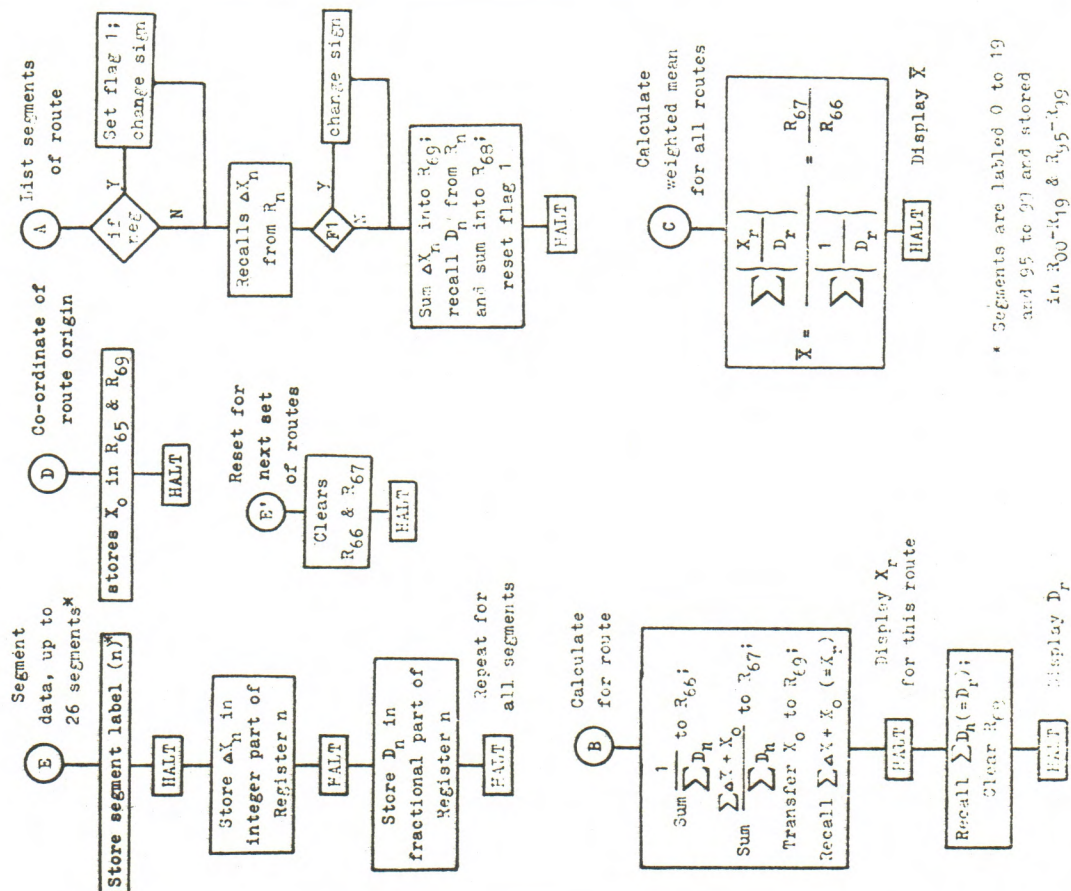


* If used immediately after calculating the baseline leg (PQ) with the TAPE or STADIA TRAVERSE programs this data will already be stored

NETWORK CLOSURE Program

(A) Data input routines

(B) Calculation routines



* Segments are labelled 0 to 19 and 95 to 99 and stored in $R_{00}-R_{19}$ & $R_{95}-R_{99}$

LONGEST & DEEPEST - 1977

Compiled by Ross Ellis

LONGEST CAVES	State	Metres
1. EXIT	TAS	16,000
2. Mullamullang	WA	10,036
3. Lannigans-Onslow	NSW	6,000
4. Queenslander-Cathedral	QLD	6,000
5. Herberts Pot	TAS	5,730
6. Corra-Lynn	SA	5,375
7. Johannsons	QLD	4,880
8. Eagles Nest System	NSW	3,600
9. Mammoth	NSW	3,510
10. Victoria	SA	3,060
11. Royal Arch	QLD	3,050
12. Niggle	QLD	2,600
13. Kubla Khan	TAS	2,507
14. Sand	SA	2,210
15. Cave Spring	WA	2,130
16. Croesus	TAS	2,050
17. Cutta Cutta	NT	2,000
18. Judds Cavern	TAS	2,000
19. Pyramid System	TAS	2,000
20. Wolf Hole	TAS	2,000
21. Wiburds Lake	NSW	2,000
22. Northern Tourist, Jenolan	NSW	1,840
23. Wyanbene	NSW	1,830
24. Arramall	WA	1,810
25. Cocklebidddy	WA	1,800
26. Weelawadji	WA	1,800
27. Khazad-Dum	TAS	1,774
28. Labyrinth	WA	1,680
29. Taplow Maze	NSW	1,680
30. Moparrabah	NSW	1,630
31. Fossil-Hogans Hole	NSW	1,620
32. Newdegate	TAS	1,600
33. Wet Cave-Georgies Hall	TAS	1,554
34. Koonalda	SA	1,540
35. Mammoth	WA	1,530
36. Spring	QLD	1,530
37. Easter	WA	1,525
38. Kintore	NT	1,525
39. Oraparinnia	SA	1,500
40. East Deep Creek	NSW	1,406
41. Fox	SA	1,400
42. Tuglow	NSW	1,400
43. Blackberry	SA	1,300
44. Weebubbie	WA	1,300
45. Welcome Stranger	TAS	1,291
46. Dip	NSW	1,280
47. Markham	QLD	1,230
48. Southern Tourist, Jenolan	NSW	1,220
49. Mystery Creek/Entrance	TAS	1,200
50. Punyelroo	SA	1,200
51. Trogdip	VIC	1,200
52. Mount Hamilton	VIC	1,190
53. Scrubby Creek	VIC	1, 60
54. Lynds	TAS	1,081
55. Camooweal (Four Mile) East	QLD	1,080
56. Carpentaria	QLD	1,070
57. Punchbowl-Signature	NSW	1,070
58. Kelly Hill	SA	1,050
59. Honeycomb	TAS	1,024
60. Arcoota Creek	SA	1,000

DEEPEST CAVES	State	Metres
1. KHAZAD-DUM	TAS	329
2. Cauldron Pot	TAS	263
3. Tassy Pot	TAS	231
4. Mini-Martin, Exit	TAS	220
5. Sesame Two	TAS	219
6. Midnight Hole, Entrance	TAS	203
7. Growling Swallet	TAS	176
8. Eagles Nest System	NSW	174
9. The Chairman	TAS	165
10. Kellers Cellar	TAS	155
11. Niagara Pot	TAS	149
12. Odyssey	NSW	148
13. Satans Lair	TAS	143
14. East Deep Creek	NSW	139
15. Revelation	TAS	137
16. Rift	TAS	131
17. Fossil-Hogans Hole	NSW	131
18. Weebubbie	WA	130
19. Gormenghast, Khazad-Dum	TAS	128
20. Argyle Hole	NSW	128
21. Grill	NSW	126
22. Drum	NSW	125
23. Mullamullang	WA	125
24. Thun Junction	TAS	120
25. Pannikin Plain	WA	120
26. Col-In-Cavern	TAS	119
27. Herberts Pot	TAS	116
28. Big Hole	NSW	113
29. Wyanbene	NSW	112
30. Y 18 Pot	NSW	110
31. Tommy Grahams	WA	110
32. Rescue Pot	TAS	107
33. Three Falls	TAS	107
34. Devils Pot	TAS	105
35. Cocklebidddy	WA	105
36. The Shaft	SA	105
37. Warbla	SA	104
38. Koonalda	SA	101
39. Winbirra	WA	100
40. Pillingers Creek	TAS	99
41. Bone Pit	TAS	98
42. Splash Pot	TAS	98
43. Blowfly- R51	NSW	94
44. Dribblespit Swallet	TAS	91
45. Croesus	TAS	91
46. Murra-el-Elevyn	WA	91
47. Glory Hole	NSW	91
48. Execution Pot	TAS	90
49. Y 40	NSW	90
50. Kellys Pot	TAS	90
51. Dwyers	NSW	88
52. Devils Coachhouse-Imperial	NSW	85
53. The Bullock Hole	SA	85
54. Owl Pot	TAS	76
55. Niggle	QLD	76
56. Victoria Arch-Creek	NSW	76
57. Speaking Tube	QLD	76
58. Lake	WA	76
59. Kestrel Number One	WA	75
60. Piccaninnie Pond	SA	75

Continued Next Page -

LONGEST AND DEEPEST Cont;

LONGEST CAVES		State	Metres	DEEPEST CAVES		State	Metres
61.	Five Corners	SA	1,000	61.	Zulu Pot	TAS	73
62.	Guy	NT	1,000	62.	Ians Hat	VIC	73
63.	Loons	TAS	1,000	63.	Kubla Khan	TAS	73
64.	Mersey Hill	TAS	1,000	64.	Camooeal (Four Mile) East	QLD	73
65.	Tailender	TAS	1,000	65.	Great Nowranie	QLD	73
66.	Damper	TAS	990	66.	Little Nowranie	QLD	73
67.	Frankcombe	TAS	980	67.	Canellan	QLD	72
68.	Glen Lyon	QLD	980	68.	N 61	VIC	71
69.	Quetzalcoatyl Conduit	TAS	950	69.	Kilsbys Hole	SA	70
70.	Collins	SA	940	70.	Wooltana	SA	70
71.	Mitchells Crossing	SA	940	71.	Carn-Dum-Coprolorum	QLD	70
72.	Geck	QLD	910	72.	Jam Pot	NSW	69
73.	Marakooopa	TAS	910	73.	Mammoth	NSW	68
74.	Cathedral-Tomato-Stick	SA	880	74.	Ela Elap	SA	68
75.	Connelly	WA	830	75.	Belt-Jolly Roger	QLD	67
76.	Yallingup	WA	825	76.	Acoustic Pot	NSW	67
77.	Glory Hole-North Glory	NSW	820	77.	Tuglow	NSW	66
78.	Mostyn Hardy	TAS	800	78.	Severance	TAS	66
79.	Smoke-Tortoise	SA	800	79.	Simpsons Hole	SA	65
80.	Snake Hill	SA	800	80.	Black Hole	SA	65
81.	Dogleg	NSW	790	81.	Christmas Pot	QLD	65
82.	Murra-el-Elevyn	WA	790	82.	Crick Hollow	QLD	64
83.	Main	QLD	770	83.	Windlass	NSW	64
84.	Elysium	QLD	760	84.	Abrakurrie	WA	64
85.	Junction	NSW	760	85.	Aqua-Mire	TAS	64
86.	Resurrection	QLD	750	86.	Old Homestead	WA	64
87.	Barkers	QLD	730	87.	Wurwurlooloo Hole	SA	63
88.	Strongs	WA	690	88.	Capstan	WA	62
89.	The Tunnel	WA	690	89.	Bottomless Pit	NSW	62
90.	Mount Sims	SA	665	90.	Tasman's Arch	TAS	62
91.	Beekeepers	SA	660	91.	Elysium	QLD	61
92.	Coorow	WA	640	92.	Johannsens	QLD	61
93.	Grill	NSW	620	93.	Waterloo Swallet	TAS	61
94.	Crystal	WA	610	94.	Canyons	VIC	61
95.	Kellys Pot	TAS	610	95.	JF 22	TAS	61
96.	Murray	NSW	610	96.	Chimneys	WA	61
97.	Growling Swallet	TAS	600	97.	Kestrel Number Two	WA	60
98.	Tommy Grahams	WA	600	98.	Moonera Tank	WA	60
99.	Wollondilly	NSW	600	99.	Dingo (Donga)	WA	60
100.	King George V	TAS	590	100.	Hells Hole	SA	60
101.	Gormenghast, Khazad-Dum	TAS	582	101.	Sellicks Hill	SA	60
102.	Abrakurrie	WA	550	102.	Bouverie	NSW	60
103.	Cliefden	NSW	540	103.	College	NSW	60
104.	Frosted Floor	SA	500	104.	Piglet Help Help	QLD	60
105.	Gunns Plains	TAS	500	105.	Oolite	VIC	59
106.	Kooairlabah	QLD	500	106.	Narrengullen	NSW	59
107.	Un-named, Gunns Plains	TAS	500	107.	Judds Cavern	TAS	58

* * * *

WHO'S WHO....**on the speleo scene?****36. steve wheatley**

Steve is Sydney's most famous aspiring psuedo-heavy. He started caving with UNSWSS in 1972 and has been a colourful figure in the club ever since. Easily recognisable by his almost red hair and beard plus females tagging along. Friendly and funny, Steve is a good guy to have along on a caving trip. At the age of 24 (we think), he is still unmarried, despite constant attempts to change this predicament. As a society politician, he rates well, having held several society positions including secretary and social secretary. His main speleological interests include getting to know the cave officials at Yarrangobilly and Jenolan and holding the tape for high-grade surveys at Yarrangobilly; as well as leading most of the Society's trips to the above areas where he is often seen rescuing some "poor defenceless" female from the dangerous pastime of caving. His greatest ambition is to lead a trip to the Southern Limestone.

* * * *

DOWN UNDER ALL OVER...

news from around the societies.

- BMSC** : Greg Powell reports that BMSC completed 1976 with a ground trogging expedition to the Southern limestone at Jenolan. This trip, in which many clubs took part, produced a few small caves. BMSC trogged an area at the far southern limit of the limestone around Paradox Cave. Two small caves were surveyed while a large area of surface limestone was explored but with little result. A li-loing trip was held on the Wallangambe Creek and a trip through the Grand Canyon at Blackheath also took place. Both were led by Phil Coburn. The club held its Christmas Dinner at the Swiss Inn at Springwood. Club members took part in the Search & Rescue stunts on the Three Sisters at Katoomba. A table was hauled up and dinner was had on the top of the first Sister. Karl Bilger helped to serve. The club also visited Yarrangobilly for the second time for some very worthwhile caving while a little history was sampled at the Ben Hall Festival at Carcoar. While on the subject of history, the club held its AGM on the 100 year old wooden dance floor in the Arch at Abercrombie. All wore period costumes which provided some very interesting cave photography. A semi-historical movie was made on the Sunday using the beautiful locations at Abercrombie. Club President for 1977 is Alan Fairweather. The club was deeply shocked by the death of Phillip Coburn in the Granville Train Disaster in January. Most members attended the very large funeral, with six members acting as pall-bearers. Phil will be greatly missed by his friends and a loss to the caving scene as a whole.
- CSS** : Gordon Taylor reports that the main sphere of activity for CSS in the last few months (and years) has been the preparation and execution of CAVCONACT. This left little time for much else. However, trips were still run and now that CAVCONACT is over, trips are prolific. Areas visited include Tuglow, Colong, Narrengullen (by boat), Wee Jasper, Wyanbene, Buchan, Jenolan and Yarrangobilly. As well, members found time to organise and participate in Convention field trips to numerous areas. Also of note was a weekend spent prior to the Convention renovating Cottrills Cottage, Yagby. Work included jacking the floor, properly installing gas system, fixing stove and bath, a good clean out and numerous other odd jobs. Some work has been done in the East Deep Creek dig and two specially made steel buckets installed there. The club has also acquired the Television Film of the Convention "Speleo Sports". It provides some very humorous viewing. On the whole, the last few months have been very productive.
- ISS** : Dave Dicker reports that they have had two trips to Wyanbene in the last three months or so. One was at the beginning of December and was completely unsuccessful due to the receiving of the wrong gas from C.I.G. - they are now using hydrogen instead of helium. The other trip to Wyanbene was mid-February and probably the most successful yet. The conditions in the Aven were probably the best ever. There was no "rain" coming down and the usual bank of mist at the 60m - 75m level was entirely missing. It was also noticed that the cross draught was also absent. However, a slight turbulence was noticed at the top - in the last 20m. With the balloon at the top and viewing the flash going off from the bottom, a distinct ledge was noted some 90m up and the Aven obviously opens up at that stage. It was observed that - 1) The rock at the top of the Aven is probably not limestone; 2) There is a large fissure in the wall that seems to run up most of the Aven; 3) The diameter of the upper part is considerably greater than that of the lower part; 4) There appears to be some evidence of an old stream gully incised in the roof or overhanging wall near the top; 5) The whole roof area appears to consist of an extremely unstable boulder choke - some of these boulders would certainly weigh many tons. One photo showed a large boulder perched precariously near the edge of the ledge at the 90m level. Members intend to get the opinion of a rockclimber re the possibility of climbing the Aven and are sure that a fairly extensive system leads off on the way up.
- KSS** : Jean Piggott informs us that the Society is plodding along and doing some good work, but nothing startling is taking place. Highlight of the last three months was a "Charity Day" in which one of their 'easier to get at' caves was electrically lit and opened to the public for a donation to the "Rathgar" Girls Home at Grafton. \$164 was raised. One great feature of this project was the 100% turnout of members and even some ex-members to attend to the mammoth task of preparing the access paths and wiring of the cave for lighting by batteries - dozens of them! Cricket Man, Glen Campbell, has been continuing his work and KSS provided two work parties to assist him in getting his gear to and from the cave. There have been two lengthy safaris, one bush walk and a canoe trip into our little known mountain country, mainly for pleasure. However, as the geology is very sketchy, it was also to see if any limestone beds were hidden in the deep valleys of the upper Macleay - no limestone was found!
- MUSIG** : Colin Killick reports that members of MUSIG are still to be seen scurrying around caves with test tubes in hand and pocket, hunting for spiders. No report has been received from the Australian Museum as yet, primarily because their member in strongest liaison is currently in Europe (Michael Marx). The dig operating in Bungonia was getting constrictingly desperate and has now been abandoned. It was particularly frustrating that a dig by HCG, a few yards away was making about 50 times more progress. A trip to Cliefden in October revealed no spiders but many beautiful slides were taken. In anticipation of Uni. Orientation, some video-taping of caving was attempted successfully at Bungonia in November. Underground video-taping (black and

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DOWN UNDER ALL OVER Cont;

- MUSIG : white) in total darkness was particularly pleasing. For lighting, they used two sealed beam car headlights powered by a single 12 volt car battery. This proved adequate for their needs though more elaborate filming by this means could use a little more light. Trips also went to Wee Jasper and Wyanbene. By means of SRT, a cave (untagged) was entered at Marble Arch. This proved to be reasonably extensive as caves at Marble Arch go. It is located about six metres below the entrance to MA 16. Does anyone have any information on this cave? Currently club eyes are turned towards Mt.Fairy following a trip there at the beginning of February and further trips are anticipated.
- SUSS : Peter Campbell informs us that Bruce Welch has become Editor of SUSS Bull - he would be pleased to publish articles from outside the society which are of general interest to speleos. Spider Cave, their mini-Chairman, has struck a few problems in regard to future exploration - namely a rockpile. Surface control at Jenolan is being revived and in future, all caves that are documented will have XYZ location co-ords to surface control tags. Malcolm Handel has said that after a recent joint SUSS-SSS trip down J41 (Dwyers Cave), he is convinced that this is the classic muddy cave. Has anyone come across a grottier one? There are also a handful of copies of "The Caves of Jenolan: The Northern Limestone" left at the remarkably cheap price of \$5.00 plus 60¢ postage (anywhere in Australia). SUSS attended Cavconact in December and a good time was had by all. Their noble tradition of bun-fights at caving-oriented dinners was not appreciated by everyone, especially those caught in the crossfire. Randall King was the only SUSS member to present a paper (on the Atea). Post-conference trips to Jenolan were relatively uneventful although Ian Lewis did a bit of diving in Mammoth and will return for some more this year. (Peter is also providing us with an article on Mammoth - aren't you Peter? Ed.)
- TCC : Yours truly reports that TCC/Maydena are without doubt the most active speleos in Tassie at present. Trips are being conducted nearly every weekend and a number of discoveries have been made, mainly by John Parker. Mid-January saw an influx of Mainlanders, namely Randall King, Alan Warild, John Minchin, Jim Caddey and others from WA, who descended on the Junee with a vengeance. The Chairman (JF99) was the principal target and investigations of this cave are still considered far from over. John Parker has spent most of his holidays combing the Junee area systematically and many of his discoveries are still awaiting exploration. We are also glad to see that Steve Annan is back on his feet after spending the last six months confined in plaster. Albert Goede and Tony Culberg represented the club at Cavconact and by reports, had a hectic but enjoyable time. Yours truly has been rather busy of late but has managed several trips to the Junee-Florentine mainly for surface photography. I now have a rather good topographical selection of slides covering these areas.
- UNSWSS : Geoff Stibbs informs me that they have been quite active lately in its two "specialist" areas, Yarrangobilly and Cliefden. During 1976 many trips were held to Yarrangobilly. Last Easter, a party led by Andrew Pavey surveyed all of West Deep Creek Cave (Y6), Y69 was surveyed by John Minchin and party and Y34 was surveyed by Sol Voron & party. New passage was found or re-discovered in Eagles Nest (Y1,2,3) and in West Deep Creek. Shattered Passage was rediscovered in East Deep Creek (Y5) adding 140m to its length, and 80m of new passage was found in Unstable Cave (Y9). Two small new caves were discovered in a large doline south of Y5. Wall detailing was completed in Coppermine and an RDF fix was taken in Eagles Nest and Glory Hole (Y24). The new scaling poles were used for the first time in Jersey Cave but the hole in the roof didn't go. Cave descriptions and maps of Y6 and Y69 can be found in Spar, 56. In October, another Yarrangobilly trip was led by Andrew Pavey, in conjunction with NUCC, SUSS and CSS. UNSWSS helped in the water-tracing experiment being run by Joe Jennings. West Eagles Nest was entered and the scaling pole was used to investigate holes high up in the walls of the Canyon. Old Inn Cave (Y10) was also entered and explored. UNSWSS members were active at Yarrangobilly during CAVCONACT, where 100m of new passage was found in Eagles Nest and surveyed by a party led by Steve Wheatley (see Who's Who). Grotto Cave (Y30) was surveyed to a length of 210m by a group led by Geoff Stibbs and Derek Synnott. During December and January, Bruiser Pot (Y59) and Red Cliff Cave (Y60) were explored and surveyed by parties led by Geoff Stibbs. During 1976 trips trips to Cliefden averaged one a month with all the work being co-ordinated by Ian Wood and Graeme Pattison. Surveying, exploration and surface traversing were carried out. The bat banding program being run by Ian Wood continued with trips to Bungonia, Abercrombie and Cliefden. Clown Cave (CP11) at Cooleman was surveyed by Alan Warild and party. Trips to Kurnell Peninsula for the purpose of surveying sea caves were led by Geoff Stibbs. Other areas visited included Wyanbene, Tuglow and Colong. Alan Warild led a trip to Tasmania in January where Khazad-Dum, Tassy Pot, Cauldron Pot and The Chairman were among the caves entered. Also in January, Andrew Pavey led several diving trips to Yarrangobilly in conjunction with divers Ron Allum and Ian Lewis (CEGSA). Caves entered were Hollin Cave (Y46), River (Y27), Federation (Y44) and Coppermine (Y12). Results will be published in a future Spar.
- UQSS : No club news but Lex Brown would like it known that the Expedition Report "Lelet: Report of the 1975 New Ireland Speleological Expedition" by Lex Brown, Michael Bourke and Henry Shannon has just been published as a special edition of Niugini Caver Vol.4 No.3. It has 11 maps and 23 photographs. This 50 page article provides full details of the month-long, eight-man

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- UQSS : expedition, and of the exciting Lelet Plateau where cave depth potential reaches 1,400 metres. Available from L. Brown, 139 Victoria Ave., Chelmer. 4068. Cost \$3.00 plus 40¢ pack & post.
- VSA : Lloyd Mill informs us that VSA have been busy in the following areas. BUCHAN: As usual Buchan was the scene of most VSA endeavours of the last few months. In October, a most successful Open Day was held at Homeliegh. VSA and Rimstone Co-op. filled Homeliegh full of speleological displays and opened the doors to about 80 locals. The day was judged a success by all and improved local relations immensely. After a most enjoyable Conference, Lloyd Mill led a ten day trip down to Buchan consisting of cavers from Queensland, A.C.T., New South Wales and Western Australia. Nothing of a serious nature was planned or done but the participants were shown a wide varying sample of caves around Buchan. The Australia Day weekend saw a bit of caving and the VSA vers Caves Reserve Staff Cricket Match. With the scores - Staff 164, VSA 20 wickets for approximately 150, the match was abandoned due to bad light! BAT RIDGES: Little was done in this area over the summer due to Brown Sanakes and Leeches. However, a bit of surface surveying was done last October. More exploration and surveying trips are planned this year. BUREAUCRACY: President Adrian Davey resigned at the last meeting due to the fact that he is moving to Canberra to undertake further studies. His place has been taken by Lloyd Mill pending a by-election at the next meeting. FUTURE TRIPS: Besides the usual spate of Buchan trips, trips to Indi & Warnambool are planned during March.
- WASG : Kerry Williamson reports WASG activities for September, October and November, 1976. AUGUSTA: In Easter Cave (AU14) an untrod passage found by a mapping party was pushed and found to lead, after crawls, to a sizeable extension containing several lakes up to three metres deep in one place and many tree roots. Leading off the passages to the extension was a maze of "rift like" passages, with a keyhole cross section in a place where vadose downcutting could not have occurred. The mazes plus part of the extension were mapped. A trip was also made past the Second Duck but did not find the "end", the native guide being indisposed. WITCHCLIFFE: Another new extension, the Evening Star, has been found in Winjans Cave. This is at the level of the old stream in places and extends from the Well towards the Crown of Jewels Chamber. An extension of the extension of the Cawa Extension has also been found - going up! The WI42 entrance to Terry Cave has been enlarged and is now negotiable. WI23 (Kangaroo Pot) has been descended. The surface mapping of southern Witchcliffe has been extended south to Breakneck Gully. Crystal Cave (WI62) and Acoustic Cave (WI67) have been mapped thoroughly. The new Boranup hut was found ablaze by a party returning from caving; with all the sleeping gear piled up neatly outside. Deliberate arson is strongly suspect. COWARAMUP: Two inflow areas and one exsurgence? have been found east of the Quinninup Lake Cave system. YANCHEP: A concentrated spring surface mapping and underground exploring effort has seen the location and exploration of numerous caves and dolines east of Wilgarup Cave.

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CAVCONACT - brief report

At the last Committee Meeting held in Canberra on December 27, 30, 31st. 1976, SRGWA were granted full membership and ASS, CCOG, CVEA and HSC were all granted associate status. It was also decided that WA would host the 12th. Conference in Summer, 1978-79. The 13th. Conference will be held in Tasmania in Summer 1980-81.

It was also announced that a South Pacific Area Conference will be held at Waikato University in New Zealand in Summer 1979-80. (Save for this one now!)

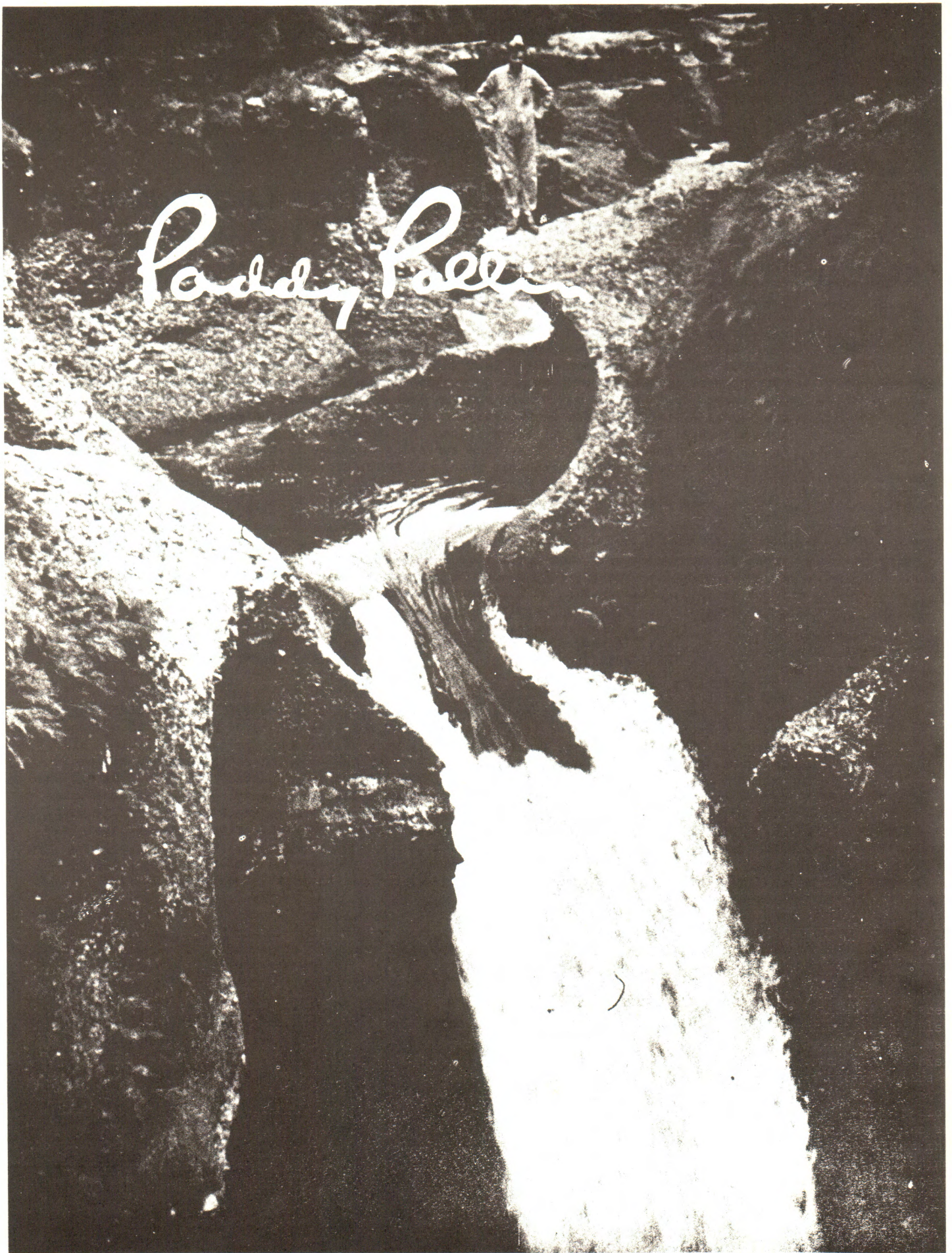
PSG has announced that it is now defunct and all clubs should cease mailing to it. Clubs are also advised that the capitation fees are unchanged. The cave safety commission was also asked to test and report on equipment. The ASF policy on publication was discussed and an overhaul set in motion. If there are any comments - contact Tony Culberg. There were also major changes to the code of ethics and these were tabled and will be printed soon. Tony Culberg was also asked to investigate the incorporation of ASF.

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SPELEO - GIGS

CAMOOWEAL

Ken Grimes and Lex Brown propose a UQSS expedition to Camooweal (Qld.-NT border) in August 1977. Dates are slightly flexible and about two weeks in the field is expected. Aims are surveying and exploration ... there hasn't been a Camooweal trip without a new find yet! All cavers are welcome but should contact Ken Grimes (45 Nelson St; Corinda. 4075) soon to check out when and if the trip is going.



John Dunkley contemplating the Sink of Harpan River Cave, Nepal — Photo by Andrew Pavey

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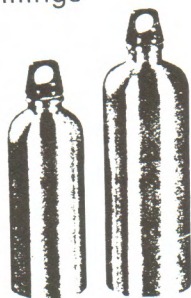
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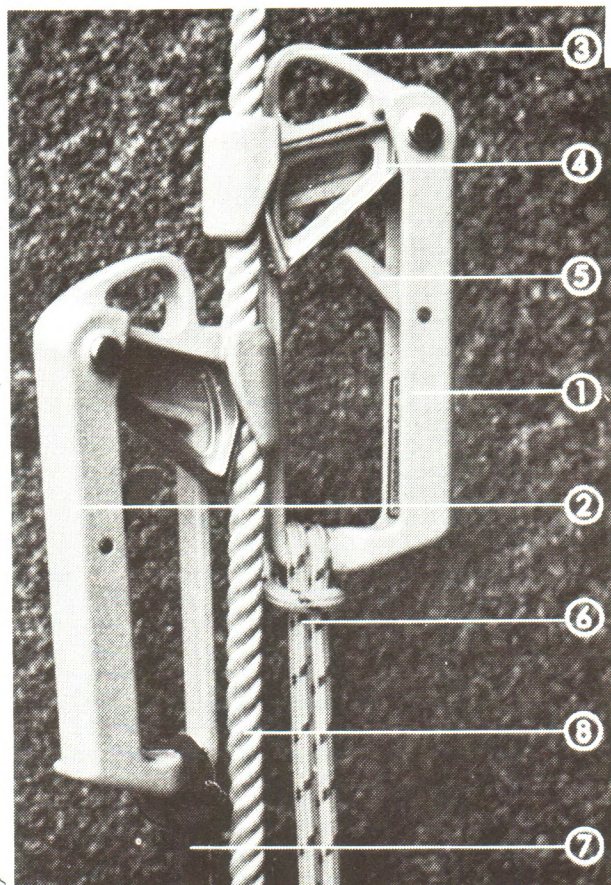
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