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Coal-seismic computer programs in BASIC; part 1: store, plot, and edit array data

by

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This report is preliminary and has not been edited or reviewed for conformity to U.S. Geological Survey standards

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ABSTRACT

Processing of geophysical data taken with the U.S. Geological Survey's coal-seismic system is done with a desk-top, stand-alone computer. Programs for this computer are written in an extended BASIC language specially augmented for acceptance by the Tektronix 4051 Graphic System[1/]. This report presents five computer programs used to store, plot, and edit array data for the line, cross, and triangle arrays commonly employed in our coal-seismic investigations.

INTRODUCTION

This Open-File report presents computer programs used to process data obtained with the U.S. Geological Survey's coal-seismic system. All programs are written for use on a desk-top, stand-alone computer. The language is an extended BASIC that has been specially augmented by Tektronix, Inc. for use on their 4051 Graphic System[1/].

Five computer programs are included in this report: one for each of the three types of arrays (line, cross, and triangle) of seismometers and shotpoints commonly used in our studies, one for editing array data stored on a magnetic tape, and one for formating an array-data magnetic tape. Sample results and data are included after each program listing.

1/ Use of brand names in this report is for descriptive purposes only and does not constitute endorsement by the U.S. Geological Survey.

Array data consist of the area name and array number, the county and state in which the data were taken, the location of the center of the array (either by latitude and longitude, or by township, range, section, and distance from the southwest corner of the section), the elevations and shotpoint-to-detector distances of all seismometers within the array, and the orientation of the array and its elements. Elevations and distances are in meters; orientations are by north azimuth in degrees. Although array information could be presented to tabular form, I prefer to see these data displayed graphically because it is easier for me to detect errors on a picture than in a listing (figs. 1-6).

All programs are written to take full advantage of the interactive capabilities of the desk-top, graphic computer. After the magnetic tape containing the program is inserted and the RUN command is entered a series of statements, instructions, and questions flash across the screen telling the user what to enter or what to do next.

In addition to the Tektronix 4051 Graphic System, a Tektronix 4662 Interactive Digital Plotter and a Tektronix 4924 Digital Cartridge Tape Drive are required by the programs of this report.

```
100 PRINT "L            YOU HAVE SELECTED THE PROGRAM TO ENTER OR PLOT"
110 PRINT "                          LINE ARRAY DATA"
120 INIT
130 SET DEGREES
140 DIM E1(14),E2(14),E3(14),E4(14),X5(14),X6(14),X7(14),V$(11)
150 DIM A$(20),C$(20),D$(13),E$(15),G$(1),Q$(10),R$(12),T$(12),U$(12)
160 VIEWPORT 0,80,0,105
170 PRINT "  ARE DATA TO BE ENTERED FROM DATA TAPE? (YES=Y, NO=N) ";
180 INPUT G$
190 IF G$="N" THEN 220
200 GOSUB 1550
210 GO TO 1690

220 REM ** ENTER ARRAY DATA FROM KEYBOARD **

230 PRINT "  AREA NAME (LIMIT 20 LETTERS): ";
240 INPUT A$
250 PRINT "  ARRAY NUMBER = ";
260 INPUT Q$
270 PRINT "  DATE DATA WERE TAKEN = ";
280 INPUT D$
290 PRINT "  COUNTY IN WHICH DATA WERE TAKEN: ";
300 INPUT C$
310 PRINT " IN THE STATE OF: ";
320 INPUT E$
330 PRINT "  DO YOU WANT TO LOCATE ARRAY WITH LAT.& LONG.? ( Y OR N ) ";
340 INPUT G$
350 IF G$="N" THEN 590
360 N7=0
370 E7=0
380 PRINT "  LATITUDE OF ARRAY CENTER = ";
390 GOSUB 420
400 R$=U$
410 GO TO 540
420 INPUT L1
430 PRINT "K                                   deg, ";
440 INPUT L2
450 PRINT "K                                          min, ";
460 INPUT L3
470 PRINT "K                                                  sec"
480 L$=STR(L1)
490 U$=STR(L2)
500 U$=L$&U$
510 L$=STR(L3)
520 U$=U$&L$
530 RETURN
540 PRINT " LONGITUDE OF ARRAY CENTER=";
550 GOSUB 420
560 T$=U$
570 S7=99
580 GO TO 690
590 PRINT "  TOWNSHIP = T";
600 INPUT T$
610 PRINT " RANGE = R";
620 INPUT R$
630 PRINT " SECTION = ";
640 INPUT S7
650 PRINT "  DIST. NORTH FROM SW CORNER = ";
660 INPUT N7
670 PRINT " DIST. EAST FROM SW CORNER = ";
```

```
680 INPUT E7

690 REM ** INPUT SEISMOMETER DISTANCES AND ELEVATIONS FROM KEYBOARD **

700 PRINT "L INPUT SEIS. DIST. ALONG SPREAD 1 FROM SP-1 TO SP-2_"
710 X5(1)=0
720 PRINT "_ UPHOLE SEIS. OFFSET ALONG SPREAD 1 NEAR SP-1 = ";
730 INPUT X5(13)
740 PRINT "_ SEIS. NO.";"  DISTANCE FROM SP-1"
750 FOR J=2 TO 12
760  PRINT "     ";J;"             ";
770  INPUT X5(J)
780 NEXT J
790 PRINT "_ UPHOLE SEIS. OFFSET BACK ALONG SPREAD 1 FROM SP-2 = ";
800 INPUT X5(14)
810 PRINT "L INPUT ELEV. ALONG SPREAD 1 FROM SP-1 TO SP-2_"
820 PRINT "_ ELEV. OF SP-1 = ";
830 INPUT E1(1)
840 PRINT "_ UPHOLE SEIS. ELEV. ALONG SPREAD 1 NEAR SP-1 = ";
850 INPUT E1(13)
860 PRINT "_ SEIS. NO.";"  ELEVATION ALONG SPREAD 1"
870 FOR J=2 TO 12
880  PRINT "     ";J;"               ";
890  INPUT E1(J)
900 NEXT J
910 PRINT "_ UPHOLE SEIS. ELEV. BACK ALONG SPREAD 1 FROM SP-2 = ";
920 INPUT E1(14)
930 PRINT "L INPUT SEIS. DIST. ALONG SPREAD 2 FROM SP-2 TO SP-3_"
940 PRINT "_ UPHOLE SEIS. OFFSET ALONG SPREAD 2 NEAR SP-2 = ";
950 INPUT X6(13)
960 X6(1)=0
970 PRINT "_ SEIS. NO.";"  DISTANCE FROM SP-2"
980 FOR J=2 TO 12
990  PRINT "     ";J;"               ";
1000  INPUT X6(J)
1010 NEXT J
1020 PRINT "_ UPHOLE SEIS. OFFSET BACK ALONG SPREAD 2 FROM SP-3 = ";
1030 INPUT X6(14)
1040 PRINT "L INPUT ELEV. ALONG SPREAD 2 FROM SP-2 TO SP-3_"
1050 E2(1)=E1(12)
1060 PRINT "_ UPHOLE SEIS. ELEV. ALONG SPREAD 2 NEAR SP-2 = ";
1070 INPUT E2(13)
1080 PRINT "_ SEIS. NO.";"  ELEVATION ALONG SPREAD 2"
1090 FOR J=2 TO 12
1100  PRINT "     ";J;"               ";
1110  INPUT E2(J)
1120 NEXT J
1130 PRINT "_ UPHOLE SEIS. ELEV. BACK ALONG SPREAD 2 FROM SP-3 = ";
1140 INPUT E2(14)
1150 FOR J=1 TO 14
1160  E3(J)=0
1170  X7(J)=0
1180 NEXT J
1190 PRINT "_ NORTH AZIMUTH OF SPREAD 1 IN DEG ";
1200 INPUT A1
1210 PRINT "_ NORTH AZIMUTH OF SPREAD 2 IN DEG ";
1220 INPUT A2
1230 D1=X5(12)
1240 A3=D1
1250 D2=X6(12)
```

```
1260 A4=D2
1270 PRINT "_ DO YOU WANT TO SEE THE DATA YOU'VE ENTERED? (Y OR N) ";
1280 INPUT G$
1290 IF G$="N" THEN 1310
1300 GOSUB 5200

1310 REM ** PROGRAM SEGMENT FOR CHANGING DATA BEFORE PLOTTING **

1320 PRINT "_ DO YOU WANT TO CHANGE ANY OF THESE DATA BEFORE THEY"
1330 PRINT "_ARE STORED ON TAPE OR ARE PLOTTED? (Y OR N) ";
1340 INPUT G$
1350 IF G$="N" THEN 1450
1360 PRINT "L   The procedure to make changes is as follows:"
1370 PRINT "_     1. Select variable (see printed list),and"
1380 PRINT "         the appropriate index;"
1390 PRINT "      2. Enter the new value, for example: if old value "
1400 PRINT "         of E2(4) was 1610.5, and you want to change it"
1410 PRINT "         to 1601.5, then enter E2(4)=1601.5;"
1420 PRINT "      3. Enter RUN 1450."
1430 PRINT "__"
1440 END
1450 PRINT "_ NOTE: IF YOU DON'T WANT TO PLOT THESE DATA,"
1460 PRINT "_       LEAVE 'LOAD' BUTTON OF 4662 DOWN"

1470 REM ** PROGRAM SEGMENT TO TRANSFER DATA TO ARRAY-DATA TAPE **

1480 PRINT "_ DO YOU WANT TO PUT THESE DATA ON TAPE? (YES=Y, NO=N) ";
1490 INPUT G$
1500 IF G$="Y" THEN 1530
1510 F1=0
1520 GO TO 1770
1530 GOSUB 1550
1540 GO TO 1610
1550 PRINT "GGG"
1560 PRINT "_ INSERT ARRAY DATA TAPE INTO THE 4924 TAPE UNIT "
1570 PRINT "_ WITHIN WHICH FILE? ";
1580 INPUT F1
1590 FIND @2:F1
1600 RETURN
1610 WRITE @2:F1,A$,C$,D$,E$,Q$,R$,T$,A1,A2,D1,D2,E1,E2,E3,E7,N7,S7
1620 WRITE @2:X5,X6,X7
1630 CLOSE
1640 DELETE A$,C$,D$,E$,Q$,R$,T$,A1,A2,D1,D2,E1,E2,E3,E7,N7,S7
1650 DELETE X5,X6,X7
1660 DIM E1(14),E2(14),E3(14),E4(14),X5(14),X6(14),X7(14),V$(11)
1670 DIM A$(20),C$(20),D$(13),E$(15),G$(1),Q$(10),R$(12),T$(12),U$(12)
1680 FIND @2:F1
1690 READ @2:F1,A$,C$,D$,E$,Q$,R$,T$,A1,A2,D1,D2,E1,E2,E3,E7,N7,S7
1700 READ @2:X5,X6,X7
1710 D1=X5(12)
1720 D2=X6(12)
1730 PRINT "_ DO YOU WANT TO PRINT THESE DATA? ( Y OR N ) ";
1740 INPUT G$
1750 IF G$="N" THEN 1770
1760 GOSUB 5200

1770 REM ** PROGRAM SEGMENT TO PLOT ARRAY DATA **

1780 WINDOW 0,80,25,105
1790 VIEWPORT 0,80,25,105
```

```
1800 PRINT @1,17:1.5,2.25
1810 MOVE @1:0,90
1820 PRINT @1:"Area: ";A$
1830 MOVE @1:60-1.5*(7+LEN(Q$)),90
1840 PRINT @1:"Array: ";Q$
1850 PRINT @1,17:1,1.5
1860 IMAGE 4D.D
1870 MOVE @1:0,84
1880 I1=1
1890 I2=2
1900 E4=E1
1910 GOSUB 1980
1920 MOVE @1:52.5,84
1930 I1=2
1940 I2=3
1950 E4=E2
1960 GOSUB 1980
1970 GO TO 2210
1980 RMOVE @1:2.5,0
1990 PRINT @1:"Seis."
2000 RMOVE @1:0,-2
2010 PRINT @1:"elev."
2020 RMOVE @1:0,-2
2030 PRINT @1:"SP.";I1
2040 RMOVE @1:1,-2
2050 PRINT @1:"to"
2060 RMOVE @1:-1,-2
2070 PRINT @1:"SP.";I2
2080 RMOVE @1:-1,-4.5
2090 PRINT @1: USING 1860:E4(1)
2100 RMOVE @1:0,-2
2110 PRINT @1: USING 1860:E4(13)
2120 FOR J=2 TO 11
2130  RMOVE @1:0,-2
2140  PRINT @1: USING 1860:E4(J)
2150 NEXT J
2160 RMOVE @1:0,-2
2170 PRINT @1: USING 1860:E4(14)
2180 RMOVE @1:0,-2
2190 PRINT @1: USING 1860:E4(12)
2200 RETURN
2210 I1=1
2220 I2=2
2230 MOVE @1:10.5,45
2240 DRAW @1:10.5,85
2250 DRAW @1:50.5,85
2260 DRAW @1:50.5,45
2270 DRAW @1:10.5,45
2280 B=1
2290 H1=(D1+B)*SIN(A1)
2300 V1=(D1+B)*COS(A1)
2310 H2=(D2+B)*SIN(A2)
2320 V2=(D2+B)*COS(A2)
2330 H3=ABS(H1) MAX ABS(H2)
2340 H4=ABS(H1+H2)
2350 H7=H3 MAX H4
2360 V3=ABS(V1) MAX ABS(V2)
2370 V4=ABS(V1+V2)
2380 V7=V3 MAX V4
2390 S=H7 MAX V7
```

```
2400 REM ** PLOT SHOTPOINTS AND SPREADS **

2410 K=S/40
2420 WINDOW -2.4*K,S+2.4*K,-2.4*K,S+2.4*K
2430 VIEWPORT 10.5,50.5,45,85
2440 MOVE @1:S/2,S/2
2450 IF V1<0 THEN 2490
2460 A=H1-H7/2
2470 C=V1-V7/2
2480 GO TO 2510
2490 A=H1-H7/2
2500 C=V1+V7/2
2510 IF A1>180 OR A2>180 THEN 2530
2520 GO TO 2570
2530 A=H1+H7/2
2540 IF SGN(H2)<>SGN(H1) THEN 2560
2550 GO TO 2570
2560 A=-SGN(H2)*H7/2
2570 RMOVE @1:A,C
2580 ROTATE 90-A1
2590 RMOVE @1:-D1,0
2600 PRINT @1,25:90-A1
2610 RMOVE @1:K,K
2620 PRINT @1,17:1,1.5
2630 PRINT @1:"SP-1"
2640 RMOVE @1:D1-6*K,0
2650 PRINT @1:"SP-2"
2660 RMOVE @1:-D1+5*K,-K
2670 GOSUB 3380
2680 GOSUB 3520
2690 RMOVE @1:B/2,0
2700 RDRAW @1:X5(13)-B/2,0
2710 GOSUB 3520
2720 RDRAW @1:X5(2)-X5(13),0
2730 GOSUB 3520
2740 FOR I=3 TO 11
2750  RDRAW @1:X5(I)-X5(I-1),0
2760  GOSUB 3520
2770 NEXT I
2780 RDRAW @1:X5(12)-X5(11)-X5(14),0
2790 GOSUB 3520
2800 RDRAW @1:X5(14)-B/2,0
2810 RMOVE @1:B/2,0
2820 GOSUB 3380
2830 GOSUB 3520
2840 RMOVE @1:-D1+2*K,-2*K
2850 PRINT @1:"Spd 1"
2860 RMOVE @1:D1-12*K,K/2
2870 RDRAW @1:2*K,0
2880 RMOVE @1:0,-K/2
2890 PRINT @1: USING "3D":A1
2900 GOSUB 3600
2910 RMOVE @1:2*K,1.5*K
2920 ROTATE 90-A2
2930 PRINT @1,25:90-A2
2940 IF A2=>0 AND A2<=180 THEN 3090
2950 PRINT @1,25:270-A2
2960 RMOVE @1:D2-K,-K
2970 PRINT @1:"SP-3"
```

```
2980 RMOVE @1:-D2+K,K
2990 GOSUB 3220
3000 RMOVE @1:-3*K,1.5*K
3010 GOSUB 3620
3020 RMOVE @1:-2*K,K/2
3030 PRINT @1: USING "4D":A2
3040 RMOVE @1:-5*K,-K/2
3050 RDRAW @1:-2*K,0
3060 RMOVE @1:-D2+18*K,K/2
3070 PRINT @1:"Spd 2"
3080 GO TO 3680
3090 RMOVE @1:D2-5*K,K
3100 PRINT @1:"SP-3"
3110 RMOVE @1:-D2+5*K,-K
3120 GOSUB 3220
3130 RMOVE @1:-D2+2*K,-2*K
3140 PRINT @1:"Spd 2"
3150 RMOVE @1:D2-12*K,K/2
3160 RDRAW @1:2*K,0
3170 RMOVE @1:0,-K/2
3180 PRINT @1: USING "3D":A2
3190 GOSUB 3600
3200 GO TO 3680

3210 REM ** SUBROUTINE TO PLOT SPREAD 2 **

3220 RMOVE @1:B/2,0
3230 RDRAW @1:X6(13)-B/2,0
3240 GOSUB 3520
3250 RDRAW @1:X6(2)-X6(13),0
3260 GOSUB 3520
3270 FOR I=3 TO 11
3280  RDRAW @1:X6(I)-X6(I-1),0
3290  GOSUB 3520
3300 NEXT I
3310 RDRAW @1:X6(12)-X6(11)-X6(14),0
3320 GOSUB 3520
3330 RDRAW @1:X6(14)-B/2,0
3340 RMOVE @1:B/2,0
3350 GOSUB 3380
3360 GOSUB 3520
3370 RETURN

3380 REM ** SUBROUTINE TO DRAW SMALL OCTAGON FOR SHOTPOINT SYMBOL **

3390 A=B*TAN(22.5)/2
3400 B1=B/2-A
3410 RMOVE @1:-B/2,A
3420 RDRAW @1:B1,B1
3430 RDRAW @1:2*A,0
3440 RDRAW @1:B1,-B1
3450 RDRAW @1:0,-2*A
3460 RDRAW @1:-B1,-B1
3470 RDRAW @1:-2*A,0
3480 RDRAW @1:-B1,B1
3490 RDRAW @1:0,2*A
3500 RMOVE @1:B/2,-A
3510 RETURN

3520 REM ** SUBROUTINE TO DRAW CROSSES **
```

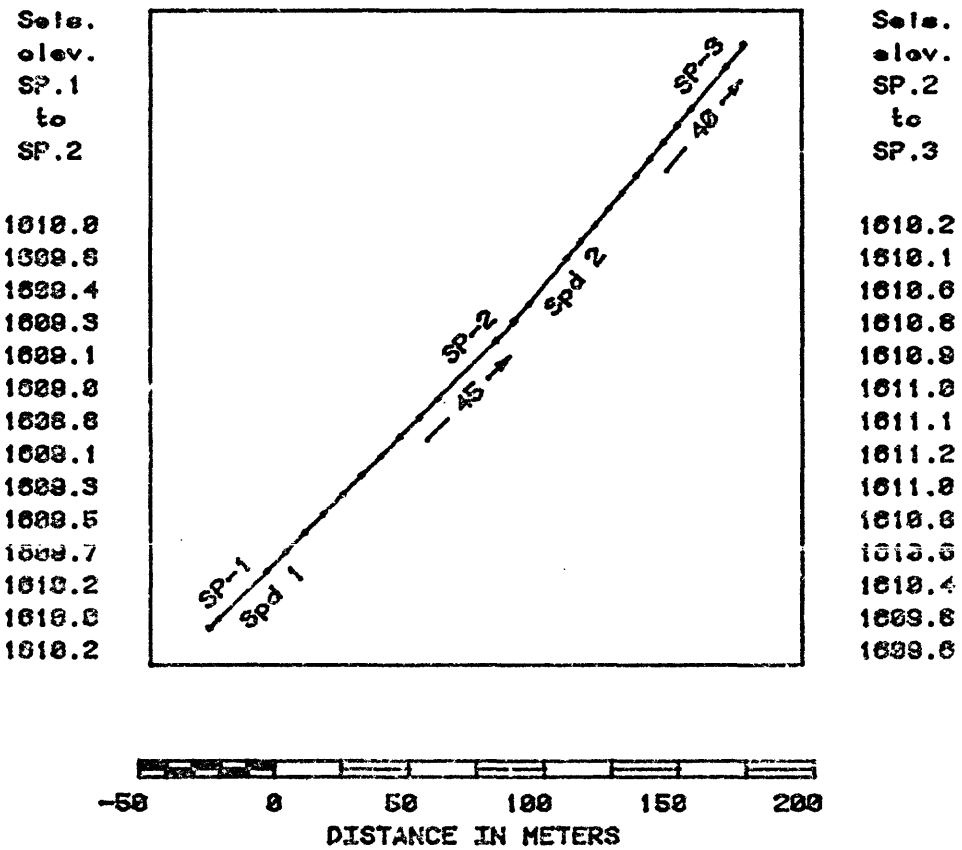
```
3530 RDRAW @1:-B/2,B/2
3540 RDRAW @1:B,-B
3550 RDRAW @1:-B/2,B/2
3560 RDRAW @1:B/2,B/2
3570 RDRAW @1:-B,-B
3580 RDRAW @1:B/2,B/2
3590 RETURN

3600 REM ** SUBROUTINE TO DRAW SPREAD-DIRECTION ARROW **

3610 RMOVE @1:4*K,K/2
3620 RDRAW @1:2*K,0
3630 RDRAW @1:-K,0.25*K
3640 RDRAW @1:0.25*K,-0.25*K
3650 RDRAW @1:-0.25*K,-0.25*K
3660 RDRAW @1:K,0.25*K
3670 RETURN

3680 REM ** PRINT SCALE DIAGRAM **

3690 ROTATE 0
3700 PRINT @1,25:0
3710 WINDOW 0,80,0,105
3720 VIEWPORT 0,80,0,105
3730 S=S*(1+4.8/40)
3740 K=40/S
3750 IF S>14 AND S<=35 THEN 3840
3760 IF S>35 AND S<=70 THEN 3860
3770 IF S>70 AND S<=140 THEN 3880
3780 IF S>140 AND S<=170 THEN 3900
3790 IF S>170 AND S<=300 THEN 3920
3800 IF S>300 AND S<=400 THEN 3940
3810 IF S>400 THEN 3960
3820 W=1*K
3830 GO TO 3970
3840 W=2*K
3850 GO TO 3970
3860 W=5*K
3870 GO TO 3970
3880 W=10*K
3890 GO TO 3970
3900 W=20*K
3910 GO TO 3970
3920 W=25*K
3930 GO TO 3970
3940 W=40*K
3950 GO TO 3970
3960 W=50*K
3970 W1=0.4*W
3980 MOVE @1:30.5,40
3990 RMOVE @1:-5*W,-2
4000 FOR I=1 TO 5
4010  RDRAW @1:0,1
4020  RMOVE @1:W1,-1
4030 NEXT I
4040 FOR I=1 TO 8
4050  RDRAW @1:0,1
4060  RMOVE @1:W,-1
4070 NEXT I
```

```
4080 RDRAW @1:0,1
4090 RDRAW @1:-10*W,0
4100 RDRAW @1:0,-1
4110 RDRAW @1:10*W,0
4120 RDRAW @1:0,1/2
4130 FOR I=1 TO 4
4140  RDRAW @1:-W,0
4150  RMOVE @1:-W,0
4160 NEXT I
4170 RMOVE @1:0,3/8
4180 RDRAW @1:-W1,0
4190 RMOVE @1:-W1,0
4200 RDRAW @1:-W1,0
4210 RMOVE @1:-W1,0
4220 RDRAW @1:-W1,0
4230 RMOVE @1:0,-1/8
4240 RDRAW @1:W1,0
4250 RMOVE @1:W1,0
4260 RDRAW @1:W1,0
4270 RMOVE @1:W1,0
4280 RDRAW @1:W1,0
4290 RMOVE @1:0,-1/8
4300 RDRAW @1:-W1,0
4310 RMOVE @1:-W1,0
4320 RDRAW @1:-W1,0
4330 RMOVE @1:-W1,0
4340 RDRAW @1:-W1,0
4350 RMOVE @1:0,-1/8
4360 RDRAW @1:5*W1,0
4370 RMOVE @1:-W1,-1/8
4380 RDRAW @1:-W1,0
4390 RMOVE @1:-W1,0
4400 RDRAW @1:-W1,0
4410 RMOVE @1:0,-1/8
4420 RDRAW @1:W1,0
4430 RMOVE @1:W1,0
4440 RDRAW @1:W1,0
4450 RMOVE @1:0,-1/8
4460 RDRAW @1:-W1,0
4470 RMOVE @1:-W1,0
4480 RDRAW @1:-W1,0
4490 RMOVE @1:-(W1+10/3),-17/8
4500 IMAGE D
4510 IMAGE 4D
4520 PRINT @1: USING 4510:-2*W/K
4530 RMOVE @1:2*W+3,0
4540 PRINT @1: USING 4500:0
4550 RMOVE @1:2*W-3,0
4560 PRINT @1: USING 4510:2*W/K
4570 RMOVE @1:2*W,0
4580 PRINT @1: USING 4510:4*W/K
4590 FOR I=3 TO 4
4600  RMOVE @1:2*W,0
4610  PRINT @1: USING 4510:2*W*I/K
4620 NEXT I
4630 MOVE @1:21.5,34
4640 PRINT @1:"DISTANCE IN METERS"

4650 REM ** PRINT SPREAD AND LOCATION INFORMATION **
```

```
4660 MOVE @1:0,25
4670 PRINT @1:"SP.1-to-SP.2  dist. = ";X5(12);" m"
4680 MOVE @1:55-LEN(C$)-LEN(E$),25
4690 PRINT @1:C$;" Co.,";E$
4700 MOVE @1:0,23
4710 PRINT @1:"SP.2-to-SP.3  dist. = ";X6(12);" m"
4720 IF S7=99 THEN 4740
4730 GO TO 4770
4740 MOVE @1:38,23
4750 PRINT @1:"Center of array is at:"
4760 GO TO 4800
4770 MOVE @1:36,23
4780 IMAGE 15A,5D,4A
4790 PRINT @1: USING 4780:"Array center is",N7," m N"
4800 MOVE @1:0,21
4810 PRINT @1:"U.H.Seis, spd.1, = ";X5(13);" & ";X5(14);" m"
4820 IF S7=99 THEN 4840
4830 GO TO 4870
4840 MOVE @1:38,21
4850 PRINT @1:"Latitude:  ";R$
4860 GO TO 4900
4870 MOVE @1:35,21
4880 IMAGE 3A,5D,17A
4890 PRINT @1: USING 4880:"and",E7," m E of SW corner"
4900 MOVE @1:0,19
4910 PRINT @1:"U.H.Seis, spd.2, = ";X6(13);" & ";X6(14);" m"
4920 IF S7=99 THEN 4940
4930 GO TO 4970
4940 MOVE @1:38,19
4950 PRINT @1:"Longitude:";T$
4960 GO TO 5080
4970 U$=", T."&T$
4980 U$=U$&"."
4990 T=LEN(U$)
5000 V$=" R."&R$
5010 V$=V$&"."
5020 R=LEN(V$)
5030 IF S7>9 THEN 5060
5040 MOVE @1:52-R-T,19
5050 GO TO 5070
5060 MOVE @1:51-R-T,19
5070 PRINT @1:"of sec.";S7;U$;V$
5080 MOVE @1:0,17
5090 PRINT @1:"Seis. int. ,spread 1 = ";X5(3)-X5(2);" m"
5100 MOVE @1:38,17
5110 IMAGE 19A,3D
5120 PRINT @1: USING 5110:"Data stored in file",F1
5130 MOVE @1:0,15
5140 PRINT @1:"Seis. int. ,spread 2 = ";X6(3)-X6(2);" m"
5150 MOVE @1:47-LEN(D$),15
5160 PRINT @1:"Surveyed on: ";D$
5170 MOVE @1:150,100
5180 PRINT "GGG      PROGRAM COMPLETED"
5190 END

5200 REM ** SUBROUTINE TO TABULATE DATA ENTERED **

5210 PRINT "L                        TABULATION OF DATA ENTERED"
5220 PRINT "_A$(Area name) = ";A$;"          Q$(Array number) = ";Q$
5230 PRINT "_                       D$(Date surveyed) = ";D$
```

```
5240 PRINT "                              ARRAY-CENTER LOCATION"
5250 IF S7=99 THEN 5270
5260 GO TO 5300
5270 PRINT "_R$(Latitude) = ";R$;"     S7 = ";S7;
5280 PRINT "     T$(Longitude) = ";T$
5290 GO TO 5340
5300 PRINT "N7(dist N from SW corner) = ";N7;"       E7(dist E from SW";
5310 PRINT "corner) = ";E7
5320 PRINT "S7(section) = ";S7;"          T$(Township) = ";T$;
5330 PRINT "          R$(Range) = ";R$
5340 PRI "C$(county) = ";C$;"                              E$(state) = ";E$
5350 PRINT "                              ARRAY PARAMETERS"
5360 PRINT "A1(line & cross: N az. of spd 1; triangle: angle ";
5370 PRINT "opposite spd 1)="
5380 IMAGE 66X,3D.D
5390 PRINT "KK"
5400 PRINT USING 5380:A1
5410 PRINT "A2(line: N az. spd 2; cross: CCW ang. spd 2; tri: ang";
5420 PRINT " opp spd 2)="
5430 IMAGE 66X,3D.D
5440 PRINT "KK"
5450 PRINT USING 5430:A2
5460 PRINT "A3(line: spd 1 dist; cross: crossover spd 2; tri";
5470 PRINT ": ang opp spd 3)="
5480 IMAGE 66X,3D.D
5490 PRINT "KK"
5500 PRINT USING 5480:D1
5510 PRINT "A4(line: spd 2 dist; cross: crossover spd 1; tri";
5520 PRINT ": array azimuth)="
5530 IMAGE 66X,3D.D
5540 PRINT "KK"
5550 PRINT USING 5530:D2
5560 PRINT "              SPREAD LENGTHS                    ";
5570 PRINT "   ELEVATIONS"
5580 PRINT " J      X5(J)     X6(J)     X7(J)          ";
5590 PRINT " E1(J)     E2(J)     E3(J)"
5600 IMAGE 2D,3(4X,4D.D),8X,3(4X,4D.D)
5610 FOR J=1 TO 14
5620  PRINT USING 5600:J,X5(J),X6(J),X7(J),E1(J),E2(J),E3(J)
5630 NEXT J
5640 MOVE 0,0
5650 PRINT
5660 RETURN
```

Area: LINE ARRAY, TEST#1A Array: 78-100



SP.1-to-SP.2 dist. = 100 m
SP.2-to-SP.3 dist. = 132 m
U.H.Sels, spd.1, = 5 & 10 m
U.H.Sels, spd.2, = 8 & 10 m
Sels. int. ,spread 1 = 10 m
Sels. int. ,spread 2 = 8 m

Weld Co.,Colo.
Center of array is at:
Latitude: 40 04 56.6
Longitude: 105 01 43.2
Data stored in file 3
Surveyed on: Nov.14,1978

Figure 1. Sample problem for line array

TABULATION OF DATA ENTERED

A$(Area name) = LINE ARRAY, TEST#1A D$(Array number) = 78-100
D$(Date surveyed) = Nov.14,1978

ARRAY-CENTER LOCATION

R$(Latitude) = 40 04 56.6 S7 = 99 T$(Longitude) = 105 01 43.2
C$(county) = Weld E$(state) = Colo.

ARRAY PARAMETERS

A1(line & cross: N az. of spd 1; triangle: angle opposite spd 1)= 45.0
A2(line: N az. spd 2; cross: CCW ang. spd 2; tri: ang opp spd 2)= 40.0
A3(line: spd 1 dist; cross: crossover spd 2; tri: ang opp spd 3)= 160.0
A4(line: spd 2 dist; cross: crossover spd 1; tri: array azimuth)= 132.0

	SPREAD LENGTHS			ELEVATIONS		
J	X5(J)	X6(J)	X7(J)	E1(J)	E2(J)	E3(J)
1	0.0	0.0	0.0	1610.0	1610.2	0.0
2	30.0	30.0	0.0	1609.4	1610.6	0.0
3	40.0	38.0	0.0	1609.3	1610.8	0.0
4	50.0	46.0	0.0	1609.1	1610.9	0.0
5	60.0	54.0	0.0	1609.0	1611.0	0.0
6	70.0	62.0	0.0	1608.8	1611.1	0.0
7	80.0	70.0	0.0	1609.1	1611.2	0.0
8	90.0	78.0	0.0	1609.3	1611.0	0.0
9	100.0	86.0	0.0	1609.5	1610.8	0.0
10	110.0	94.0	0.0	1609.7	1610.6	0.0
11	120.0	102.0	0.0	1610.2	1610.4	0.0
12	160.0	132.0	0.0	1610.2	1609.6	0.0
13	5.0	8.0	0.0	1609.8	1610.1	0.0
14	10.0	10.0	0.0	1610.0	1609.8	0.0

Figure 2. Copy from screen of 4051 Graphic System showing array data entered for the plot of figure 1.

```
100 PRINT "L            YOU HAVE SELECTED THE PROGRAM TO ENTER AND PLOT"
110 PRINT "                              CROSS ARRAY DATA"
120 INIT
130 SET DEGREES
140 DIM E1(14),E2(14),E3(14),E4(14),X5(14),X6(14),X7(14),V$(11)
150 DIM A$(20),C$(12),D$(13),E$(15),G$(1),Q$(10),R$(15),T$(15),U$(15)
160 VIEWPORT 0,80,0,105
170 PRINT "  ARE DATA TO BE ENTERED FROM DATA TAPE? (YES=Y, NO=N) ";
180 INPUT G$
190 IF G$="N" THEN 220
200 GOSUB 1540
210 GO TO 1690

220 REM ** ENTER ARRAY DATA FROM KEYBOARD **

230 PRINT "  NAME OF AREA (LIMIT 20 LETTERS): ";
240 INPUT A$
250 PRINT "  ARRAY NUMBER = ";
260 INPUT Q$
270 PRINT "  DATE DATA WERE TAKEN = ";
280 INPUT D$
290 PRINT "  COUNTY IN WHICH DATA WERE TAKEN: ";
300 INPUT C$
310 PRINT " IN THE STATE OF ";
320 INPUT E$
330 PRINT "  DO YOU WANT TO LOCATE ARRAY WITH LAT.& LONG.? ( Y OR N ) ";
340 INPUT G$
350 IF G$="N" THEN 590
360 N7=0
370 E7=0
380 PRINT "  LATITUDE OF ARRAY CENTER = ";
390 GOSUB 420
400 R$=U$
410 GO TO 540
420 INPUT L1
430 PRINT "K                                   deg, ";
440 INPUT L2
450 PRINT "K                                          min, ";
460 INPUT L3
470 PRINT "K                                                 sec"
480 L$=STR(L1)
490 U$=STR(L2)
500 U$=L$&U$
510 L$=STR(L3)
520 U$=U$&L$
530 RETURN
540 PRINT " LONGITUDE OF ARRAY CENTER=";
550 GOSUB 420
560 T$=U$
570 S7=99
580 GO TO 690
590 PRINT "  TOWNSHIP = T";
600 INPUT T$
610 PRINT " RANGE = R";
620 INPUT R$
630 PRINT " SECTION = ";
640 INPUT S7
650 PRINT "  DISTANCE NORTH, IN METERS, FROM SW CORNER = ";
660 INPUT N7
670 PRINT " DISTANCE EAST, IN METERS, FROM SW CORNER = ";
```

```
680 INPUT E7

690 REM ** ENTER SEISMOMETER DISTANCES AND ELEVATIONS FROM KEYBOARD **

700 PRINT "L INPUT DISTANCES ALONG SPREAD 1 FROM SP-1 TO SP-3"
710 X5(1)=0
720 PRINT "  UPHOLE SEIS. OFFSET ALONG SPREAD 1 NEAR SP-1 = ";
730 INPUT X5(13)
740 PRINT "  SEIS. NO.";"  DISTANCE FROM SP-1"
750 FOR J=2 TO 12
760  PRINT "     ";J;"             ";
770  INPUT X5(J)
780 NEXT J
790 PRINT "  UPHOLE SEIS. OFFSET BACK ALONG SPREAD 1 FROM SP-3 = ";
800 INPUT X5(14)
810 PRINT "L INPUT ELEVATIONS ALONG SPREAD 1 FROM SP-1 TO SP-3"
820 PRINT "  ELEV OF SP-1 = ";
830 INPUT E1(1)
840 PRINT "  UPHOLE SEIS. ELEV. ALONG SPREAD 1 NEAR SP-1 = ";
850 INPUT E1(13)
860 PRINT "  SEIS. NO.";"  ELEVATION ALONG SPREAD 1"
870 FOR J=2 TO 12
880  PRINT "     ";J;"             ";
890  INPUT E1(J)
900 NEXT J
910 PRINT "  UPHOLE SEIS. ELEV. BACK ALONG SPREAD 1 FROM SP-3 = ";
920 INPUT E1(14)
930 PRINT "L INPUT DISTANCES ALONG SPREAD 2 FROM SP-4 TO SP-2"
940 PRINT "  UPHOLE SEIS. OFFSET ALONG SPREAD 2 NEAR SP-4 = ";
950 INPUT X6(13)
960 X6(1)=0
970 PRINT "  SEIS. NO.";"  DISTANCE FROM SP-4"
980 FOR J=2 TO 12
990  PRINT "     ";J;"             ";
1000  INPUT X6(J)
1010 NEXT J
1020 PRINT "  UPHOLE SEIS. OFFSET BACK ALONG SPREAD 2 FROM SP-2 = ";
1030 INPUT X6(14)
1040 PRINT "L INPUT ELEVATIONS ALONG SPREAD 2 FROM SP-4 TO SP-2"
1050 PRINT "  ELEV. OF SP-4 = ";
1060 INPUT E2(1)
1070 PRINT "  UPHOLE SEIS. ELEV. ALONG SPREAD 2 NEAR SP-4 = ";
1080 INPUT E2(13)
1090 PRINT "  SEIS. NO.";"  ELEVATION ALONG SPREAD 2"
1100 FOR J=2 TO 12
1110  PRINT "     ";J;"             ";
1120  INPUT E2(J)
1130 NEXT J
1140 PRINT "  UPHOLE SEIS. ELEV. BACK ALONG SPREAD 2 FROM SP-2 = ";
1150 INPUT E2(14)
1160 FOR J=1 TO 14
1170  X7(J)=0
1180  E3(J)=0
1190 NEXT J
1200 PRI "L DIST.FROM SP-1 ALONG SPREAD 1 TO WHERE SPREAD 2 CROSSES = ";
1210 INPUT D1
1220 PRI "  DIST.FROM SP-4 ALONG SPREAD 2 TO WHERE SPREAD 1 CROSSES = ";
1230 INPUT D2
1240 PRINT "  NORTH AZIMUTH OF SPREAD 1 IN DEGREES = ";
1250 INPUT A1
```

```
1260 PRINT "_ ANGLE, CCW, TO ROTATE SPREAD 1 INTO SPREAD 2 = ";
1270 INPUT A2
1280 PRINT "_ DO YOU WANT TO SEE THE DATA YOU'VE ENTERED? (Y OR N) ";
1290 INPUT G$
1300 IF G$="N" THEN 1320
1310 GOSUB 5160

1320 REM ** PROCEDURE TO CHANGE DATA BEFORE PLOTTING OR TAPING **

1330 PRINT "_ DO YOU WANT TO CHANGE ANY OF THESE DATA BEFORE THEY"
1340 PRINT "_EITHER ARE STORED ON TAPE OR ARE PLOTTED? (Y OR N) ";
1350 INPUT G$
1360 IF G$="N" THEN 1460
1370 PRINT "L   The procedure to make changes is as follows:"
1380 PRINT "_     1. Select variable (see printed list),and"
1390 PRINT "        the appropriate index;"
1400 PRINT "      2. Enter the new value, for example: if old value "
1410 PRINT "        of E2(4) was 1610.5, and you want to change it"
1420 PRINT "        to 1601.5, then enter E2(4)=1601.5;"
1430 PRINT "      3. Enter RUN 1460."
1440 PRINT "__"
1450 END
1460 PRINT "_ NOTE: IF YOU DON'T WANT TO PLOT THESE DATA,"
1470 PRINT "_LEAVE 'LOAD' BUTTON OF 4662 DOWN"

1480 REM ** PROCEDURE TO TRANSFER DATA TO ARRAY-DATA TAPE **

1490 PRINT "_ DO YOU WANT TO PUT THESE DATA ON TAPE? (YES=Y, NO=N) ";
1500 INPUT G$
1510 IF G$="N" THEN 1710
1520 GOSUB 1540
1530 GO TO 1610
1540 PRINT "GGG"
1550 PRINT "_INSERT ARRAY DATA TAPE INTO THE 4924 TAPE UNIT "
1560 PRINT "_-------------------------------------------"
1570 PRINT "_ WITHIN WHICH FILE? ";
1580 INPUT F1
1590 FIND @2:F1
1600 RETURN
1610 WRITE @2:F1,A$,C$,D$,E$,Q$,R$,T$,A1,A2,D1,D2,E1,E2,E3,E7,N7,S7
1620 WRITE @2:X5,X6,X7
1630 CLOSE
1640 DELETE A$,C$,D$,E$,Q$,R$,T$,A1,A2,D1,D2,E1,E2,E3,E7,N7,S7
1650 DELETE X5,X6,X7
1660 DIM E1(14),E2(14),E3(14),E4(14),X5(14),X6(14),X7(14),V$(11)
1670 DIM A$(20),C$(12),D$(13),E$(15),G$(1),Q$(10),R$(15),T$(15),U$(15)
1680 FIND @2:F1
1690 READ @2:F1,A$,C$,D$,E$,Q$,R$,T$,A1,A2,D1,D2,E1,E2,E3,E7,N7,S7
1700 READ @2:X5,X6,X7

1710 REM ** PRINT TOP LINE AND TABULATE ELEVATIONS **

1720 WINDOW 0,80,25,105
1730 VIEWPORT 0,80,25,105
1740 PRINT @1,17:1.5,2.25
1750 MOVE @1:0,90
1760 PRINT @1:"Area: ";A$
1770 MOVE @1:60-1.5*(7+LEN(Q$)),90
1780 PRINT @1:"Array: ";Q$
1790 PRINT @1,17:1,1.5
```

```
1800 IMAGE 4D.D
1810 MOVE @1:0,84
1820 I1=1
1830 I2=3
1840 E4=E1
1850 GOSUB 1920
1860 MOVE @1:52.5,84
1870 I1=4
1880 I2=2
1890 E4=E2
1900 GOSUB 1920
1910 GO TO 2150
1920 RMOVE @1:2.5,0
1930 PRINT @1:"Seis."
1940 RMOVE @1:0,-2
1950 PRINT @1:"elev."
1960 RMOVE @1:0,-2
1970 PRINT @1:"SP.";I1
1980 RMOVE @1:1,-2
1990 PRINT @1:"to"
2000 RMOVE @1:-1,-2
2010 PRINT @1:"SP.";I2
2020 RMOVE @1:-1,-4.5
2030 PRINT @1: USING 1800:E4(1)
2040 RMOVE @1:0,-2
2050 PRINT @1: USING 1800:E4(13)
2060 FOR J=2 TO 11
2070  RMOVE @1:0,-2
2080  PRINT @1: USING 1800:E4(J)
2090 NEXT J
2100 RMOVE @1:0,-2
2110 PRINT @1: USING 1800:E4(14)
2120 RMOVE @1:0,-2
2130 PRINT @1: USING 1800:E4(12)
2140 RETURN
2150 I1=1
2160 I2=2

2170 REM ** DRAW BORDER **

2180 MOVE @1:10.5,45
2190 DRAW @1:10.5,85
2200 DRAW @1:50.5,85
2210 DRAW @1:50.5,45
2220 DRAW @1:10.5,45

2230 REM ** POSITION PLOT WITHIN ALLOTTED SPACE **

2240 B=1

2250 REM ** B=BOX DIMENSION **

2260 H1=(D1+B)*SIN(A1)
2270 V1=(D1+B)*COS(A1)
2280 H2=(X5(12)-D1+B)*SIN(A1)
2290 V2=(X5(12)-D1+B)*COS(A1)
2300 H3=(D2+B)*SIN(A2-A1)
2310 V3=(D2+B)*COS(A2-A1)
2320 H4=(X6(12)-D2+B)*SIN(A2-A1)
2330 V4=(X6(12)-D2+B)*COS(A2-A1)
```

```
2340 H5=H1 MAX H4
2350 H6=H2 MAX H3
2360 H7=H6+H5
2370 V5=V1 MAX V3
2380 V6=V2 MAX V4
2390 V7=V6+V5
2400 S=H7 MAX V7

2410 REM ** PLOT SHOTPOINTS AND SPREADS **

2420 IF A1=>A2 THEN 2450
2430 A3=360+A1-A2
2440 GO TO 2460
2450 A3=A1-A2
2460 K=S/40
2470 WINDOW -2.4*K,S+2.4*K,-2.4*K,S+2.4*K
2480 VIEWPORT 10.5,50.5,45,85
2490 MOVE @1:S/2,S/2
2500 RMOVE @1:H7/2-H6,V7/2-V6
2510 ROTATE 90-A1
2520 RMOVE @1:-D1,0
2530 PRINT @1,25:90-A1
2540 RMOVE @1:K,K
2550 PRINT @1,17:1,1.5
2560 PRINT @1:"SP-1"
2570 RMOVE @1:X5(12)-6*K,0
2580 PRINT @1:"SP-3"
2590 RMOVE @1:-X5(12)+5*K,-K
2600 GOSUB 3380
2610 GOSUB 3480
2620 RMOVE @1:B/2,0
2630 RDRAW @1:X5(13)-B/2,0
2640 GOSUB 3480
2650 RDRAW @1:X5(2)-X5(13),0
2660 GOSUB 3480
2670 FOR I=3 TO 11
2680  RDRAW @1:X5(I)-X5(I-1),0
2690  GOSUB 3480
2700 NEXT I
2710 RDRAW @1:X5(12)-X5(11)-X5(14),0
2720 GOSUB 3480
2730 RDRAW @1:X5(14)-B/2,0
2740 RMOVE @1:B/2,0
2750 GOSUB 3380
2760 GOSUB 3480
2770 RMOVE @1:-X5(12)+K,-2*K
2780 PRINT @1:"Spread 1"
2790 RMOVE @1:X5(12)-11*K,K/2
2800 RDRAW @1:2*K,0
2810 RMOVE @1:0*K,-K/2
2820 PRINT @1: USING "X,3D":A1
2830 GOSUB 3560
2840 RMOVE @1:-X5(12)+1*K+D1,1.5*K
2850 ROTATE 90-A1+A2
2860 PRINT @1,25:90-A1+A2
2870 IF A2<=A1 THEN 3040
2880 PRINT @1,25:-90+A2-A1
2890 RMOVE @1:X6(12)-D2-K,-K
2900 PRINT @1:"SP-2"
2910 RMOVE @1:-X6(12)+6*K,0
```

```
2920 PRINT @1:"SP-4"
2930 RMOVE @1:-5*K,+K
2940 GOSUB 3190
2950 RMOVE @1:-3*K,1.5*K
2960 GOSUB 3580
2970 RMOVE @1:-2*K,+K/2
2980 PRINT @1: USING "X,3D":A3
2990 RMOVE @1:-5*K,-K/2
3000 RDRAW @1:-2*K,0
3010 RMOVE @1:-X6(12)+19*K,+K/2
3020 PRINT @1:"Spread 2"
3030 GO TO 3640
3040 RMOVE @1:X6(12)-D2-4*K,K
3050 PRINT @1:"SP-2"
3060 RMOVE @1:-X6(12)+5*K,0
3070 PRINT @1:"SP-4"
3080 RMOVE @1:-K,-K
3090 GOSUB 3190
3100 RMOVE @1:-3*K,-1.5*K
3110 GOSUB 3580
3120 RMOVE @1:-7*K,-K/2
3130 PRINT @1: USING "X,3D":A3
3140 RMOVE @1:-K/2,K/2
3150 RDRAW @1:-2*K,0
3160 RMOVE @1:-X6(12)+12*K,-K/2
3170 PRINT @1:"Spread 2"
3180 GO TO 3640

3190 REM ** SUBROUTINE TO PLOT SPREAD 2 **

3200 GOSUB 3380
3210 GOSUB 3480
3220 RMOVE @1:B/2,0
3230 RDRAW @1:X6(13)-B/2,0
3240 GOSUB 3480
3250 RDRAW @1:X6(2)-X6(13),0
3260 GOSUB 3480
3270 FOR I=3 TO 11
3280  RDRAW @1:X6(I)-X6(I-1),0
3290  GOSUB 3480
3300 NEXT I
3310 RDRAW @1:X6(12)-X6(11)-X6(14),0
3320 GOSUB 3480
3330 RDRAW @1:X6(14)-B/2,0
3340 RMOVE @1:B/2,0
3350 GOSUB 3380
3360 GOSUB 3480
3370 RETURN

3380 REM ** SUBROUTINE TO DRAW SMALL BOX FOR SHOTPOINT SYMBOL **

3390 B=B*3/2
3400 RMOVE @1:-B/2,-B/2
3410 RDRAW @1:0,B
3420 RDRAW @1:B,0
3430 RDRAW @1:0,-B
3440 RDRAW @1:-B,0
3450 RMOVE @1:B/2,B/2
3460 B=B*2/3
3470 RETURN
```

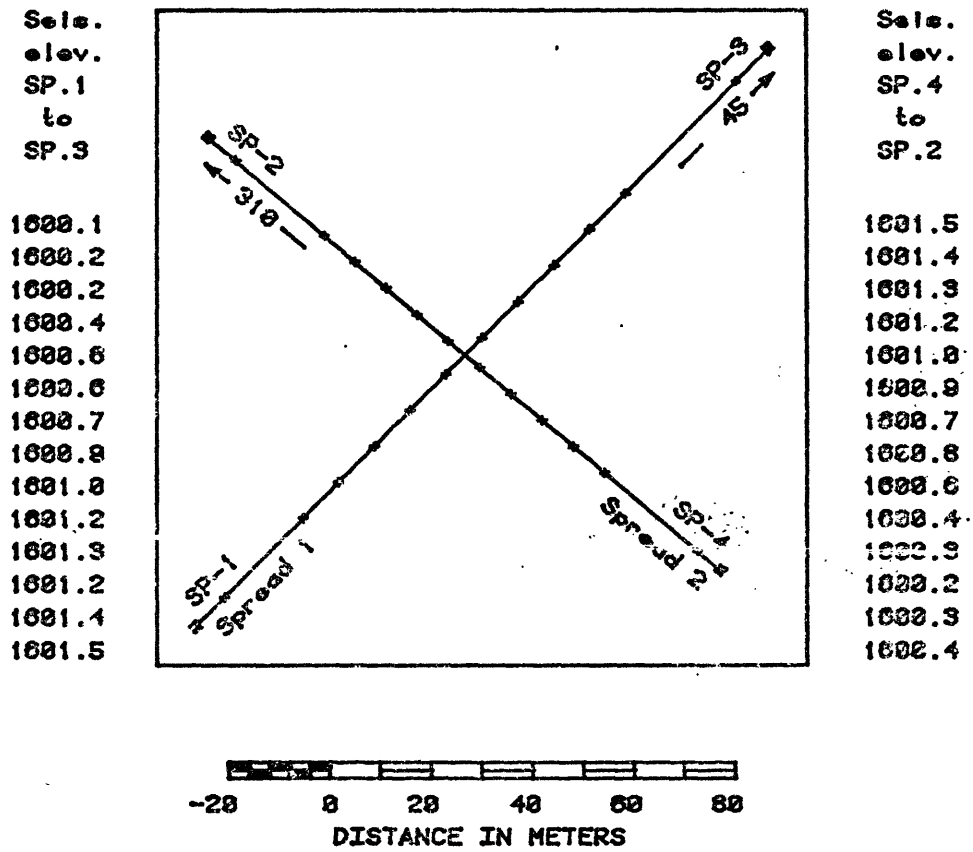
```
3480 REM ** SUBROUTINE TO DRAW CROSSES **

3490 RDRAW @1:-B/2,B/2
3500 RDRAW @1:B,-B
3510 RDRAW @1:-B/2,B/2
3520 RDRAW @1:B/2,B/2
3530 RDRAW @1:-B,-B
3540 RDRAW @1:B/2,B/2
3550 RETURN

3560 REM ** SUBROUTINE TO DRAW SPREAD-DIRECTION ARROW **

3570 RMOVE @1:5*K,K/2
3580 RDRAW @1:2*K,0
3590 RDRAW @1:-K,0.25*K
3600 RDRAW @1:0.25*K,-0.25*K
3610 RDRAW @1:-0.25*K,-0.25*K
3620 RDRAW @1:K,0.25*K
3630 RETURN

3640 REM ** PRINT SCALE DIAGRAM **

3650 ROTATE 0
3660 PRINT @1,25:0
3670 WINDOW 0,80,0,105
3680 VIEWPORT 0,80,0,105
3690 S=S*(1+4.8/40)
3700 K=40/S
3710 IF S>14 AND S<=35 THEN 3800
3720 IF S>35 AND S<=70 THEN 3820
3730 IF S>70 AND S<=140 THEN 3840
3740 IF S>140 AND S<=170 THEN 3960
3750 IF S>170 AND S<=300 THEN 3880
3760 IF S>300 AND S<=400 THEN 3900
3770 IF S>400 THEN 3920
3780 W=1*K
3790 GO TO 3930
3800 W=2*K
3810 GO TO 3930
3820 W=5*K
3830 GO TO 3930
3840 W=10*K
3850 GO TO 3930
3860 W=20*K
3870 GO TO 3930
3880 W=25*K
3890 GO TO 3930
3900 W=40*K
3910 GO TO 3930
3920 W=50*K
3930 W1=0.4*W
3940 MOVE @1:30.5,40
3950 RMOVE @1:-5*W,-2
3960 FOR I=1 TO 5
3970  RDRAW @1:0,1
3980  RMOVE @1:W1,-1
3990 NEXT I
4000 FOR I=1 TO 8
4010  RDRAW @1:0,1
```

```
4020  RMOVE @1:W,-1
4030 NEXT I
4040 RDRAW @1:0,1
4050 RDRAW @1:-10*W,0
4060 RDRAW @1:0,-1
4070 RDRAW @1:10*W,0
4080 RDRAW @1:0,1/2
4090 FOR I=1 TO 4
4100  RDRAW @1:-W,0
4110  RMOVE @1:-W,0
4120 NEXT I
4130 RMOVE @1:0,3/8
4140 RDRAW @1:-W1,0
4150 RMOVE @1:-W1,0
4160 RDRAW @1:-W1,0
4170 RMOVE @1:-W1,0
4180 RDRAW @1:-W1,0
4190 RMOVE @1:0,-1/8
4200 RDRAW @1:W1,0
4210 RMOVE @1:W1,0
4220 RDRAW @1:W1,0
4230 RMOVE @1:W1,0
4240 RDRAW @1:W1,0
4250 RMOVE @1:0,-1/8
4260 RDRAW @1:-W1,0
4270 RMOVE @1:-W1,0
4280 RDRAW @1:-W1,0
4290 RMOVE @1:-W1,0
4300 RDRAW @1:-W1,0
4310 RMOVE @1:0,-1/8
4320 RDRAW @1:5*W1,0
4330 RMOVE @1:-W1,-1/8
4340 RDRAW @1:-W1,0
4350 RMOVE @1:-W1,0
4360 RDRAW @1:-W1,0
4370 RMOVE @1:0,-1/8
4380 RDRAW @1:W1,0
4390 RMOVE @1:W1,0
4400 RDRAW @1:W1,0
4410 RMOVE @1:0,-1/8
4420 RDRAW @1:-W1,0
4430 RMOVE @1:-W1,0
4440 RDRAW @1:-W1,0
4450 RMOVE @1:-(W1+10/3),-17/8
4460 IMAGE D
4470 IMAGE 4D
4480 PRINT @1: USING 4470:-2*W/K
4490 RMOVE @1:2*W+3,0
4500 PRINT @1: USING 4460:0
4510 RMOVE @1:2*W-3,0
4520 PRINT @1: USING 4470:2*W/K
4530 RMOVE @1:2*W,0
4540 PRINT @1: USING 4470:4*W/K
4550 FOR I=3 TO 4
4560  RMOVE @1:2*W,0
4570  PRINT @1: USING 4470:2*W*I/K
4580 NEXT I
4590 MOVE @1:21.5,34
4600 PRINT @1:"DISTANCE IN METERS"
```

```
4610 REM ** PRINT INFORMATION ON SPREADS AND LOCATION **

4620 MOVE @1:0,25
4630 PRINT @1:"SP.1-to-SP.3  dist. = ";X5(12);" m"
4640 MOVE @1:55-LEN(C$)-LEN(E$),25
4650 PRINT @1:C$;" Co.,";E$
4660 MOVE @1:0,23
4670 PRINT @1:"SP.4-to-SP.2  dist. = ";X6(12);" m"
4680 IF S7=99 THEN 4700
4690 GO TO 4730
4700 MOVE @1:38,23
4710 PRINT @1:"Center of array is at:"
4720 GO TO 4760
4730 MOVE @1:36,23
4740 IMAGE 15A,5D,4A
4750 PRINT @1: USING 4740:"Array center is",N7," m N"
4760 MOVE @1:0,21
4770 PRINT @1:"Crossover from SP.1 = ";D1;" m"
4780 MOVE @1:35,21
4790 IMAGE 3A,5D,17A
4800 IF S7=99 THEN 4820
4810 GO TO 4850
4820 MOVE @1:38,21
4830 PRINT @1:"Latitude:  ";R$
4840 GO TO 4860
4850 PRINT @1: USING 4790:"and",E7," m E of SW corner"
4860 MOVE @1:0,19
4870 PRINT @1:"Crossover from SP.4 = ";D2;" m"
4880 IF S7=99 THEN 4900
4890 GO TO 4930
4900 MOVE @1:38,19
4910 PRINT @1:"Longitude:";T$
4920 GO TO 5040
4930 U$=", T."&T$
4940 U$=U$&"."
4950 T=LEN(U$)
4960 V$=" R."&R$
4970 V$=V$&"."
4980 R=LEN(V$)
4990 IF S7>9 THEN 5020
5000 MOVE @1:52-R-T,19
5010 GO TO 5030
5020 MOVE @1:51-R-T,19
5030 PRINT @1:"of sec.";S7;U$;V$
5040 MOVE @1:0,17
5050 PRINT @1:"Seis. int.,spread 1 = ";X5(3)-X5(2);" m"
5060 MOVE @1:38,17
5070 IMAGE 19A,3D
5080 PRINT @1: USING 5070:"Data stored in file",F1
5090 MOVE @1:0,15
5100 PRINT @1:"Seis. int.,spread 2 = ";X6(3)-X6(2);" m"
5110 MOVE @1:47-LEN(D$),15
5120 PRINT @1:"Surveyed on: ";D$
5130 MOVE @1:150,100
5140 PRINT "GGG       PROGRAM COMPLETED"
5150 END

5160 REM ** SUBROUTINE TO TABULATE DATA ENTERED **

5170 PRINT "L                          TABULATION OF DATA ENTERED"
```

```
5180 PRINT "_A$(Area name) = ";A$;"          Q$(Array number) = ";Q$
5190 PRINT "_                    D$(Date surveyed) = ";D$
5200 PRINT "                          ARRAY-CENTER LOCATION"
5210 IF S7=99 THEN 5230
5220 GO TO 5260
5230 PRINT "_R$(Latitude) = ";R$;"     S7 = ";S7;
5240 PRINT "_    T$(Longitude) = ";T$
5250 GO TO 5300
5260 PRINT "N7(dist N from SW corner) = ";N7;"       E7(dist E from SW";
5270 PRINT "corner) = ";E7
5280 PRINT "S7(section) = ";S7;"          T$(Township) = ";T$;
5290 PRINT "          R$(Range) = ";R$
5300 PRI "C$(county) = ";C$;"                          E$(state) = ";E$
5310 PRINT "                              ARRAY PARAMETERS"
5320 PRINT "A1(line & cross: N az. of spd 1; triangle: angle ";
5330 PRINT "opposite spd 1)="
5340 IMAGE 66X,3D.D
5350 PRINT "KK"
5360 PRINT USING 5340:A1
5370 PRINT "A2(line: N az. spd 2; cross: CCW ang. spd 2; tri: ang";
5380 PRINT " opp spd 2)="
5390 IMAGE 66X,3D.D
5400 PRINT "KK"
5410 PRINT USING 5390:A2
5420 PRINT "A3(line: spd 1 dist; cross: crossover spd 2; tri";
5430 PRINT ": ang opp spd 3)="
5440 IMAGE 66X,3D.D
5450 PRINT "KK"
5460 PRINT USING 5440:D1
5470 PRINT "A4(line: spd 2 dist; cross: crossover spd 1; tri";
5480 PRINT ": array azimuth)="
5490 IMAGE 66X,3D.D
5500 PRINT "KK"
5510 PRINT USING 5490:D2
5520 PRINT "_              SPREAD LENGTHS                    ";
5530 PRINT "_   ELEVATIONS"
5540 PRINT " J      X5(J)     X6(J)     X7(J)          ";
5550 PRINT " E1(J)     E2(J)     E3(J)"
5560 IMAGE 2D,3(4X,4D.D),8X,3(4X,4D.D)
5570 FOR J=1 TO 14
5580  PRINT USING 5560:J,X5(J),X6(J),X7(J),E1(J),E2(J),E3(J)
5590 NEXT J
5600 MOVE 0,0
5610 PRINT
5620 RETURN
```

Area: CROSS ARRAY, TEST#2 Array: 78-102



SP.1-to-SP.3 dist. = 160 m
SP.4-to-SP.2 dist. = 132 m
Crossover from SP.1 = 75 m
Crossover from SP.4 = 66 m
Sels. int., spread 1 = 10 m
Sels. int., spread 2 = 8 m

Jefferson Co., Colorado
Array center is 1023 m N
and 456 m E of SW corner
of sec.16, T.3S., R.67W.
Data stored in file 4
Surveyed on: Nov.16,1978

Figure 3. Sample problem for cross array

TABULATION OF DATA ENTERED

A$(Area name) = CROSS ARRAY,TEST#2 Q$(Array number) = 78-102
D$(Date surveyed) = Nov.16,1978

ARRAY-CENTER LOCATION

N7(dist N from SW corner) = 1023 E7(dist E from SWcorner) = 456
S7(section) = 16 T$(Township) = 3S R$(Range) = 67W
C$(county) = Jefferson E$(state) = Colorado

ARRAY PARAMETERS

A1(line & cross: N az. of spd 1; triangle: angle opposite spd 1)= 45.0
A2(line: N az. spd 2; cross: CCW ang. spd 2; tri: ang opp spd 2)= 95.0
A3(line: spd 1 dist; cross: crossover spd 2; tri: ang opp spd 3)= 75.0
A4(line: spd 2 dist; cross: crossover spd 1; tri: array azimuth)= 66.0

	SPREAD LENGTHS			ELEVATIONS		
J	X5(J)	X6(J)	X7(J)	E1(J)	E2(J)	E3(J)
1	0.0	0.0	0.0	1600.1	1601.5	0.0
2	30.0	30.0	0.0	1600.2	1601.3	0.0
3	40.0	38.0	0.0	1600.4	1601.2	0.0
4	50.0	46.0	0.0	1600.6	1601.0	0.0
5	60.0	54.0	0.0	1600.6	1600.9	0.0
6	70.0	62.0	0.0	1600.7	1600.7	0.0
7	80.0	70.0	0.0	1600.9	1600.8	0.0
8	90.0	78.0	0.0	1601.0	1600.6	0.0
9	100.0	86.0	0.0	1601.2	1600.4	0.0
10	110.0	94.0	0.0	1601.3	1600.3	0.0
11	120.0	102.0	0.0	1601.2	1600.2	0.0
12	160.0	132.0	0.0	1601.5	1600.4	0.0
13	8.0	6.0	0.0	1600.2	1601.4	0.0
14	9.0	7.0	0.0	1601.4	1600.3	0.0

Figure 4. Copy from screen of 4051 Graphic System showing array data entered for the plot of figure 3.

```
100 PRI "L              YOU HAVE SELECTED THE PROGRAM TO ENTER AND PLOT"
110 PRINT "                              TRIANGLE ARRAY DATA".
120 INIT
130 DIM E1(14),E2(14),E3(14),X5(14),X6(14),X7(14),U$(15),V$(15)
140 DIM A$(20),B$(5),C$(20),D$(13),E$(15),Q$(10),G$(1),R$(12),T$(12)
150 SET DEGREES
160 PRINT "  ARE DATA TO BE ENTERED FROM DATA TAPE? (YES=Y, NO=N) ";
170 INPUT G$
180 IF G$="N" THEN 210
190 GOSUB 1700
200 GO TO 1850

210 REM ** ENTER ARRAY DATA FROM KEYBOARD **

220 PRINT "  NAME OF AREA (LIMIT 20 LETTERS): ";
230 INPUT A$
240 PRINT "  ARRAY NUMBER = ";
250 INPUT Q$
260 PRINT "  DATE DATA WERE TAKEN = ";
270 INPUT D$
280 PRINT "  COUNTY IN WHICH DATA WERE TAKEN: ";
290 INPUT C$
300 PRINT " IN THE STATE OF: ";
310 INPUT E$
320 PRINT "  DO YOU WANT TO LOCATE ARRAY WITH LAT.& LONG.? ( Y OR N ) ";
330 INPUT G$
340 IF G$="N" THEN 580
350 N7=0
360 E7=0
370 PRINT "  LATITUDE OF ARRAY CENTER = ";
380 GOSUB 410
390 R$=U$
400 GO TO 530
410 INPUT L1
420 PRINT "K                                   deg, ";
430 INPUT L2
440 PRINT "K                                          min, ";
450 INPUT L3
460 PRINT "K                                                  sec"
470 L$=STR(L1)
480 U$=STR(L2)
490 U$=L$&U$
500 L$=STR(L3)
510 U$=U$&L$
520 RETURN
530 PRINT " LONGITUDE OF ARRAY CENTER = ";
540 GOSUB 410
550 T$=U$
560 S7=99
570 GO TO 680
580 PRINT "  TOWNSHIP = T";
590 INPUT T$
600 PRINT " RANGE = R";
610 INPUT R$
620 PRINT " SECTION = ";
630 INPUT S7
640 PRINT "  DISTANCE NORTH, IN METERS, FROM SW CORNER = ";
650 INPUT N7
660 PRINT " DISTANCE EAST, IN METERS, FROM SW CORNER = ";
670 INPUT E7
```

```
680 PRINT "_ NORTH AZIMUTH OF ARRAY IN DEGREES = ";
690 INPUT A4

700 REM ** ENTER SEISMOMETER DISTANCE AND ELEVATIONS **

710 PRINT "L INPUT SEIS. DIST. ALONG SPREAD 1 FROM SP-1 TO SP-2_"
720 X5(1)=0
730 PRINT "_ UPHOLE SEIS. OFFSET ALONG SPREAD 1 NEAR SP-1 = ";
740 INPUT X5(13)
750 PRINT "_ SEIS. NO.";"  DISTANCE FROM SP-1"
760 FOR J=2 TO 12
770  PRINT "     ";J;"             ";
780  INPUT X5(J)
790 NEXT J
800 PRINT "_ UPHOLE SEIS. OFFSET BACK ALONG SPREAD 1 FROM SP-2 = ";
810 INPUT X5(14)
820 S1=X5(12)
830 PRINT "L INPUT ELEV. ALONG SPREAD 1 FROM SP-1 TO SP-2_"
840 PRINT "_ ELEV. OF SP-1 = ";
850 INPUT E1(1)
860 PRINT "_ UPHOLE SEIS. ELEV. ALONG SPREAD 1 NEAR SP-1 = ";
870 INPUT E1(13)
880 PRINT "_ SEIS. NO.";"  ELEVATION ALONG SPREAD 1"
890 FOR J=2 TO 12
900  PRINT "     ";J;"               ";
910  INPUT E1(J)
920 NEXT J
930 PRINT "_ UPHOLE SEIS. ELEV. BACK ALONG SPREAD 1 FROM SP-2 = ";
940 INPUT E1(14)
950 PRINT "L INPUT DISTANCES ALONG SPREAD 2 FROM SP-3 TO SP-2"
960 X6(1)=0
970 PRINT "_ UPHOLE SEIS. OFFSET ALONG SPREAD 2 NEAR SP-3 = ";
980 INPUT X6(13)
990 PRINT "_ SEIS. NO.";"  DISTANCE FROM SP-3"
1000 FOR J=2 TO 12
1010  PRINT "     ";J;"               ";
1020  INPUT X6(J)
1030 NEXT J
1040 PRINT "_ UPHOLE SEIS. OFFSET BACK ALONG SPREAD 2 FROM SP-2 = ";
1050 INPUT X6(14)
1060 S2=X6(12)
1070 PRINT "L INPUT ELEVATIONS ALONG SPREAD 2 FROM SP-3 TO SP-2"
1080 PRINT "_ UPHOLE SEIS. ELEV. ALONG SPREAD 2 NEAR SP-3 = ";
1090 INPUT E2(13)
1100 PRINT "_ SEIS. NO.";"  ELEVATION ALONG SPREAD 2"
1110 FOR J=2 TO 12
1120  PRINT "     ";J;"               ";
1130  INPUT E2(J)
1140 NEXT J
1150 PRINT "_ UPHOLE SEIS. ELEV. BACK ALONG SPREAD 2 FROM SP-2 = ";
1160 INPUT E2(14)
1170 PRINT "L INPUT DISTANCES ALONG SPREAD 3 FROM SP-1 TO SP-3"
1180 X7(1)=0
1190 PRINT "_ UPHOLE SEIS. OFFSET ALONG SPREAD 3 NEAR SP-1 = ";
1200 INPUT X7(13)
1210 PRINT "_ SEIS. NO.";"  DISTANCE FROM SP-1"
1220 FOR J=2 TO 12
1230  PRINT "     ";J;"             ";
1240  INPUT X7(J)
1250 NEXT J
```

```
1260 PRINT "_ UPHOLE SEIS. OFFSET BACK ALONG SPREAD 3 FROM SP-3 = ";
1270 INPUT X7(14)
1280 PRINT "L INPUT ELEVATIONS ALONG SPREAD 3 FROM SP-1 TO SP-3"
1290 PRINT "_ UPHOLE SEIS. ELEV. ALONG SPREAD 3 NEAR SP-1 = ";
1300 INPUT E3(13)
1310 PRINT "_ SEIS. NO.";"  ELEVATION ALONG SPREAD 3"
1320 FOR J=2 TO 12
1330  PRINT "     ";J;"             ";
1340  INPUT E3(J)
1350 NEXT J
1360 E2(1)=E3(12)
1370 E3(1)=E1(1)
1380 PRINT "_ UPHOLE SEIS. ELEV. BACK ALONG SPREAD 3 FROM SP-3 = ";
1390 INPUT E3(14)
1400 S3=X7(12)
1410 A1=ACS((S2^2+S3^2-S1^2)/(2*S2*S3))
1420 A2=ACS((S1^2+S3^2-S2^2)/(2*S1*S3))
1430 A3=180-A1-A2
1440 PRINT "_ DO YOU WANT TO SEE THE DATA YOU'VE ENTERED? (Y OR N) ";
1450 INPUT G$
1460 IF G$="N" THEN 1480
1470 GOSUB 5170

1480 REM ** PROCEDURE TO CHANGE ENTERED DATA **

1490 PRINT "_ DO YOU WANT TO CHANGE ANY OF THESE DATA BEFORE THEY"
1500 PRINT "_ARE STORED ON TAPE OR ARE PLOTTED? (Y OR N) ";
1510 INPUT G$
1520 IF G$="N" THEN 1620
1530 PRINT "L   The procedure to make changes is as follows:"
1540 PRINT "_     1. Select variable (see printed list),and"
1550 PRINT "        the appropriate index;"
1560 PRINT "      2. Enter the new value, for example: if old value "
1570 PRINT "        of E2(4) was 1610.5, and you want to change it"
1580 PRINT "        to 1601.5, then enter E2(4)=1601.5;"
1590 PRINT "      3. Enter RUN 1620."
1600 PRINT "__"
1610 END
1620 PRINT "_ NOTE: IF YOU DON'T WANT TO PLOT THESE DATA,"
1630 PRINT "_       LEAVE 'LOAD' BUTTON OF 4662 DOWN"

1640 REM ** PROCEDURE TO PUT DATA ON ARRAY-DATA TAPE **

1650 PRINT "_ DO YOU WANT TO PUT THESE DATA ON TAPE? (YES=Y, NO=N) ";
1660 INPUT G$
1670 IF G$="N" THEN 1870
1680 GOSUB 1700
1690 GO TO 1770
1700 PRINT "GGG"
1710 PRINT "_ INSERT ARRAY DATA TAPE INTO THE 4924 TAPE UNIT "
1720 PRINT "_-------------------------------------------"
1730 PRINT "_ WITHIN WHICH FILE? ";
1740 INPUT F1
1750 FIND @2:F1
1760 RETURN
1770 WRITE @2:F1,A$,C$,D$,E$,Q$,R$,T$,A1,A2,A3,A4,E1,E2,E3,E7,N7,S7
1780 WRITE @2:X5,X6,X7
1790 CLOSE
1800 DELETE A$,C$,D$,E$,Q$,R$,T$,A1,A2,A3,A4,E1,E2,E3,E7,N7,S7
1810 DELETE X5,X6,X7
```

```
1820 DIM E1(14),E2(14),E3(14),E4(14),X5(14),X6(14),X7(14),V$(11)
1830 DIM A$(20),C$(12),D$(13),E$(15),G$(1),Q$(10),R$(15),T$(15),U$(15)
1840 FIND @2:F1
1850 READ @2:F1,A$,C$,D$,E$,Q$,R$,T$,A1,A2,A3,A4,E1,E2,E3,E7,N7,S7
1860 READ @2:X5,X6,X7

1870 REM ** SET PLOT PARAMETERS **

1880 S1=X5(12)
1890 S2=X6(12)
1900 S3=X7(12)
1910 S4=S1*SIN(A2)
1920 S=S4 MAX S3
1930 K=40/S
1940 B=0.5
1950 B1=30-S3*K/2
1960 B2=65-S4*K/2
1970 B3=S1*COS(A2)*K+B1
1980 B4=65+S4*K/2
1990 B5=30+S3*K/2

2000 REM ** PRINT TOP LABEL **

2010 MOVE @1:0,95
2020 PRINT @1,17:1.5,2.25
2030 PRINT @1:"Area: ";A$
2040 MOVE @1:60-1.5*(7+LEN(Q$)),95
2050 PRINT @1:"Array: ";Q$

2060 REM ** LABEL SHOTPOINTS AND SPREADS **

2070 MOVE @1:B3-3,B4+4
2080 PRINT @1:"SP-2"
2090 MOVE @1:B3,B4
2100 ROTATE -A1
2110 RMOVE @1:S2*K/2-6,9
2120 PRINT @1,25:-A1
2130 PRINT @1:"SPREAD-2"
2140 ROTATE 0
2150 MOVE @1:B5+2,B2-0.77
2160 PRINT @1,25:0
2170 PRINT @1:"SP-3"
2180 MOVE @1:24,B2-9.5
2190 PRINT @1:"SPREAD-3"
2200 MOVE @1:B1-7,B2-0.77
2210 PRINT @1:"SP-1"
2220 MOVE @1:B1,B2
2230 ROTATE A2
2240 RMOVE @1:S1*K/2-6,9
2250 PRINT @1,25:A2
2260 PRINT @1:"SPREAD-1"
2270 PRINT @1,25:0
2280 ROTATE 0
2290 PRINT @1,17:1,1.5

2300 REM ** PLOT SHOTPOINT AND SEIS. POSITIONS AND THEIR ELEVATIONS **

2310 IMAGE 5D.D
2320 MOVE @1:B1-8,B2-3
2330 PRINT @1: USING 2310:E1(1)
```

```
2340 MOVE @1:B1,B2
2350 GOSUB 3250
2360 PRINT @1,25:A2-90
2370 ROTATE A2
2380 RDRAW @1:X5(13)*K,0
2390 GOSUB 3370
2400 RMOVE @1:-0.52,8
2410 PRINT @1: USING 2310:E1(13)
2420 RMOVE @1:0.52,-8
2430 RDRAW @1:(X5(2)-X5(13))*K,0
2440 GOSUB 3370
2450 RMOVE @1:-0.52,8
2460 PRINT @1: USING 2310:E1(2)
2470 RMOVE @1:0.52,-8
2480 FOR J=3 TO 11
2490  RDRAW @1:(X5(J)-X5(J-1))*K,0
2500  GOSUB 3370
2510  RMOVE @1:-0.52,8
2520  PRINT @1: USING 2310:E1(J)
2530  RMOVE @1:0.52,-8
2540 NEXT J
2550 RDRAW @1:(X5(12)-X5(11)-X5(14))*K,0
2560 GOSUB 3370
2570 RMOVE @1:-0.52,8
2580 PRINT @1: USING 2310:E1(14)
2590 RMOVE @1:0.52,-8
2600 RDRAW @1:X5(14)*K,0
2610 ROTATE 0
2620 PRINT @1,25:0
2630 GOSUB 3250
2640 MOVE @1:B3-4,B4+2
2650 PRINT @1: USING 2310:E1(12)
2660 MOVE @1:B3,B4
2670 PRINT @1,25:90-A1
2680 ROTATE -A1
2690 RDRAW @1:X6(14)*K,0
2700 GOSUB 3370
2710 RMOVE @1:0.52,0
2720 PRINT @1: USING 2310:E2(14)
2730 RMOVE @1:-0.52,0
2740 RDRAW @1:(X6(12)-X6(11)-X6(14))*K,0
2750 GOSUB 3370
2760 RMOVE @1:0.52,0
2770 PRINT @1: USING 2310:E2(11)
2780 RMOVE @1:-0.52,0
2790 FOR J=10 TO 2 STEP -1
2800  RDRAW @1:(X6(J+1)-X6(J))*K,0
2810  GOSUB 3370
2820  RMOVE @1:0.52,0
2830  PRINT @1: USING 2310:E2(J)
2840  RMOVE @1:-0.52,0
2850 NEXT J
2860 RDRAW @1:(X6(2)-X6(13))*K,0
2870 GOSUB 3370
2880 RMOVE @1:0.52,0
2890 PRINT @1: USING 2310:E2(13)
2900 RMOVE @1:-0.52,0
2910 RDRAW @1:X6(13)*K,0
2920 ROTATE 0
2930 PRINT @1,25:0
```

```
2940 GOSUB 3250
2950 MOVE @1:B5+1,B2-3
2960 PRINT @1: USING 2310:E2(1)
2970 MOVE @1:B5,B2
2980 ROTATE 180
2990 PRINT @1,25:90
3000 RDRAW @1:X7(14)*K,0
3010 GOSUB 3370
3020 RMOVE @1:-0.52,8
3030 PRINT @1: USING 2310:E3(14)
3040 RMOVE @1:0.52,-8
3050 RDRAW @1:(X7(12)-X7(11)-X7(14))*K,0
3060 GOSUB 3370
3070 RMOVE @1:-0.52,8
3080 PRINT @1: USING 2310:E3(11)
3090 RMOVE @1:0.52,-8
3100 FOR J=10 TO 2 STEP -1
3110  RDRAW @1:(X7(J+1)-X7(J))*K,0
3120  GOSUB 3370
3130  RMOVE @1:-0.52,8
3140  PRINT @1: USING 2310:E3(J)
3150  RMOVE @1:0.52,-8
3160 NEXT J
3170 RDRAW @1:(X7(2)-X7(13))*K,0
3180 GOSUB 3370
3190 RMOVE @1:-0.52,8
3200 PRINT @1: USING 2310:E3(13)
3210 RMOVE @1:0.52,-8
3220 RDRAW @1:X7(13)*K,0
3230 ROTATE 0
3240 GO TO 3440

3250 REM ** SUBROUTINE FOR DRAWING OCTAGON AT SHOTPOINT LOCATION **

3260 RMOVE @1:-B,-B/2
3270 RDRAW @1:0,B
3280 RDRAW @1:B/2,B/2
3290 RDRAW @1:B,0
3300 RDRAW @1:B/2,-B/2
3310 RDRAW @1:0,-B
3320 RDRAW @1:-B/2,-B/2
3330 RDRAW @1:-B,0
3340 RDRAW @1:-B/2,B/2
3350 RMOVE @1:B,B/2
3360 RETURN

3370 REM ** SUBROUTINE FOR DRAWING TRIANGLES **

3380 RMOVE @1:-B,-0.577*B
3390 RDRAW @1:B,1.732*B
3400 RDRAW @1:B,-1.732*B
3410 RDRAW @1:-2*B,0
3420 RMOVE @1:B,0.577*B
3430 RETURN

3440 REM ** PLOT AND LABEL ARRAY DIRECTION ARROW **

3450 MOVE @1:B3,B4-4
3460 RDRAW @1:-0.5,-2
3470 RDRAW @1:0.5,1
```

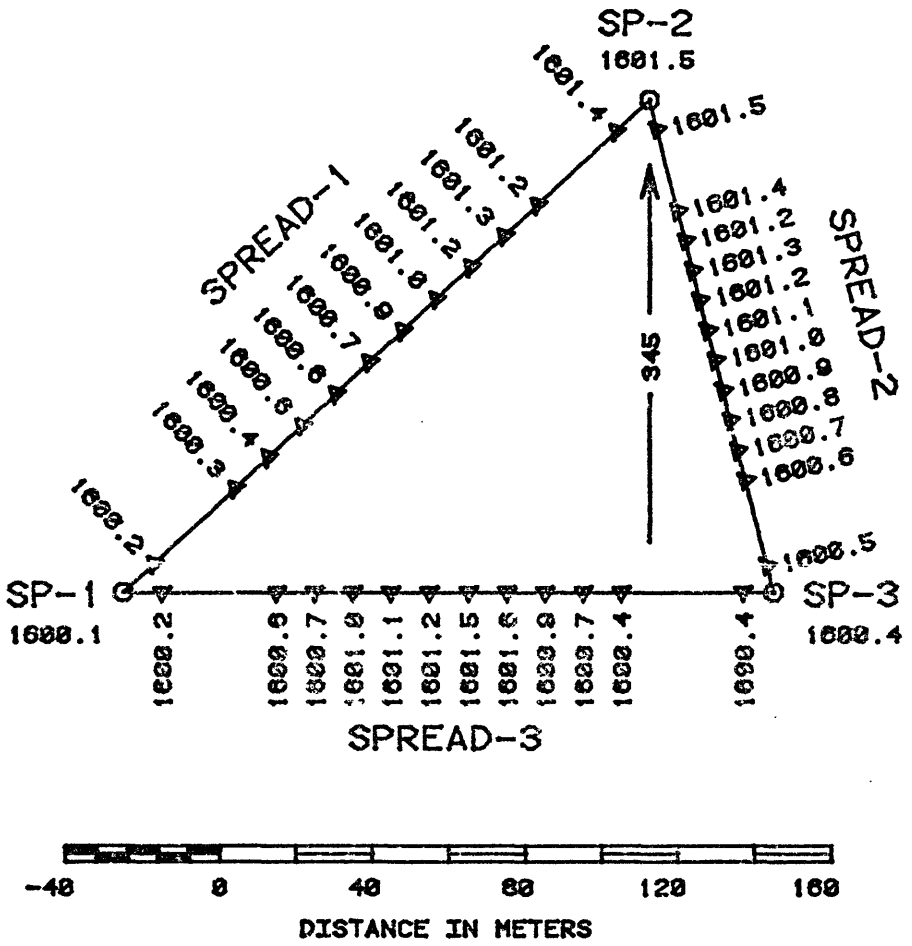
```
3480 RDRAW @1:0.5,-1
3490 RDRAW @1:-0.5,2
3500 L=1
3510 B$=STR(A4)
3520 L1=S4*K/2-4-LEN(B$)/2
3530 FOR J=1 TO 22
3540  IF L=>L1 THEN 3580
3550  RDRAW @1:0,-1
3560  L=L+1
3570 NEXT J
3580 RMOVE @1:0.52,-LEN(B$)-1
3590 PRINT @1:B$
3600 RMOVE @1:-0.52,0
3610 L=1
3620 FOR J=1 TO 22
3630  IF L=>L1 THEN 3670
3640  RDRAW @1:0,-1
3650  L=L+1
3660 NEXT J
3670 PRINT @1,25:0

3680 REM ** PRINT SCALE DIAGRAM **

3690 IF S>14 AND S<=35 THEN 3790
3700 IF S>35 AND S<=70 THEN 3810
3710 IF S>70 AND S<=105 THEN 3830
3720 IF S>105 AND S<=140 THEN 3850
3730 IF S>140 AND S<=175 THEN 3870
3740 IF S>175 AND S<=210 THEN 3890
3750 IF S>210 AND S<=315 THEN 3910
3760 IF S>310 THEN 3930
3770 W=1*K
3780 GO TO 3940
3790 W=2*K
3800 GO TO 3940
3810 W=5*K
3820 GO TO 3940
3830 W=10*K
3840 GO TO 3940
3850 W=15*K
3860 GO TO 3940
3870 W=20*K
3880 GO TO 3940
3890 W=25*K
3900 GO TO 3940
3910 W=40*K
3920 GO TO 3940
3930 W=50*K
3940 W1=0.4*W
3950 MOVE @1:30,35.5
3960 RMOVE @1:-5*W,-2
3970 FOR I=1 TO 5
3980  RDRAW @1:0,1
3990  RMOVE @1:W1,-1
4000 NEXT I
4010 FOR I=1 TO 8
4020  RDRAW @1:0,1
4030  RMOVE @1:W,-1
4040 NEXT I
4050 RDRAW @1:0,1
```

```
4060 RDRAW @1:-10*W,0
4070 RDRAW @1:0,-1
4080 RDRAW @1:10*W,0
4090 RDRAW @1:0,1/2
4100 FOR I=1 TO 4
4110  RDRAW @1:-W,0
4120  RMOVE @1:-W,0
4130 NEXT I
4140 RMOVE @1:0,3/8
4150 RDRAW @1:-W1,0
4160 RMOVE @1:-W1,0
4170 RDRAW @1:-W1,0
4180 RMOVE @1:-W1,0
4190 RDRAW @1:-W1,0
4200 RMOVE @1:0,-1/8
4210 RDRAW @1:W1,0
4220 RMOVE @1:W1,0
4230 RDRAW @1:W1,0
4240 RMOVE @1:W1,0
4250 RDRAW @1:W1,0
4260 RMOVE @1:0,-1/8
4270 RDRAW @1:-W1,0
4280 RMOVE @1:-W1,0
4290 RDRAW @1:-W1,0
4300 RMOVE @1:-W1,0
4310 RDRAW @1:-W1,0
4320 RMOVE @1:0,-1/8
4330 RDRAW @1:5*W1,0
4340 RMOVE @1:-W1,-1/8
4350 RDRAW @1:-W1,0
4360 RMOVE @1:-W1,0
4370 RDRAW @1:-W1,0
4380 RMOVE @1:0,-1/8
4390 RDRAW @1:W1,0
4400 RMOVE @1:W1,0
4410 RDRAW @1:W1,0
4420 RMOVE @1:0,-1/8
4430 RDRAW @1:-W1,0
4440 RMOVE @1:-W1,0
4450 RDRAW @1:-W1,0
4460 RMOVE @1:-(W1+10/3),-17/8
4470 IMAGE D
4480 IMAGE 4D
4490 PRINT @1: USING 4480:-2*W/K
4500 RMOVE @1:2*W+3,0
4510 PRINT @1: USING 4470:0
4520 RMOVE @1:2*W-3,0
4530 PRINT @1: USING 4480:2*W/K
4540 RMOVE @1:2*W,0
4550 PRINT @1: USING 4480:4*W/K
4560 FOR I=3 TO 4
4570  RMOVE @1:2*W,0
4580  PRINT @1: USING 4480:2*W*I/K
4590 NEXT I
4600 MOVE @1:21,29
4610 PRINT @1:"DISTANCE IN METERS"

4620 REM ** PRINT SPREAD AND LOCATION INFORMATION **

4630 MOVE @1:0,25
```

```
4640 PRINT @1:"SP.1-to-SP.2  dist. = ";X5(12);" m"
4650 MOVE @1:55-LEN(C$)-LEN(E$),25
4660 PRINT @1:C$;" Co.,";E$
4670 MOVE @1:0,23
4680 PRINT @1:"SP.3-to-SP.2  dist. = ";X6(12);" m"
4690 IF S7=99 THEN 4710
4700 GO TO 4740
4710 MOVE @1:38,23
4720 PRINT @1:"Center of array is at:"
4730 GO TO 4770
4740 MOVE @1:36,23
4750 IMAGE 15A,5D,4A
4760 PRINT @1: USING 4750:"Array center is",N7," m N"
4770 MOVE @1:0,21
4780 PRINT @1:"SP.1-to-SP.3  dist. = ";X7(12);" m"
4790 IF S7=99 THEN 4810
4800 GO TO 4840
4810 MOVE @1:38,21
4820 PRINT @1:"Latitude:  ";R$
4830 GO TO 4870
4840 MOVE @1:35,21
4850 IMAGE 3A,5D,17A
4860 PRINT @1: USING 4850:"and",E7," m E of SW corner"
4870 MOVE @1:0,19
4880 PRINT @1:"Seis. int.,spread 1 = ";X5(3)-X5(2);" m"
4890 IF S7=99 THEN 4910
4900 GO TO 4940
4910 MOVE @1:38,19
4920 PRINT @1:"Longitude:";T$
4930 GO TO 5050
4940 U$=", T."&T$
4950 U$=U$&".,"
4960 T=LEN(U$)
4970 V$=" R."&R$
4980 V$=V$&"."
4990 R=LEN(V$)
5000 IF S7>9 THEN 5030
5010 MOVE @1:52-R-T,19
5020 GO TO 5040
5030 MOVE @1:51-R-T,19
5040 PRINT @1:"of sec.";S7;U$;V$
5050 MOVE @1:0,17
5060 PRINT @1:"Seis. int.,spread 2 = ";X6(3)-X6(2);" m"
5070 MOVE @1:38,17
5080 IMAGE 19A,3D
5090 PRINT @1: USING 5080:"Data stored in file",F1
5100 MOVE @1:0,15
5110 PRINT @1:"Seis. int.,spread 3 = ";X7(3)-X7(2);" m"
5120 MOVE @1:47-LEN(D$),15
5130 PRINT @1:"Surveyed on: ";D$
5140 MOVE @1:150,100
5150 PRINT "GGG      PROGRAM COMPLETED"
5160 END

5170 REM ** SUBROUTINE TO TABULATE DATA ENTERED **

5180 PRINT "L                    TABULATION OF DATA ENTERED"
5190 PRINT "_A$(Area name) = ";A$;"          Q$(Array number) = ";Q$
5200 PRINT "                    D$(Date surveyed) = ";D$
5210 PRINT "_                        ARRAY-CENTER LOCATION"
```

```
5220 IF S7=99 THEN 5240
5230 GO TO 5270
5240 PRINT "_R$(Latitude) = ";R$;"     S7 = ";S7;
5250 PRINT "_     T$(Longitude) = ";T$
5260 GO TO 5310
5270 PRINT "N7(dist N from SW corner) = ";N7;"       E7(dist E from SW";
5280 PRINT "corner) = ";E7
5290 PRINT "S7(section) = ";S7;"          T$(Township) = ";T$;
5300 PRINT "          R$(Range) = ";R$
5310 PRI "C$(county) = ";C$;"                         E$(state) = ";E$
5320 PRINT "                              ARRAY PARAMETERS"
5330 PRINT "A1(line & cross: N az. of spd 1; triangle: angle ";
5340 PRINT "opposite spd 1)="
5350 IMAGE 66X,3D.D
5360 PRINT "KK"
5370 PRINT USING 5350:A1
5380 PRINT "A2(line: N az. spd 2; cross: CCW ang. spd 2; tri: ang";
5390 PRINT " opp spd 2)="
5400 IMAGE 66X,3D.D
5410 PRINT "KK"
5420 PRINT USING 5400:A2
5430 PRINT "A3(line: spd 1 dist; cross: crossover spd 2; tri";
5440 PRINT ": ang opp spd 3)="
5450 IMAGE 66X,3D.D
5460 PRINT "KK"
5470 PRINT USING 5450:A3
5480 PRINT "A4(line: spd 2 dist; cross: crossover spd 1; tri";
5490 PRINT ": array azimuth)="
5500 IMAGE 66X,3D.D
5510 PRINT "KK"
5520 PRINT USING 5500:A4
5530 PRINT "              SPREAD LENGTHS                    ";
5540 PRINT "_   ELEVATIONS"
5550 PRINT " J      X5(J)     X6(J)     X7(J)          ";
5560 PRINT " E1(J)     E2(J)     E3(J)"
5570 IMAGE 2D,3(4X,4D.D),8X,3(4X,4D.D)
5580 FOR J=1 TO 14
5590  PRINT USING 5570:J,X5(J),X6(J),X7(J),E1(J),E2(J),E3(J)
5600 NEXT J
5610 MOVE 0,0
5620 PRINT
5630 RETURN
```

Area: TRIANGLE, TEST#3A Array: 78-104



SP.1-to-SP.2 dist. = 166 m
SP.3-to-SP.2 dist. = 132 m
SP.1-to-SP.3 dist. = 170 m
Sels. Int., spread 1 = 12 m
Sels. Int., spread 2 = 8 m
Sels. Int., spread 3 = 10 m

Campbell Co., Wyoming
Center of array is at:
Latitude: 44 52 36.2
Longitude: 105 43 21.6
Data stored in file 7
Surveyed on: Nov.17, 1978

Figure 5. Sample problem for triangle array

TABULATION OF DATA ENTERED

A$(Area name) = TRIANGLE,TEST#3A Q$(Array number) = 78-104
D$(Date surveyed) = Nov.17,1978

ARRAY-CENTER LOCATION

R$(Latitude) = 44 52 36.2 S7 = 99 T$(Longitude) = 105 43 21.6
C$(county) = Campbell E$(state) = Wyoming

ARRAY PARAMETERS

A1(line & cross: N az. of spd 1; triangle: angle opposite spd 1)= 75.8
A2(line: N az. spd 2; cross: CCW ang. spd 2; tri: ang opp spd 2)= 42.9
A3(line: spd 1 dist; cross: crossover spd 2; tri: ang opp spd 3)= 61.3
A4(line: spd 2 dist; cross: crossover spd 1; tri: array azimuth)= 345.0

	SPREAD LENGTHS			ELEVATIONS		
J	X5(J)	X6(J)	X7(J)	E1(J)	E2(J)	E3(J)
1	0.0	0.0	0.0	1600.1	1600.4	1600.1
2	40.0	30.0	40.0	1600.3	1600.6	1600.6
3	52.0	38.0	50.0	1600.4	1600.7	1600.7
4	64.0	46.0	60.0	1600.5	1600.8	1601.0
5	76.0	54.0	70.0	1600.6	1600.9	1601.1
6	88.0	62.0	80.0	1600.7	1601.0	1601.2
7	100.0	70.0	90.0	1600.9	1601.1	1601.5
8	112.0	78.0	100.0	1601.0	1601.2	1601.6
9	124.0	86.0	110.0	1601.2	1601.3	1600.9
10	136.0	94.0	120.0	1601.3	1601.2	1600.7
11	148.0	102.0	130.0	1601.2	1601.4	1600.4
12	188.0	132.0	170.0	1601.5	1601.5	1600.4
13	11.0	7.0	10.0	1600.2	1600.5	1600.2
14	12.0	8.0	8.0	1601.4	1601.5	1600.4

Figure 6. Copy from screen of 4051 Graphic System showing array data entered for the plot of figure 5.

```
100 PRINT "L          YOU HAVE SELECTED THE PROGRAM TO READ OR"
110 PRINT "       CHANGE THE DATA STORED ON AN ARRAY DATA TAPE"
120 INIT
130 DIM A$(20),C$(12),D$(13),E$(15),G$(1),Q$(10),R$(12),T$(12)
140 DIM E1(14),E2(14),E3(14),X5(14),X6(14),X7(14)
150 PRINT "GGG"
160 PRINT "__INSERT ARRAY DATA TAPE INTO THE 4924 UNIT"
170 PRINT "_----------------------------------------"
180 PRINT "_ WITHIN WHICH FILE ARE ARRAY DATA STORED? ";
190 INPUT F1
200 FIND @2:F1
210 READ @2:F1,A$,C$,D$,E$,Q$,R$,T$,A1,A2,A3,A4,E1,E2,E3,E7,N7,S7
220 READ @2:X5,X6,X7
230 PRINT "_ DO YOU WANT TO PRINT DATA CONTAINED WITHIN THIS FILE?";
240 PRINT "_( Y OR N ) ";
250 INPUT G$
260 IF G$="N" THEN 280
270 GOSUB 560
280 PRINT "_ DO YOU WANT TO CHANGE ANY DATA IN THIS FILE ( Y OR N ) ";
290 INPUT G$
300 IF G$="N" THEN 390
310 PRINT "_ The procedure to change data is as follows:"
320 PRINT "    1. Select variable name (from the printed list),and"
330 PRINT "       select appropriate index;"
340 PRINT "    2. Enter the new value, for example: if old value of"
350 PRINT "       of E2(4) was 1610.5 and you wish to change it"
360 PRINT "       to 1601.5, then enter E2(4)=1601.5;"
370 PRINT "    3. Enter RUN 400."
380 PRINT "__"
390 END
400 FIND @2:F1
410 WRITE @2:F1,A$,C$,D$,E$,Q$,R$,T$,A1,A2,A3,A4,E1,E2,E3,E7,N7,S7
420 WRITE @2:X5,X6,X7
430 CLOSE
440 DELETE A$,C$,D$,E$,Q$,R$,T$,A1,A2,A3,A4,E1,E2,E3,E7,N7,S7
450 DELETE X5,X6,X7
460 DIM A$(20),C$(12),D$(13),E$(15),G$(1),Q$(10),R$(12),T$(12)
470 DIM E1(14),E2(14),E3(14),X5(14),X6(14),X7(14)
480 FIND @2:F1
490 READ @2:F1,A$,C$,D$,E$,Q$,R$,T$,A1,A2,A3,A4,E1,E2,E3,E7,N7,S7
500 READ @2:X5,X6,X7
510 PRINT "__ DO YOU WANT TO PRINT THESE DATA? ( Y=YES, N=NO ) ";
520 INPUT G$
530 IF G$="N" THEN 550
540 GOSUB 560
550 END

560 REM ** SUBROUTINE TO PRINT OUT FILE CONTENTS **

570 PRINT "L                  CONTENTS OF FILE ";F1;" OF ARRAY DATA TAPE"
580 PRINT "_A$(Area name) = ";A$;"          Q$(Array number) = ";Q$
590 PRINT "_                    D$(Date surveyed) = ";D$
600 PRINT "                        ' ARRAY-CENTER LOCATION"
610 IF S7=99 THEN 630
620 GO TO 660
630 PRINT "_R$(Latitude) = ";R$;
640 PRINT "_                  T$(Longitude) = ";T$
650 GO TO 700
660 PRINT "N7(dist N from SW corner) = ";N7;"       E7(dist E from SW";
670 PRINT " corner) = ";E7
```

```
680 PRINT "S7(section) = ";S7;"          T$(Township) = ";T$;
690 PRINT "          R$(Range) = ";R$
700 PRINT "C$(county) = ";C$;"                          E$(state) = ";E$
710 PRINT "_                          ARRAY PARAMETERS"
720 PRINT "A1(line & cross: N az. of spd 1; triangle: angle ";
730 PRINT "opposite spd 1)="
740 IMAGE 66X,3D.D
750 PRINT "KK"
760 PRINT USING 740:A1
770 PRINT "A2(line: N az. spd 2; cross: CCW ang. spd 2; tri: ang";
780 PRINT " opp spd 2)="
790 IMAGE 66X,3D.D
800 PRINT "KK"
810 PRINT USING 790:A2
820 PRINT "A3(line: spd 1 dist; cross: crossover spd 2; tri";
830 PRINT ": ang opp spd 3)="
840 IMAGE 66X,3D.D
850 PRINT "KK"
860 PRINT USING 840:A3
870 PRINT "A4(line: spd 2 dist; cross: crossover spd 1; tri";
880 PRINT ": array azimuth)="
890 IMAGE 66X,3D.D
900 PRINT "KK"
910 PRINT USING 890:A4
920 PRINT "_              SPREAD LENGTHS                    ";
930 PRINT "_   ELEVATIONS"
940 PRINT " J      X5(J)     X6(J)     X7(J)          ";
950 PRINT " E1(J)     E2(J)     E3(J)"
960 IMAGE 2D,3(4X,4D.D),8X,3(4X,4D.D)
970 FOR J=1 TO 14
980  PRINT USING 960:J,X5(J),X6(J),X7(J),E1(J),E2(J),E3(J)
990 NEXT J
1000 RETURN
```

```
100 PRINT "L       YOU HAVE SELECTED THE PROGRAM TO MARK ARRAY-DATA"
110 PRINT "              TAPES, AND TO SET UP CONTENTS LIST"
120 DIM G$(1)
130 PRINT "GGG"
140 PRINT "_ SET TAPE TO BE MARKED INTO THE 4051"
150 PRINT "_ ARE YOU READY TO PROCEED? ( Y OR N ) ";
160 INPUT G$
170 IF G$="N" THEN 150
180 FIND 1
190 MARK 1,2048
200 FIND 1
210 SAVE 260,350
220 FIND 2
230 MARK 80,3072
240 FIND 1
250 PRINT "GGG";"_ PROGRAM COMPLETED"
260 PRINT "L                    YOU HAVE SELECTED AN ARRAY DATA TAPE"
270 PRINT "                          WHEN NEW DATA ARE ADDED,"
280 PRINT "                   BE SURE TO UPDATE THE CONTENTS LIST!"
290 PRINT "                                CONTENTS"
300 PRINT "                               --------"
310 PRINT "_FILE NO.  AREA                 ARRAY NUMBER          DATE";
320 PRINT " SURVEYED "
330 PRINT "   1      Contents"
340 PRINT "_ 11/17/78"
350 END
```