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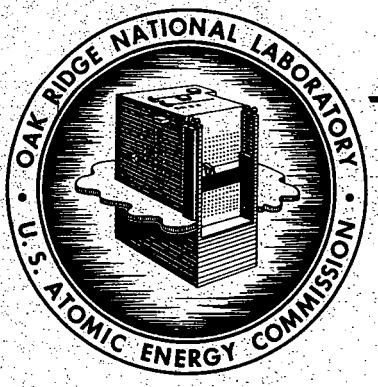

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Abstract

A CDC-1604 subroutine package has been written to facilitate the plotting of curves and points on linear, logarithmic, and semilogarithmic graphs using the CALCOMP plotter. The subroutines accomplish the necessary computations and prepare a magnetic tape for use by the plotter.

The CALCOMP Digital Incremental Plotter may be used to plot curves and points from data placed on tape by the CDC-1604 or certain other computers. A FORTRAN subroutine package has been written to aid the programmer when making linear, log-log, or semilog plots. These routines make use of subroutines described by Cavin.[1] The package is very similar to an IBM-7090 package described previously[2] but had to be completely rewritten to make use of the new CDC-1604 routines described in Ref. 1. In the explanation which follows, a knowledge of FORTRAN will be assumed.

The height of the graphs is fixed at 10 in. but the width is under control of the user. The width of the plotting area should be set at 7 in. if an 8-1/2 x 11 in. graph is desired. The number of cycles is optional and so blank paper should be used in general but, with care, lined paper may also be used. There are three lines drawn per cycle at the values 10^N, 2×10^N, and 5×10^N.

The number of vertical lines drawn on the semilog and linear grids and the number of horizontal lines drawn on the linear grid are under the control of the user. Each line is labeled. The spacing between lines (called an "interval") is a parameter needed by the routines. Various labeling fixed-point formats are used to ensure at least two-figure accuracy on the x axis (independent variable) and at least three-figure accuracy on the y axis (dependent variable). To avoid truncation error in the labeling, the values of the interval should conform to the above specified accuracy. The maximum limits of the linear variables are -999 and 9999.

Data points may be shown, or curves drawn, or both done as desired. If any data points lie outside the range specified for the graph, these points will not be plotted. The entire curve will be drawn except for portions connecting points which do not lie on the graph. The various data points available are shown in Fig. 1. A curve is drawn by connecting

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1. D. K. Cavin, "CALCOMP Plotter Subroutine Package," unpublished memorandum.

2. D. K. Trubey and M. B. Emmett, "An IBM-7090 Subroutine Package for Making Logarithmic and Semilogarithmic Graphs Using the CALCOMP Plotter," ORNL-TM-430 (Dec. 12, 1962) (see also Supplement ORNL-TM-430, Feb. 27, 1963).

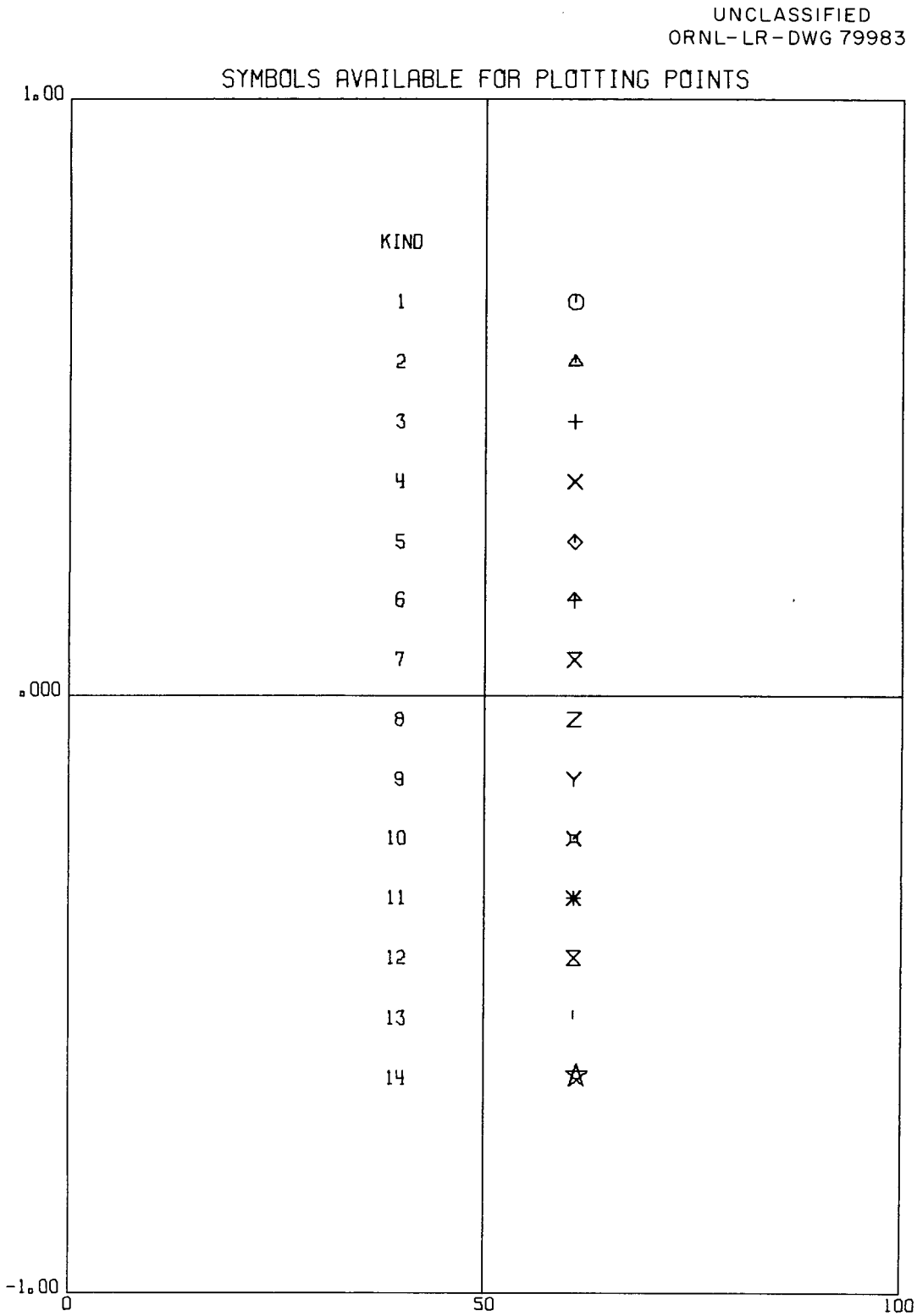

Fig. 1. Example of Linear Grid Showing Symbols Available for Plotting Points.

given points by straight lines. An option in the subroutine POINT allows one to mark the point only or draw a straight line to the point before marking it. If it is desired to fit a curve through a number of data points, a large number of values may be generated between data points by Lagrangian interpolation[3] or by some other means. Then straight lines are drawn between these points.

The axes may be labeled and a title written at the top of the graph through a subroutine which uses Hollerith characters.

The logical tape assignment is a parameter supplied to the subroutine. The user writes a main program which calls the various subroutines of the package as desired. The parameters in the call statements are integers or floating point numbers consistent with FORTRAN nomenclature. The use of each part of the package is as follows:

1. MAIN (calling program supplied by user)

   (a) Must have a 6-cell array for passing information from one subroutine to another.

   (b) Must call LINEAR, SEMILOG, or LOGLOG before calling any other routine (except HOLLER) in the package.

2. LOGLOG

   The routine is called by

   ```
   CALL LOGLOG(NCY,ITOPY,ITOPX,NCX,WIDTH,JTAPE,A)
   ```

   where

   NCY = number of cycles of dependent variable (y).

   ITOPY = largest exponent of 10 on y axis; the largest possible value of y is 10^{ITOPY}.

   ITOPX = largest exponent of 10 on x axis.

   NCX = number of cycles of independent variable (x).

---

3. S. K. Penny and M. B. Emmett, "An IBM-7090 Subroutine Package for Lagrangian Interpolation," ORNL-3428 (1962).

WIDTH = width of plotting area in inches.

JTAPE = logical tape unit used for CALCOMP tape.

A = 6-cell array described for main routine (Sec. 1a).

This routine performs initialization which includes drawing the grid. An example is shown in Fig. 2.

3. SEMLOG

The routine is called by

CALL SEMLOG(NCY,ITOPY,XZERO,DELX,NOINT,WIDTH,JTAPE,A)

where

NCY = number of cycles of dependent variable (y).

ITOPY = largest exponent of 10 on y axis.

XZERO = smallest value of x.

DELX = "interval" width (described above) on x axis or space between grid lines in units of the x variable. (In Fig. 3, DELX = 2.)

NOINT = number of "intervals" along x axis. The largest value of x is XZERO + NOINT * DELX. (In Fig. 3, NOINT = 5.)

WIDTH = width of plotting area in inches.

JTAPE = logical tape unit used for CALCOMP tape.

A = 6-cell array described for main routine.

This routine initializes and draws the grid.

4. LINEAR

The routine is called by

CALL LINEAR(YZERO,DELY,NOINTY,XZERO,DELX,NOINTX,WIDTH,JTAPE,A)

where

YZERO = smallest value of dependent variable (y).

DELY = "interval" width on y axis or space between grid lines in units of the y variable.

NOINTY = number of "intervals" along y axis. The largest value of y is YZERO + NOINTY * DELY.

XZERO = smallest value of independent variable (x).

DELX = "interval" width along x axis.

NOINTX = number of "intervals" along x axis.

WIDTH = width of plotting area in inches.

JTAPE = logical tape unit used for CALCOMP tape.

A = 6-cell array described for main routine.

5. CURVE

The routine is called by

CALL CURVE(N,X,Y,A)

where

N = 1 for the first point on a curve
≠ 1 for second and subsequent points.

X = value of x.

Y = value of y.

A = 6-cell array described for main routine.

The routine must be called for every point (x,y) on the curve to be plotted. A straight line will be drawn between successive points provided both points are on the graph. Each time CURVE is called, the pen moves to (x,y), with the pen either up (N=1) or down (N≠1). The value of N must be 1 for the first point on the curve. If the points are supplied by means of a loop, it is often convenient to set the value of N equal to the loop index.

6. POINT

The routine is called by

CALL POINT(N,X,Y,KIND,SIZE,THETA,I,A)

where

N = 1 for the first point on a curve (see definition of I)
≠ 1 for the second and subsequent points.

X = value of x.

Y = value of y.

KIND = type of symbol to be plotted (see Fig. 1); $1 \leq KIND \leq 14$.

SIZE = height of field of character to be plotted. For best results, SIZE should be an integral multiple of 0.04. In Fig. 1, SIZE = 0.12; in Figs. 2 and 3, SIZE = 0.08.

THETA = angle (counterclockwise) in degrees at which the point symbol is to be rotated. (In Fig. 1, THETA=0.)

I = curve option
= 1 for point symbols only (value of N immaterial)
≥ 2 for point symbols plus a straight line drawn from previous point to (x,y).

A = 6-cell array described for main routine.

7. LETTER

The purpose of this subroutine is to label the x axis and y axis or to provide a title at the top. The routine is called by

CALL LETTER(LPOS,NL,nH----,A)

where

LPOS = lettering position
= 0 for a title at the top
= 1 for x axis labeling
= 2 for y axis labeling.

NL = number of Hollerith characters (including spaces).

n = NL.

---- = Hollerith characters.

A = 6-cell array described for main routine.

The Hollerith array will be centered and will be of a size shown in the figures. There will be 8.33 characters plotted per inch. Thus the limit of characters depends on the field width. If LPOS = 2, the field width (graph height) is 10 in. Otherwise it is the graph width.

If a title is read into memory with input cards using HOLLER, the parameter nH--- is replaced by TITLE in the call statement (see Sec. 9).

8. EXPON

This routine will provide an exponent for any of the Hollerith characters provided by LETTER. The routine is called by

CALL EXPON(LPOS,NL,L,1H-,A)

where

LPOS = lettering position (see Sec. 7).

NL = number of Hollerith characters in corresponding LETTER statement.

L = position of exponent, the Lth character will have the exponent.

\- = exponent desired.

A = 6-cell array described for main routine.

9. HOLLER

This routine will read a title from input cards (via input tape) for use in LETTER. This provides flexibility in that the main program need not contain Hollerith titling. The routine is called by

CALL HOLLER(NL,TITLE,INTAPE)

where

NL = number of Hollerith characters to be read in (including blanks) starting in col. 1.

TITLE = array for storing the Hollerith characters (dimensioned by NL/8 or larger).

INTAPE = logical number of input tape.

The input for HOLLER is as follows:

CARD 1	FORMAT (I5)	NL.
CARD 2	FORMAT(9A8)	Hollerith title.

10. ADVANCE

The routine is called by

CALL ADVANCE(A)

(where A = 6-cell array described for main program). The routine must be called at the conclusion of each graph. The paper is then advanced, ready for the next plot.

Copies of the source or object decks may be obtained from the authors.

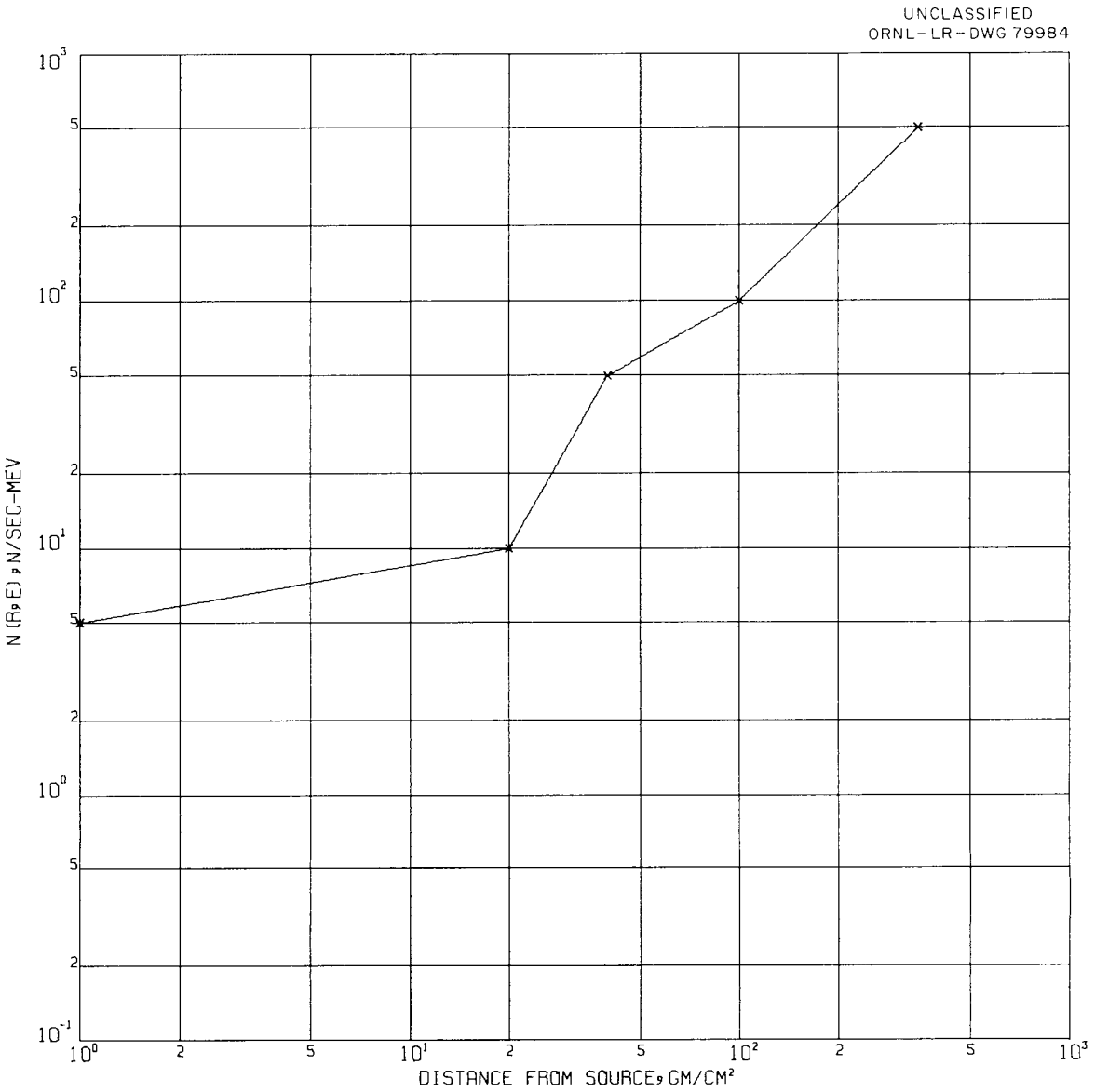

Fig. 2. Example of Log-Log Plot.

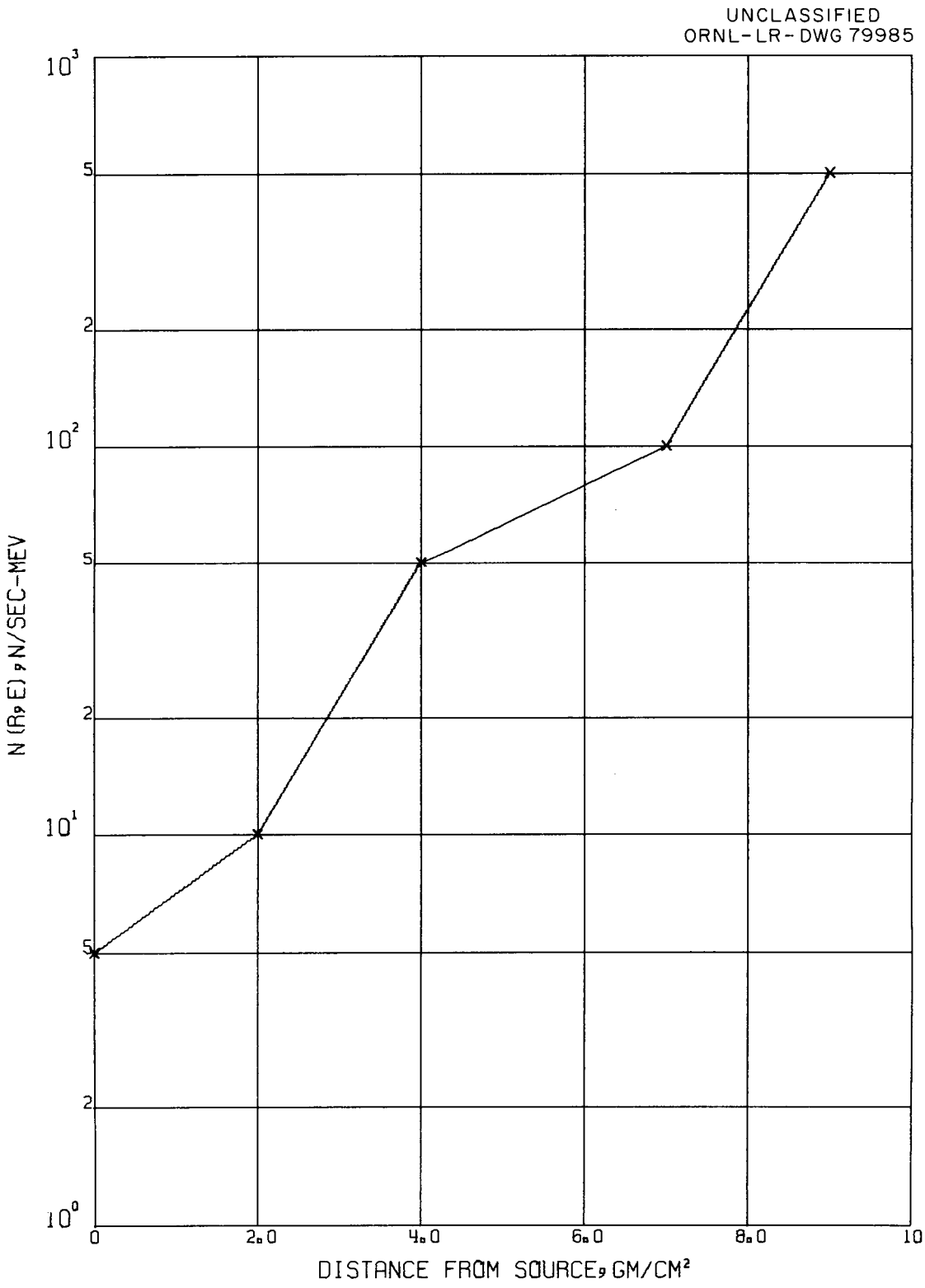

Fig. 3. Example of Semi-Log Plot.

Appendix

The following subroutines are in the package and consequently none of the user's routines can have the same names.

General Purpose CALCOMP Routines

NUMBER

SYMBOL

PLOT

PLOTS

Special Routines for the Present Package

RS

TENS

XTENS

YS

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74. C. D. Goodman
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76. D. A. Griffin
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79. M. T. Harkrider
80. C. A. Horton
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82. W. H. Jordan
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85. W. E. Kinney
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