

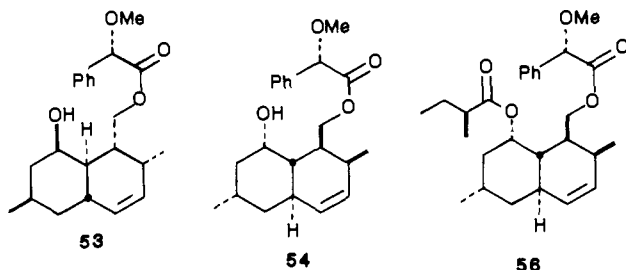
Additions and Corrections

Total Synthesis of (+)-Dihydromevinolin [*J. Am. Chem. Soc.* **1986**, *108*, 4586-4594]. SCOTT J. HECKER and CLAYTON H. HEATHCOCK*

The use of a sample of (*S*)-(+)-*O*-methylmandelic acid incorrectly labeled as (*R*)-(+)-*O*-methylmandelic acid resulted in several text and structure errors in this publication.

Abstract, page 4586, line 7 should read: Selective DCC-promoted esterification with (*S*)-(+)-*O*-methylmandelic acid ...

Body, page 4590, Scheme IX, and page 4591, eq 4: The structures of compounds **53**, **54**, and **56**, drawn originally with the (*R*)-isomer of the resolving agent, are shown correctly below. Reagent (g) in Scheme IX should read: (*S*)-(+)-PhCH(OMe)CO₂H.



Page 4590, column 2, line 14 should read: Selective esterification of **52** with (*S*)-(+)-*O*-methylmandelic acid ...

Page 4591, column 1, line 11 should read: The (*S*)-*O*-methylmandelate ester would be expected ...

Page 4591, footnote 26 refers the reader to a paper by G. Barth et al. *J. Am. Chem. Soc.* **1970**, *92*, 875; footnote 20 of the Barth paper incorrectly reports that (*S*)-(-)-methyl *O*-methylmandelate has $[\alpha]^{25} -124^\circ$ (neat). Our footnote 26 should read: (*S*)-(+)-*O*-Methylmandelic acid has $[\alpha]^{25} +151^\circ$ (see ref 33 this paper).

Experimental Section, page 4593, column 1: The name of compounds **53** and **54** should read: (1*S*,2*S*,4*R*,5*S*,6*S*,7*R*,8*S*,8*a**S*)-1,2,4*a*,5,6,7,8,8*a*-octahydro-2,6-dimethyl-8-hydroxy-1-((*S*)-(*O*-methylmandelyloxy)methyl)naphthalene.

Page 4593, column 1, line 33 should read: To a stirring solution of diol **52** ..., (*S*)-(+)-*O*-methylmandelic acid ... and DMAP ... was added ...

Page 4593, column 1: The name of compound **56** should read: (1*S*,2*S*,4*R*,6*S*,8*S*,8*a**S*)-1,2,4*a*,5,6,7,8,8*a*-octahydro-2,6-dimethyl-8-((*S*)-(2-methylbutyryloxy)-1-((*S*)-(*O*-methylmandelyloxy)methyl)naphthalene).

Tetratellurafulvalene (TTeF) [*J. Am. Chem. Soc.* **1987**, *109*, 4115-4116]. RICHARD D. MCCULLOUGH, GAIK B. KOK, KNUD A. LERSTRUP, and DWAIN O. COWAN

We were remiss in not citing Hünig and co-workers as one of the groups to first prepare tetrathiafulvalene (TTF).¹ We regret this oversight.

Page 4116, column 1, line 12: The temperature -20°C , should read -70°C .

(1) (a) Zahradnik, R.; Carsky, P.; Hünig, S.; Kiesslich, G.; Scheut-zow, D. *Int. J. Sulfur Chem.* **1971**, *6*, 109. (b) Kiesslich, G. Ph.D. Dissertation, University of Würzburg, 1968. (c) Hünig, S.; Kiesslich, G.; Quast, H.; Scheut-zow, D. *Liebigs Ann. Chem.* **1973**, 310.

Characterization of an Endogenous Factor Controlling the Cell Cycle of Complex Tissues [*J. Am. Chem. Soc.* **1987**, *109*, 5858-5859]. DAVID G. LYNN,* KEEVE JAFFE, MICHAEL CORNWELL, and WILLIAM TRAMONTANO

Page 5858: In the published communication Michael Cornwell's name was misspelled as Cornwall.

Computer Software Reviews

Graph-Pad Graph Plotter and Digitizer. By Harvey Motulsky. Academic Press, Inc.: Orlando, FL 32887. List price \$340.00.

Graph-Pad is a program designed to enter, display, manipulate, and plot data on standard plotters (such as the IBM 7371, IBM 1742, HP 7470A, or HP 7475a) with use of the IBM PC or other compatible microcomputers. The hardware requirements of the program are an IBM PC, XT, or AT with at least 256K of memory and a serial port (or equivalent). Also requires is PC-DOS or MS-DOS system software. The software is copy protected, requiring insertion of the master disk on startup although backup copies are able to perform all functions other than actual plotting.

Data for plotting may be entered via the keyboard by using a spreadsheet type input, via the plotter itself through digitizing by using existing diagrams, or from another program. The program can graph data as a curve in various line styles, as points using different symbols, with error bars, or as bar graphs. Options are included to position and size the graph and its axes. Labels may be placed anywhere on the graph and may use subscripts, superscripts, and special characters. Data once entered, either from the spreadsheet or digitized input, may be conveniently saved to or read from a disk.

Graph-Pad is unusually easy to use. Menus are displayed with an effective use of highlighting or color and positioning on the screen. The commands are easily selected from the keyboard with a single keystroke. Commands need not be learned and the program is laid out so that a plot may be constructed in minutes. The organization of the menus make the manual, although well written, essentially unnecessary. The spreadsheet input of the data is very logical for this type of program and quite simple, allowing easy data entry and updating. The data may be previewed directly on the screen, and the *x* and *y* values may be transformed under several common functions. A least-squares straight line fit (unfortunately this is the only curve fitting ability of the program) may also be done, and several types of curves may be plotted. When the data have been

manipulated the actual plot may be set up with a large selection of parameters, and default values for all parameters are automatically shown. This allows flexibility for most conceivable plotting requirements.

This package has many useful features for both the academic and industrial scientist. In fact anyone with raw data can produce professional quality plots with minimal effort and experience. The only negative aspects are the following: (i) The package contains very few statistical capabilities for curve fitting data. The package can only fit to straight lines, although this can be remedied by interfacing the package with a statistical analysis program. The inclusion of a statistical analysis capability would greatly enhance the value of this package. (ii) The method of plotting more than one curve per graph is awkward. Multiple curve plots can only be produced by loading in each curve and initiating the plot sequence individually. However, both of these limitations do not decrease the general usefulness of this package. Users with some programming experience will find that these limitations can be over come by interfacing the package with other programs. By writing short programs to interface with this package, we were able to use it in all our plotting applications.

Graph-Pad is a useful scientific plotting package with flexibility which allows it to be used in many applications. With the addition of a statistical analysis capability this package would be a must for anyone who uses a plotter.

Loudon L. Campbell and James C. Crump, *The University of Texas at Austin*

Omnis 3. Blyth Software: 2929 Campus Drive, Suite 425, San Mateo, CA 94403. \$495.00; copy protected.

Omnis 3 is by far the most comprehensive and powerful relational database system this reviewer has seen for the Macintosh. The features of Omnis 3 are comparable to or surpass the standards set by dBase III and R:base 5000 for the IBM microcomputer. If you need nothing more than simple manuscript tracking or mailing list maintenance, there are

many other programs better suited to your needs. If you require nothing less than a full blown relational system, then Omnis 3 is likely to be the program for you.

Omnis 3 is not a small system. The minimal requirements are 512K of RAM, an external drive, and realistically a printer. To make serious use of the package, a hard disk drive is a must. Omnis 3 is compatible with AppleTalk so a LaserWriter may be used. In addition, Omnis 3 provides for true multi-user applications, with true record locking. If you have already started using another database manager, then chances are good that you can share data with Omnis 3. Omnis 3 supports data conversion (in both directions) with DIF files, SYLK files, and a number of ASCII formats.

Omnis 3 has some very impressive statistics. A data file can be up to 64Mbytes, spread over four volumes. Each file can have up to 120 fields; each field can be up to 80 characters wide. Omnis 3 provides for the standard data types: text (ASCII), date, boolean, numeric (to 11 significant digits), as well as calculated fields. A unique feature is the "national" type—a text field that will sort in true alphabetical order, e.g., "computer" before "Disk", contrary to their ASCII ordering. Up to 12 index fields can be associated with a file. An indexed field can be used to access data based on a set of keywords in a remarkably short time. A severe limitation is the lack of large text fields, which could be used to maintain research summaries. Another limitation is the lack of a mechanism for dealing with graphical images, which are so important to the Macintosh concept.

The design of the database begins with the designation of the various fields. For a first time user this is a formidable task, due to the large number of options available. This reviewer found the task impossible without consulting the manual several times. A rather annoying limitation is that field names are limited to 6 alphabetic characters, which differs from most Macintosh applications. After a few tries, the task of designating a database becomes routine.

Not following Macintosh user guidelines makes database design more difficult. There is a noticeable lack of Cancel buttons. Canceling an operation requires clicking the go-away box of a window. The mechanism for loading files is somewhat unorthodox. One is first presented with a default file name, at which time an additional click is required to summon the standard file box. Even the standard file box is somewhat nonstandard, as it appears in a rather awkward location on the screen. The program never switches to a watch cursor when it is loading files, so you are never quite sure when Omnis 3 is through loading.

Once the database is designed, the data-entry screens must be created. Each data file may have up to 12 data-entry screens. As with most relational database systems, the screens can be designed to model paper forms already in use. The tools available for designing the form were disappointing. The forms can be displayed in only a singlet font, Chicago or Monaco. In order to line items up on the form, you must insert and delete spaces and lines. This is another example of non-standard Macintosh interface. The resulting data entry screen is unattractive but functional. Omnis 3 provides a range of data validating functions second to none, and these features help to maintain the integrity of the database. One drawback of the validation features is that entering unacceptable data returns a message saying that the entry is unacceptable, but no reason is given for the failure.

After data entry screens are designed, Omnis provides for standard data entry and data browsing. After requesting a new record, you fill in the fields in the standard manner. Omnis 3 supports clipboard use during data entry. Data records can be scanned forward or backward by pressing a button. Records can also be deleted by pressing a button. If you request deletion of a record, a dialog box appears confirming the deletion. While this is useful as a safety feature, it becomes rather cumbersome if a large number of records must be deleted. One missing feature is a lack of a recall, or undelete, feature. Of course such a feature would require Blyth to create an additional audit trail file, or some similar mechanism to allow for backtracking. Omnis 3 provides for record location in two additional ways: the find command and the search command. Find makes use of an indexed field and is lightning fast. The press release claims that one record in 20 000 can be found in 0.57 s. The search command, while much slower, can locate data by non-indexed fields. Search criteria can be saved and recalled with a few keystrokes for later use.

The report facilities of Omnis 3 are very complete. Unfortunately, the generation of a report is another formidable task. Omnis 3 provides a large variety of titles, totals, subtotals, as well as math functions and string functions. By providing all of these features, Omnis 3 provides too many options for the novice user. A first time user soon becomes overwhelmed with the number of options and is forced to define a report by trial and error. However, once a report has been constructed, it can be saved and recalled from a user installed pull down menu. Reports, unlike data entry screens, can make use of the available Macintosh fonts, type

sizes, and type styles.

One of the most powerful and difficult features to master is Omnis 3's built in programming language. By writing programs, or sequences as they are called, one can design applications that run transparently in the unfriendly environment of Omnis 3. These applications can have their own menus, dialog boxes, buttons, scroll bars, etc.

Writing an Omnis 3 sequence is a unique experience which requires more pointing and clicking than actual coding. Instead of typing language statements, you choose a control structure (such as if/then/else, goto, etc.) from a list of valid structures. All the programmer needs to fill in are the details specific to the application. This template oriented approach, while somewhat slower, virtually eliminates syntax errors, and allows the developer to concentrate on logic rather than syntactic expression. Once created, these sequences can be printed for reference. In addition, the sequences can be locked to prevent further modification. Unfortunately, once sequences are locked, they cannot be unlocked. If a backup unlocked version of the program is not around, quite a bit of work will be lost.

Since Omnis 3 is such a sophisticated program, the documentation breaks the basic rule of Macintosh documentations, that less is more. Omnis 3 comes with a formidable, albeit necessary, manual reminiscent of manuals for the MS-DOS computer programs. The manual includes an extensive tutorial section, as well as a reference section. The tutorial assumes no knowledge of database design. While this approach is useful for users new to the relational database world, it proves frustrating to those already familiar with the concept. Such users will most likely skip the tutorial. Unfortunately, Omnis 3 is a bit too complicated to use in this manner, and one will be forced to plod through the tutorial. Several sample applications are included with Omnis 3. These applications can serve as models, or they can be modified to suit your own needs. The applications included are accounts receivable, personnel management, time/cost accounting, inventory control, expense accounting, mail list management, and client tracking. From this list of programs it is obvious that business is the intended audience of Omnis 3.

Omnis 3 is a serious data base management program. Omnis 3 is difficult to learn, but if you have a serious application in mind, then there is probably not another system around that can solve your problem in as short a time as Omnis 3. It is unfortunate that Omnis 3 does not make better use of the features of the Macintosh user interface, for both the application developer and the application being developed. The lack of graphics capabilities and unlimited length text fields are serious problems. These limitations will all but eliminate the use of Omnis 3 as a serious research database. Unless you are faced with a serious relational application, such as managing a stock room, then there are probably other programs around that are easier to use, better suited to your needs, and less expensive.

Steven Sinofsky and Jon Clardy, Cornell University

MathCAD, Version 1.1. Mathsoft, Inc.: One Kendall Square, Cambridge, MA 02139. List price \$249.

MathCAD is an amazing program that enables the user to access the power of a computer in solving mathematical problems with the same ease of a text editor. Basically, it is a free format spreadsheet on which equations are typed as they appear in books, variables defined, and calculations performed with the speed of a computer. Mathematics, texts, and plots can all be combined in one convenient document.

MathCAD is superb in many ways that the novice user will appreciate, foremost being its documentation. The manual is exceptionally easy to read, being a large spiral bound book filled with examples and actual screen representations enabling the user to see what to type and how it should appear, including an entire chapter of examples. In addition to the manual, a video is available, but not included, that provides a 20-min demonstration on the program's salient features. This is a highly commendable feature that can save much time in acquainting oneself with the program. With these two resources, a user can begin using this very sophisticated program within a few minutes.

An IBM PC, PC/XT, PC/AT, or compatible with 512K RAM running MS-DOS or PC-DOS version 2.0 or later is required. In addition, MathCAD requires an IBM Color/Graphics Adapter with color or composite monitor, IBM Enhanced Graphics Adapter with any monitor, or Hercules Graphics Card with monochrome monitor. Although a coprocessor is not required, both the Intel 8087 and 80287 are supported and recommended by the developers. Hard disk drives are supported but only one double-sided floppy drive is required.

No knowledge of the PC and its DOS is assumed. Instead, exact directions lead the beginner through installation and start-up including directions on creating a directory and copying to the hard drive or running off the floppy. A Program Disk containing MathCAD and an Auxiliary Disk containing the help file and examples are provided. Neither disk is copy protected.

The MathCAD work area consists of a document extending from the upper left corner of the screen and continuing down to the right indefinitely. Text or equations can be started at any place by positioning the cursor and typing.

Automatic word wrap, simple margin adjustment commands, and cutting and pasting features make text manipulation simple (including the use of fifteen Greek symbols). Mathematical expressions can be moved about the document with similar ease.

Commands may be executed from menus or directly from the keyboard. Except for memory intensive ones, DOS commands can be executed after interrupting MathCAD. The Help feature on all commands is very thorough and easy to access and a convenient reference card of the commands is provided.

MathCAD supports the IBM Graphics Printer or compatible dot-matrix printer as well as the Hewlett-Packard LaserJet or LaserJet Plus printers. Before printing, execution of the Breakpage command prevents equations and plots from crossing page boundaries. Page sizes can be easily altered and sizes larger than the width of the printer are broken into strips from which the document can be reconstructed. Directions are provided in the use of ASCII code in text regions as well as escape sequences that will allow the use of printer specific features such as different fonts and special characters.

Of course, the real strength of MathCAD is in manipulating and evaluating mathematical expressions. The mechanics of inputting algebraic expressions is very simple with the order of operations convention followed. Parentheses can be used individually or created in pairs which makes keeping track of them much easier.

Scalar variables have a single value but array ones are possible as well as range variables which are similar to the index variables used in DO-CONTINUE loops of a programming language. When a variable is defined, its value is used in any expression employing that variable with the result updated automatically upon redefining the variable. The variable definition applies to all expressions below and to the right or it may be defined globally. Variables may be either real or complex.

The strength of MathCAD is that a mathematical expression can be easily evaluated and the results plotted or displayed in tabular form. A plot is initiated with a keystroke and the range and axis definitions readily applied. If any change is made to the expressions being plotted, then the plot is automatically updated. Plots can be made more sophisticated to include logarithmic scales and various geometrical figures for indicating points. What would have taken a program and a plotting routine can be done with MathCAD in minutes. This feature alone justifies the purchase price.

MathCAD has too many features to completely enumerate but some highlights are the following: Sums and products can be calculated with a few keystrokes. Numerical differentiation and integration (via the trapezoidal rule) as well as a range of statistical functions such as mean, variance, and standard deviation are readily available in addition to histograms of frequencies for data. Roots of functions can be found or discrete Fourier transforms performed. Regression analyses can be performed or data points connected with cubic spline routines. MathCAD supports trigonometric, hyperbolic, and Bessel functions and random numbers can be generated.

Version 2.0, to be released by October with a retail price of \$349, promises a built-in simultaneous equation solver, full matrix operation capabilities, and two to four times calculation speed increases along with other enhancements including support for a wider range of printers and plotters.

MathCAD is not a program specifically for chemists but is an outstanding success in enabling any scientist to manipulate mathematical expressions and obtain numerical results without much more difficulty than typing the expressions. Not only are the results simple to obtain but pleasing output of the results including tables and graphs can be prepared with ease.

John Pojman, University of Texas at Austin

DATASURF. Version 1.3 (For IBM PC, XT, AT or Compatibles). By Mark Bridger. Bridge Software: P.O. Box 118, New Town Branch, Boston, MA 02258. List price: \$125.00.

Description: Datasurf is 3-dimensional analysis and presentation program for tabular data. The data used by Datasurf may originate from any of the Lotus spreadsheet programs or from ASCII files created by text editors or from other sources, or the data may be entered directly from the keyboard. The data may then be manipulated and displayed on a graphics screen and/or plotted as a 2-D projection of a 3-D representation in a variety of ways. Data manipulation capabilities include rotations about any of the 3 axes, regional zoom, annotation of data, cross sectional slicing, and more. In all, it is a powerful little program for 3-D presentation of scientific or business data.

Requirements: The Datasurf program requires an IBM compatible

computer (PC-XT or AT) and at least 384K RAM, but 512K RAM or more is recommended. A graphics card is also needed and the program supports the IBM, CGA, EGA, and Hercules standards or some card compatible with these. The graphics card must be specified when the program is ordered since the program is supplied in one specific version for each hardware configuration. The standard version will output plots to IBM or Epson compatible dot-matrix printers. Versions may be requested which support Toshiba, Gemini, NEC, and Prowriter printers. For an additional charge (\$25.00) a version supporting HP-plotters can be obtained. A version supporting HP Laserjet printers is mentioned in the product literature but was not available for testing. For this review the Hercules Graphics version was tested on AT and XT compatibles; output was obtained on an HP plotter. The program also supports an 8087 math co-processor with significant speed improvements for large tables. Datasurf is not copy protected.

Documentation: Datasurf is supplied with a 118-page manual with a complete table of contents but lacking an index. Included in the manual is a short tutorial-style demonstration and three workshops that highlight many of the program's capabilities. Demonstration data files and Lotus worksheets are included with the package on diskette for use in the workshops. The remainder of the manual is devoted to a systematic discussion of the program menus and the significance of various parameters and operations. A nice treatment is also given to the structure of the data in the program and how various operations affect the display.

Data Preparation: Two other programs are provided to prepare data for input to Datasurf. The KEY-IN program allows data to be entered interactively at the keyboard. This method has a drawback since once the information is entered it cannot be corrected or changed. The CONVRT program will take tabular data from Lotus spreadsheets or ASCII files. For Lotus data conversion, the range containing only the tabular data must have been previously named in the worksheet unless the entire worksheet is only the table. No labels or empty spaces are allowed in the range. Text files (ASCII) may also be prepared with a wide flexibility of format, which means that work processors, database programs, or other programs may be used to create the data table. The user must know the number of rows and columns in the data and the numbers need to occur in sequential order in the file.

To test its capabilities, we used Datasurf to create stack plots of infrared spectral data. A short FORTRAN program was easily written to provide the data in the necessary format. One can visualize many uses for such a program to display trends in large data sets. Once the data are converted for Datasurf the file may be read in and manipulated by the commands the program provides.

The DSURF module has three menus: (1) the main menu responsible for file input/output, autoscaling, and display of the data; (2) the customization menu, which allows the user to change all accessible parameters of the display including rotation about the axes, selection between a leaf mode of presentation and a 3-D surface mode, stretching, and scaling of the data and other minor parameters; and (3) the printing menu, which allows selection of printer type and control of output to the printer.

In the main menu, the "autograph" option calculates a default set of display parameters which in most cases gives a nice stack plot of the data in 3-D perspective. These parameters can be altered with the customizing options in many ways. Lines which go beneath a closer portion of the data surface can be hidden or displayed. Values may be scaled logarithmically provided all are positive. The values of the parameters may be sent to the printer or stored to a disk file. Finally, the display may be annotated with several different sized fonts.

Limitations: The Datasurf package provides a useful 3-D data presentation capability for the PC environment, at a much lower cost than the more expensive packages like RS/1 (BBN software) or Asystant (Macmillan Software). There are, however, a few limitations of which the scientific user should be aware. First, each datum handled by Datasurf corresponds to the distance along the z-axis from the x-y plane. The position in the x-y plane is determined only by the row and column of the data. Therefore the spacings along both the x and y axes are assumed to be regular. Furthermore, no provision for retaining x or y values is available in the Datasurf data structure. Although much scientific data would be adequately represented in this form, this is not always the case. Data collected at a number of concentrations, times, or temperatures which are not equally spaced would be inadequately represented by the Datasurf presentation.

Some applications may be limited by the size of data table that can be handled. The current version requires all the data to be in RAM and requires 6 bytes each entry in the matrix. On our computer, with roughly 520K available for transient programs and data, Datasurf could handle a table of approximately 300 x 200 entries if the printer pack option was used. This is not necessarily a serious limitation since a graph of this many points may overcrowd the display device. In this case, the docu-

mentation suggests viewing the table in partial segments. Storage of one data set requires approximately 150K of disk space. On a floppy based PC, only one or two such projects could be allocated per diskette.

A few other aspects of the program should be noted although some of these reflect the personal preference of the reviewer. Datasurf continually asks for confirmation on the actions requested, which in some cases tripled the expected number of keystrokes in an operation. It would be a useful option to be able to shut off these confirmations via some "expert" mode for the confident user. We also found no convenient way to save a set of parameters for a standard configuration which would be desired by the frequent user.

Finally, the program always warned that the work had not been saved when the program was exited. This was true even if the save option was selected from the main menu and all the portions of the work were saved. This is an obvious but annoying bug, and it will surely be fixed.

In conclusion, Datasurf by Bridge Software provides a useful 3-D data display and plot capability for tabular data in the IBM PC environment. The product appears to be geared primarily at users in academic institutions and is best suited to data that are spaced at regular intervals in the x - y plane.

Kenneth W. Van Every and Peter R. Griffiths, *University of California, Riverside*

Cricket Draw. Version 1.01. Cricket Software: 30 Valley Stream Parkway, Great Valley Corporate Center, Malvern, PA 19355. List price \$295.

Cricket Draw is a powerful object oriented drawing program that will operate on a Macintosh 512 Enhanced, Macintosh Plus, Macintosh SE, or Macintosh II. It is supplied on a single 800K noncopy-protected disk and is accompanied by a 188-page manual and several loose-leaf release notes that update the manual and point out some hidden features of the software. The manual is fairly well written; however, some of the nicer features of the program are not entirely obvious and may not be fully appreciated until the user becomes familiar with the fundamental operations of the program.

The operation of this program is similar to that of MacDraw (Reviewed in *J. Am. Chem. Soc.* **1985**, 107, 6140) or MacDraft (Reviewed in *J. Am. Chem. Soc.* **1986**, 108, 5044); however, Cricket Draw has a number of features that make it more versatile.

Objects are created from a tool palette which includes icons for text, straight lines, rectangles, rounded rectangles, ovals, diamonds, arcs, polygons, freehand lines, a grate, and a starburst pattern. Icons which allow for the rotation, tilting, or duplication of objects and for the control of line width and object fill are at the bottom of the drawing window.

Drawings may be created and viewed at actual size or reduced or enlarged by factors of two, four, or eight. It is quite easy to select desired objects, even in crowded complex drawings, using either an arrow cursor or marquee. Objects may be repositioned with either the mouse or the cursor keys. When the option key is used, movement is restricted to horizontal or vertical. When the cursor key are used, the exact amount of horizontal or vertical movement may be specified. In addition, by using the option and cursor keys, objects may be moved one pixel at a time. This is particularly useful for fine tuning of drawings in the zoomed-in mode.

The positioning of objects relative to one another may also be precisely controlled. Horizontal and vertical rulers may be displayed in inches, centimeters, picas, or pixels, and the number of tick marks and origin of the ruler may be set as desired. The position of the cursor is tracked by dotted line in the ruler bar. The program allows for an unlimited number of nonprinting horizontal and vertical guide lines to be positioned on the screen. Customized, nonprinting grid lines may also be shown. If desired, objects may be restricted to snap to the grid, or the intersections of horizontal and vertical guide lines. As in MacDraw or MacDraft, multiple objects may be aligned by their tops, or bottoms, or top-bottom middles, and/or left sides, or right sides, or left-right middles. When an

object is duplicated, the horizontal and vertical offset may be specified. When objects are created in the Show Specs mode their dimensions are displayed on the screen. Objects may be easily resized, stretched horizontally or vertically, or smoothed. Multiple objects may be resized, or grouped as desired, and the stacking order of objects may be easily changed.

Multiple windows may be open, thus template files may be created for commonly used structures. There is a undo command that reverses the last operation conducted, including the moving, resizing, rotating, tilting, or deleting of an object, or the editing of text.

Double clicking on an object opens a dialog box which permits various attributes of that object to be specified. For example, a straight or freehand line may be set to any width from 0.05 to 99 points in 0.01-point increments, the intensity may be set at any value from none (transparent) to zero (opaque) to shades from 1 to 100%, the style of the line may be selected as solid or one of nine dashed styles, and arrowheads may be added to either or both ends. The borders of objects may be likewise manipulated. Object fills may be either transparent, opaque, or shades from 1 to 100%, and interesting special effects and patterns may be created with fountain, shadow, and transfer mode options.

Objects may be duplicated, rotated, or tilted either by clicking on the appropriate icon at the bottom of the drawing window or by a key command that opens a dialog box. In the former case, rotation and tilting by one-degree increments is possible, while in the latter case the angle of rotation may be specified to 0.01 deg. When an object is duplicated with the dialog box, the number of copies from 1 to 99, as well as the horizontal and vertical offset for those copies, may be specified. The object may also be reflected about the horizontal or vertical axis, with or without duplication.

It is possible to make regular polygons in two ways. The first involves using the starburst tool. For example, a regular pentagon could be created by making a circular starburst containing five lines at 72-degree increments, and then using the starburst as a template for the polygon tool. Alternately, the rotation feature could be utilized by creating five identical lines, rotating one line by 72°, another by 144°, another by 216°, and another by 288°, and then accurately repositioning the lines in a zoomed-in mode to make a pentagon. The lines could then be grouped and used as is, or the polygon tool could be used to trace over the lines. By using the rotation feature, it is possible to create irregular polygons with any desired angles, such as a chair cyclohexane with acute angles of 24° and 118°. Polygons may be edited with vertices repositioned, added, or removed.

One of the most versatile features of Cricket Draw is the way it handles text. A single block of text may contain multiple font types, font sizes, subscripts and superscripts, and styles (plain, bold, italic, underline, and/or outline). Irregular font sizes up to 140 points may be specified in one-point increments. The text may be centered, or right, left, or fully justified, and single, one and one-half, or double spaced. The horizontal and vertical boundaries of the text may be easily controlled by changing the size of the text editing rectangle. Text may be rotated and tilted to any angle, reflected on an axis, and made to follow an arbitrary path, such as an arc or spiral. Unfortunately the text fill is always transparent, so if an atom is to be positioned at the vertex of a polygon, it is necessary to place an opaque box under the letter. Commonly used letters such as "N", "O", and "S" that have already been grouped with an opaque box could be placed in a template file.

Cricket Draw utilizes PostScript, the language of the LaserWriter, so what you get on a LaserWriter is better than what you see on the screen. In addition, when an image created in Cricket Draw is pasted via the Clipboard or Scrapbook into other applications, including MacWrite, Microsoft Word, WriteNow, or PageMaker 2.0, and then printed on a LaserWriter, the PostScript description is transferred and there is absolutely no loss in quality. It is also possible to print drawings made with Cricket Draw on an ImageWriter, and, as with MacDraw, better images are obtained by printing at 50% reduction.

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