VOLUME 11 NUMBER 6 JUNE 1985 $2.95

# Creative Computing

THE #1 MAGAZINE OF COMPUTER APPLICATIONS AND SOFTWARE

Now including features from Computers & Electronics

**IN-DEPTH EVALUATIONS:**

**AT&T 6300**

**Tandy 1200 HD**

**Star Micronics SD-10**

**Industry Insider**

**32-Bit Technology: What Does The Future Hold?**

**Michael Ecker: Recreational Computing**

**Forrest Mims: A Home Alarm System**

**Tutorials: Sorting Techniques, Probability**

**Columns: Apple, IBM, Tandy, Atari, Commodore, Teletalk, Books, New Products, I/O**


# A printer impresses the press.

**Read what the experts say about Smith-Corona Dot Matrix Printers.**

## *PC Products**:

"I picked the Smith-Corona D-300 for overall value. It is the fastest in actual use, among the least noisy, and it provides the best flexibility in terms of document printing."
"Programming can also produce near letter-quality print so convincing that it takes a magnifying glass to reveal the individual dots."

## *PC Magazine*†:

"The D-300 is the only economy class printer with a wide (15 inch) carriage we can seriously recommend."
"At $795, the D-300 can't be beat."—John Dickinson

## *Creative Computing:*

"...truly versatile dot matrix printer, the D-300 from Smith-Corona."
"This...workhorse is durable enough for heavy-duty use in the office...its relatively low price keeps it within reach of home users...in addition to its excellent text capabilities, this printer fully supports high resolution graphics printing."

## *Hot CoCo:*

"The Smith-Corona D-300 pulls away from its competition as a near letter-quality printer."
"I find the correspondence print of the D-300 to be the best in its price range."

**SMITH CORONA™**
WE'RE WRITING THE FUTURE.

Smith-Corona is an operating group of SCM Corporation. For more information on this product, write to Smith-Corona, 65 Locust Avenue, New Canaan, CT 06840
*From a review of the following printers: Epson FX 10, Okidata Microline 83A, Panasonic KX-P1091, Star Micronics Delta-15 †From a review of 31 printers tested, selling for under $800

**CIRCLE 136 ON READER SERVICE CARD**

# IF YOU CAN FIND A BETTER PROGRAM WE'LL BUY IT FOR YOU!*


## WORD WRITER with Spell Checker

**Now with 40,000 word Spelling Checker**

- An efficient, 80-column professional word processing system which includes a spelling checker and built-in calculator.
- Contains all the features you'll need for everyday word processing, plus most of the sophisticated features found in more expensive programs: document chaining, form letter printout, page separations, horizontal and vertical scrolling, and more.

## DATA MANAGER 2

**Faster, more efficient, more versatile**

- A complete general information storage and retrieval system with report-writing, graphics, statistics, and label-making capabilities.
- Exclusive X-SEARCH, X-SORT, and X-CHART features allow you to cross-search any category of information; sort items alphabetically, numerically, or by date; break down statistical information into categories; and graphically view your results.

## SWIFTCALC with SIDEWAYS

**New easy-to-use spreadsheet for home and small business use**

- The SIDEWAYS option lets you pnnt all your columns on one, continuous sheet . . . sideways.
- 250 rows and up to 250 columns (128K version) provide up to 62,500 cells in which to place information.
- Performs mathematical functions up to 17 digits. Allows the use of minimum and maximum values, averages, sums, integers, absolute values and exponential notation.

### With Timeworks you get more power for your dollar

You can use each program alone. Or interface this trio – one at a time if you like – into a completely integrated productivity system that delivers all the power and features most of you will ever need . . . at a cost that lets you enjoy their use.

Look for these and other Timeworks programs at your favorite dealer. Or contact Timeworks, 444 Lake Cook Road, Deerfield, IL 60015. Phone: (312) 948-9200.

### With Timeworks you get more than software

***You Get Our Customer Technical Support Team***

At the other end of our toll-free hotline, you'll find our full-time Customer Technical Support Team. Free of charge to all registered users.

***You Get Our Liberal Trade-Up Policy***

You'll find the details inside each package.

### *With Timeworks you get our Money Back Guarantee

If you can find anything that works better for you, simply send us your Timeworks program, your paid receipt, and the name of the program you want, along with your check or credit card number for any retail price difference. If it's available, we'll buy it for you.**

Available for Apple, IBM, Commodore, and Atari computers.***

These programs interface with each other

TIMEWORKS

*More power for your dollar.*

**Other Timeworks Programs:** ▪ The Evelyn Wood Dynamic Reader ▪ Sylvia Porter's Personal Finance Series ▪ Swiftax ▪ Cave of the Word Wizard ▪ Business Systems ▪ The Electronic Checkbook ▪ The Money Manager ▪ Wall Street

** Offer valid for 90 days from date of purchase.

*** Registered trademarks of Apple Computer, Inc., International Business Machines Corporation, and Commodore Computer Systems



CIRCLE 141 ON READER SERVICE CARD

VOLUME 11 NUMBER 6 JUNE 1985

# Creative Computing

On the cover this month, Dick Tracy (© Tribune Media Services, Inc.) models Seiko's Datagraph wristwatch terminal with the help of designer Chris DeMilia and photographer Jeff MacWright. The terminal is reviewed on page 28.

## PRODUCT REVIEWS



## FEATURES



## APPLICATIONS



## DEPARTMENTS



*Creative Computing* (ISSN 0097-8140) is published monthly at 3460 Wilshire Blvd., Los Angeles, CA 90010 by Ahl Computing, Inc., a subsidiary of Ziff-Davis Publishing Company. David Ahl, President; Elizabeth Staples, Vice President; Selwyn Taubman, Treasurer; Bertram A. Abrams, Secretary. 39 East Hanover Ave., Morris Plains, NJ 07950. Second Class Postage paid at Los Angeles, CA 90052 and additional mailing offices.


**Editorial material**, including article submissions, press releases, and products for evaluation should be sent to Creative Computing, 39 E. Hanover Ave., Morris Plains, NJ 07950 Phone (201) 540-0445. Creative Computing will not be responsible for the return of unsolicited manuscripts, cassettes, floppy disks, program listings, etc. not submitted with a self-addressed stamped envelope.

**Subscriptions:** Domestic: 12 issues $24.97; 24 issues $43.97; 36 issues $57.97. Canadian: add $5.00 per year. Foreign add $10.00 per year. Foreign subscriptions must be accompanied by payment in U.S. currency. Airmail delivery on foreign subscriptions is available for a one-year period only at $75.00 additional for mail to Asia and Australia, and $50.00 additional for all other countries. Subscribers in the United Kingdom may send payment in sterling to Hazel Gordon, 10 Bishops Way, Sutton Coldfield, West Midlands B74 4XU. POSTMASTER. Send address changes to Creative Computing, P.O. Box 5214, Boulder, CO 80321. Please allow at least eight weeks for change of address. Call (303) 447-9330 to order a subscription.


CIRCLE 138 ON READER SERVICE CARD


# Creative Computing

Founder/Editor-in-Chief: **David H. Ahl**
Editor: **Elizabeth B. Staples**
Managing Editor: **Peter Fee**
Associate Editor: **John J. Anderson**
Technical Editor: **Joseph Desposito**
Assistant Editors: **Owen Linzmayer**, **Russ Lockwood**
Reviews Editor: **Paul Grosjean**
Editor-at-Large: **Ken Uston**
Contributing Editors: Robert Carlson, Jake Commander, Michael Ecker, Will Fastie, Susan Glinert-Cole, Danny Goodman, Stephen B. Gray, Glenn Hart, Bill Jacobson, Barry Keating, Forrest Mims III, Ted Nelson, Tim Onosko, Peter Payack, David Small
Editorial Assistants: **Jane M. Lewis**, **Carol A. Crowell**
Associate Art Directors: **Chris DeMilia**, **Peter Kelley**
Assistant Art Director: **Eugene Bicknell**
Typesetting: **Dianna Mizell**

## ADVERTISING SALES

Publisher: **William S. David**
One Park Avenue, New York, N.Y. 10016
212-503-5026
Assistant to the Publisher: **Jean Anderson**
Advertising Coordinator: **Desirée Sample**
212-503-5030

**Northern California/Northwest**
Janet Bish, 11 Davis Dr., Belmont, CA 94002. (415) 598-2083

**Southern California/Southwest**
Anne Abeln, 3460 Wilshire Blvd., Los Angeles, CA 90010. (213) 387-2100

**Midwest/Texas**
Jeff Edman, Louise Grauel, The Pattis Group, 4761 W. Touhy Ave., Lincolnwood, IL 60646. (312) 679-1100

**New England**
Merrie Lynch, CEL Associates, Inc., 61 Adams St., Braintree, MA 02184. (617) 848-9306

**New York/New Jersey**
Linda Holbrook, 160 State St., Boston, MA 02109. (617) 367-7190

**New York City/Mid-Atlantic**
Ken Lipke, One Park Ave., New York, NY 10016. (212) 503-5029

**Southeast**
Mark Browning, P.O. Box 81306, 2511 Carroll Ave., Atlanta, GA 30366. (404) 455-3430

**Canada**
Frank Lederer, The Pattis Group, 501 Eglinton Ave. E., Suite 202, Toronto, Ontario M4P 1N4. (416) 482-6288

**Japan**
James Yagi, IWAI Trading Company Ltd., 603 Ginza Sky Heights Building, 18-13, Ginza 7-Chome, Chuo-Ku, Tokyo, Japan 104. (03) 545-3908

**Ziff-Davis Computer Publications Division**

President: Kenneth H. Koppel
Vice President, Editorial: Jonathan D. Lazarus
Vice President, Production: Baird Davis
Vice President, Licensing & Special Projects: Jerry Schneider
Vice President, Creative Services: Herbert Stern
Vice President, Circulation: Alicia Marie Ivans
Vice President, Circulation Services: James Ramaley
Marketing Manager: Ronni Sonnenberg
Director, Marketing Services: Ann Adelman
Business Manager: Gary A. Gustafson
Editorial Director: Ernest F. Baxter

# INDUSTRY INSIDER

## David H. Ahl

### Employee Computer Crime on the Rise

Most computer crimes are not committed by hackers but by trusted employees—programmers, managers, clerks, and consultants—who turn against their employers, using company computers for extortion, theft, and sabotage. Consider these recent cases.

Allen Green, a clerk at Girard Bank in Philadelphia, was to scan computer printouts for signs of suspicious automatic teller machine transactions. His department also received automatic teller machine cards that the Post Office couldn't deliver. According to police, Green made a fake deposit in the account of a man whose card was returned. He then raised the withdrawal limit, made an actual withdrawal of $4500, and later returned the withdrawal limit to its usual $200 ceiling. He repeated these maneuvers 13 times before an audit program—in a sense a backup to his own job—finally nabbed him.

In Washington, Stanley Slyngstad was a programmer who developed software through which the state authorized payments to injured loggers. Mr. Slyngstad lost an arm in a childhood accident and, according to his supervisor, was all the more trusted because of his own handicap. However, he used his program to authorize $17,000 of payments to himself and two friends, and then erased all record of the fraud. The daughter of one of his friends tipped police to the scheme, and Slyngstad was arrested.

Sabotage by disgruntled employees is becoming increasingly popular. For example, Dennis Williams and Michael Lampert, unhappy with the management at Collins Foods, are accused by police of placing "logic bombs" in the company's two computers. They were set to activate in the future and destroy the operating systems. The company was tipped off by a worker who overheard Williams discussing the scheme. Fortunately, both bombs were deactivated before causing any damage.

Last February an employee of Micro Porcelain Dental Laboratories tampered with the company computer so it couldn't be started without his help. But that would cost the company $573 in vacation pay he claimed he was owed. Police filmed the transaction and, with that as evidence, arrested the employee.

Most computer crimes are not reported because companies feel that customers may interpret such events as managerial shortcomings. Chance, informers, and errors on the part of the culprit, not security controls, are the clues that reveal most crimes. Experts say that for security systems to be effective, there should be two overlapping systems (as there were at the Girard Bank) and no single employee should have the details of both systems.

---

The omnibus federal 1984 crime bill took some tentative first steps toward combatting computer crime. However, it defined only a few limited categories of computer crime mainly related to breaking into files containing classified data or credit records of individuals.

On the other hand, some of the newly passed state laws go much further. South Dakota, for example, added a provision in 1984 that punishes the use or disclosure of passwords, as well as unauthorized access. Kentucky makes it a felony to fraudulently access a system to obtain money, or alter, damage, or attempt to alter information. Hawaii defines any unauthorized computer use as a felony, whereas Idaho distinguishes between altering information (a felony) and access only (a misdemeanor).

In all, 36 states have enacted laws on computer crime, but the 14 states without such laws include two of the three largest. The states *without* computer crime laws are Alabama, Arkansas, Indiana, Kansas, Maine, Mississippi, Nebraska, New Hampshire, New Jersey, New York, Oregon, Texas, Vermont, and West Virginia.

A complete list of the statutes is available in *Compilation of State and Federal Privacy Laws 1984-85* for $22 from *Privacy Journal*, P.O. Box 15300, Washington, DC 20003.

---

### Printer Price Erosion

When we purchased our first daisywheel printer, a Qume Sprint 5, in 1978, daisywheel prices were in the $3000 range. Today, however, daisywheel technology has proliferated, and industry oldtimers Diablo and Qume are being forced to lower their prices in response to Japanese competition. Street prices of Diablo and Qume units are generally 25% under the suggested list prices (for example, the Qume Sprint 11/40 has a list price of $1699, but generally sells for $1299). NEC units are similarly discounted with the $2350 list price 3550 selling in the $1300 range.

And now the upstarts are lowering their prices also to move stagnant inventory and retain market share. For example, C. Itoh has just cut prices on the StarWriter family by 33% ($1199 for the 40 cps model), and Fujitsu has reduced the price of their high performance DaisyMax 830 from $2995 to $2295.

Trying to edge into the low end of the daisywheel market is Alphacom with their 101 priced at just $400. Juki and Silver Reed also have units selling for under $400, while the Brother HR-25 sells in the $500 range.

Prices are also plummeting on dot matrix printers. Industry leaders Epson and Okidata lowered prices in the fourth quarter of 1984, and now other manufacturers are following suit. Mannesmann Tally just reduced prices of its dot matrix line by 20% while C. Itoh cut prices by 30%.

Some representative street prices show the trend: Epson RX-80, $299; Okidata 92, $359; Mannesmann Tally Spirit 80, $249; Star Micronics Delta 10, $349; Inforunner Riteman+, $249; and Panasonic 1091, $289.

---

### Home Market Not for IBM?

Although some industry watchers have interpreted IBM's decision to stop producing the PCjr as the death knell for the home market, I disagree. The PCjr never completely recovered from its initial introduction with a Chiclet-style keyboard and limited expansion capabilities, although the deep price cuts for a bundled system before Christmas gave it a short-term boost.

If anything, IBM's exit provides opportunities for Apple and Tandy who currently market full-featured systems in the under $1000 price range. Later this year when the upper end Commodore and Atari computers hit the shelves, the competition will be tough, but the window seems to be wide open for Apple and Tandy for the next few months.

Is IBM out of the home market for good? Not likely. They are still reported to be looking at building an MSX machine at a very attractive price. And you

can be sure that when IBM sees significant profits in the market they will jump back in with both feet.

On the business market end, IBM cut prices 4% to 12% on the PC line and introduced two lower-priced versions of the XT, the first to be sold without a hard disk. Some analysts view the price cuts as a method of clearing out inventory to prepare for the introduction of the PC2, the successor to the original PC, and to get ready for the debut of a briefcase-size computer.

## Shortage of Experts

Nobel laureate Kenneth Wilson along with senior executives from NASA, IBM, AT&T, and Hewlett Packard at the Cornell Universary EE Centennial Symposium predicted a serious shortfall in computer experts by the end of the century. The number of applications for computers is increasing at a geometric rate but the ability of universities to educate computer scientists is increasing much more gradually. Although manufacturers are attempting to build more user-friendly systems, it is likely that computer experts will continue to be in heavy demand.

The situation is particularly critical with respect to supercomputers. The best estimate is that there are only about 250 people in the U.S. who really understand supercomputers. Today, only two universities actually have state-of-the-art supercomputers.

To remedy this shortage, the National Science Foundation said it would provide $200 million to create four supercomputer centers around the country. The four are to be at Cornell, Princeton, the University of Illinois, and University of California at San Diego. Nevertheless, it is not likely that this effort will have any real impact for at least ten years.

## Whither Kaypro

Kaypro, with its cheap but functional computers and direct distribution to retailers, was riding high a year ago while companies with more advanced products and "proven" distribution schemes were hurting.

However, an antitrust complaint was filed against Kaypro in March for threatening some of its dealers with termination for not selling at list prices. Kaypro paid $19,500 in civil penalties and court costs to settle the suit, and, although the company did not admit or deny the allegations, it would appear that they now will have to give their dealers greater latitude in setting prices, selling to non-Kaypro dealers, and advertising mail order sales.

## Random Bits

After inundating the market with **personal computer magazines**, publishers faced a test of endurance in 1984. A total of 55 publications failed in 1984, a complete reversal of the 1983 market when the same number were introduced . . . The Software Publishers Association reports that sales of **Macintosh software** have jumped from nil to 8% in early 1985 . . . In March 1985, **Compaq** shipped its 200,000th personal computer . . . IDC projects the market for **business graphics** will grow from $59 million in 1984 to over $1 billion in 1989.

**Acorn** has had a tough time in the U.S. market but may get an unexpected boost now that **Olivetti has purchased** a 49.3% stake in the company. **AT&T**, 25% owner of Olivetti, is considering an agreement to help Acorn crack the U.S. education market, now dominated by Apple . . . **Consumer Products**, a maverick division of giant **AT&T**, has released an image capture board (for the IBM PC!) which captures a standard composite video image and allows modification and manipulation of it by the computer. It is made possible by the development of a new design architecture using RARAM memory, a high density, low cost, two-port dynamic memory with very fast access time.

Having discontinued its 16/8 and 820 family of computers in February, **Xerox Corp.** is negotiating with Olivetti to sell the M-24 computer, an IBM compatible unit . . . **Lotus and Cullinet** announced an alliance to develop and market products to connect *Lotus 1-2-3* and *Symphony* to powerful IBM (and compatible) mainframe computers. One catch: while the integrated package, *Symphony Link*, is expected to cost only $300 to $500, customers will have to buy a communications peripheral for each PC (about $1100 each) plus Cullinet's mainframe *Information Center Management System* package for a cool $150,000.

In the March issue of *Computers & Electronics Marketing*, experts **ranked** the ads of seven makers of boards for the IBM PC. On top: Persyst and Tecmar. In the middle: Idea Associates, STB Systems, and AST. On the bottom (scoring just one point each): Microlog and Orange Micro. On the other hand, award-winning ads don't necessarily sell products, and ads that sell don't necessarily win awards. ■

THE ONLY COMMUNICATION SOFTWARE YOU'LL EVER NEED
BCN Telpath
For those who only want the best communication software
BCN Telgate
For those who also want the only automatic microaccess to the gamut of online information services
BCN Telmail
For those seeking the universal EMail system. And all three for those who understandably want it all . . . and it didn't exist
"Very few products are both imaginatively conceived and superbly executed. The Business Computer Network (BCN) takes its rightful place along side 1-2-3, Hill Street Blues, and the Sony Walkman as one of those rare products."
Alfred Glossbrenner
PC Magazine
April 2, 1985
What Alfred Glossbrenner Couldn't Know
The rave review was very welcome Who could ask for more? BCN could. As Alfred Glossbrenner's review left the press BCN was ready to announce another PC software breakthrough: a 3-in-1 communication software package.
Telpath
In a Class by Itself Communication software that never needs to be replaced? Yes, BCN automatically updates Telpath online. (Someday even Telpath will be improved.)
Universal protocol selection? Telpath offers micro-to-micro communications without regard to type of PC
Frustrated by your inability to execute other application programs while online? BCN's Telpath gives you another good reason to replace your present communication software
Worried about losing your passwords and phone numbers? You should be Only BCN offers a Save/Replacement 'insurance policy' — for $25 BCN's host computer will upload and store your phone numbers and passwords four times a year and provide two replacement diskettes.
Anxious about password security? Telepath offers guaranteed password protection.
Did you ever wish that your monitor showed modem status indicators? Only Telpath has them.
Of course Telpath also offers everything else you would expect from leading communication software products: definable function keys, automatic log-on menus, X Modem and Kermit protocols executable programs transmitted with complete error protection, unattended mail-to-disk transfer capture of data at any speed for off-line editing, remote takeover and operation.
And the introductory price for Telpath is only $99.95 at your nearest computer dealer Telpath purchasers can obtain both Telgate and Telmail online from BCN.
Telgate
When You're Ready for More Than Just the Best Communication Software
Telgate offers Telpath's unique combination of communication software PLUS automatic access to more than 25 information services with no subscription fees or monthly minimums, almost twice the number of services in the SuperScout package Glossbrenner reviewed: Dialog, BRS, BRS BRKThru, NewsNet, VU/Text, and many others.
And as BCN adds more online services they are downloaded to your Telgate diskette
Telmail
It's Electronic Mail Call Time
Convert your PC into an electronic post office BCN;s Telmail collects all of your electronic mail and has it ready to read on disk when you want it. And sending EMail on any service becomes almost as simple as collecting it.
Both Telgate and Telmail are available only from BCN. For further information, call 1-800-446-6255.
The Leader in Online Information Services
BUSINESS COMPUTER NETWORK, INC.
BCN
CIRCLE 158 ON READER SERVICE CARD
1046 South Central Parkway
San Antonio, TX 78247
1-800-446-6255

# We're about to ch business views the co

A computer revolution of enormous magnitude is about to take place.

Because Europe's most successful business computer company is now doing business in America. Introducing Apricot. A full line of computers specifically designed for business.

Not adapted to it.

In fact, the facts speak for themselves.

Apricots are elegant and compact 16-bit computers. They employ the MS-DOS operating system, and a minimum of 256K memory. One of our models, the Apricot Xi, boasts an incredible one Megabyte of memory, and features a Winchester hard disk with 20 Megabytes of storage. We also have models that feature speech recognition, full-size LCD, and icon driven menus.

In addition, you also have a choice between 9″ or 12″ b/w or 10″ color monitors. All of which

# ange how American
# mputer industry.

have a higher screen resolution than Apple.

And as if that weren't enough, all of our models can be networked from the moment you take them out of the box. They're also capable of running thousands of business software programs specially written for Apricot on 3½ inch disks.

So, if you still think that Apple is a better business computer, look at it from a different perspective.

It's not.

Apricot, Inc., 3375 Scott Boulevard, Santa Clara, CA 95054. Call 800-227-6703, or in California 800-632-7979.

The Apricot Xi 1Mb RAM
20Mb hard disk 720K floppy diskette MS-DOS $4495 (excluding monitor)

apricot

We're changing how
American business does business.

CIRCLE 101 ON READER SERVICE CARD

# INPUT/OUTPUT

## In Pursuit of Trivia

Dear Editor:

I enjoyed Russ Lockwood's article on computer-based trivia games ("Trivia Mania," March 1985). I would like to bring to your readers' attention two trivia games written by our firm and published by IBM. They are: *Trivia 101—The Introductory Course*, and *TV and Cinema 101—Trivia from Talkies to Trekkies*. We believe that these products set a new standard for computer-based trivia games.

George T. Thibault, P.E.
President
Digital Learning Systems, Inc.
4 Century Dr.
Parsippany, NJ 07054

*After our roundup of trivia games went to press, we learned of several more games. The games Mr. Thibault mentions are distributed by IBM, hold 5000 questions, and cost $29.95 each. Mr. Thibault notes these games were included in the official IBM PCjr promotion during the fourth quarter 1984.*

*Other trivia games are:*

The Game Show *for the Apple II, IBM PC, and Commodore 64: $39.95, 49 additional question disks at $19.95 each, from Advanced Ideas, 2550 Ninth St., Berkeley, CA 94710. (415) 526-9100.*

Comp-Triv *for the IBM PC: $34.99 (Canadian) from Soft Tech, 26 Sugar Maple St., Kitchener, Ontario, Canada, N2N 1X5. (519) 744-5586.*

Trivial Towers *for IBM PC and TI Pro: $35, from Dr. Ed Mickolus, 9322 Humphries Dr., Burke, VA 22015. (703) 351-7926.*

Terminal Trivia *for the Apple II and IBM PC: $39.95, additional question disks $19.95 from Humans, P.O. Box 82, Evington, VA 24550. (804) 525-3441.*

PC-Trivia *for the IBM PC: $29 from Stilwell Software, 16403 N. 43rd Dr., Glendale, AZ 85306. (602) 978-4678.*

TrivMania *for the IBM PC: $51.95 from Star Software, 3903 S. Espana St., Aurora, CO 80013. (303) 699-7353.*

*We have not reviewed any of the above software. Please contact the manufacturer for further details. —RSL*

## Checklist Correction

Dear Editor:

Thank you for the mention of the Mathematical Study Unit (MSU) in the "Computers on Stamps" article in the March 1985 edition of *Creative Computing*. Unfortunately, my name and address were listed as the source of a checklist of computer stamps. I can't provide such a list, but there is a 47-page checklist of "Mathematics and Measurement on Postage Stamps" available from the MSU. Supplements are included with each issue of *Philamath*, the journal of the MSU. This checklist is available for $6 from the secretary-treasurer of the MSU: Estelle A. Buccino, 135 Witherspoon Ct., Athens, GA 30606.

Larry Dodson
3624 W. Frier Dr.
Phoenix, AZ 85021

## TermExec Update

Dear Editor:

Thanks for your excellent coverage of *TermExec* in the Special Report on Telecommunications Software in your February issue. We appreciate the endorsement of our backscrolling feature and our time sequencing capability without a clock card.

Since the first review of *TermExec* in the June 1984 *Creative Computing* we have had a major release and now offer several new features. In particular, we now support 80-column cards on the Apple II+ as well as the IIe and IIc; separately we will now auto-redial busy phone numbers. The auto-redial feature addresses one of the few limitations *TermExec* had on your software comparison chart.

Additional new features not on your chart which we find useful are: 2400 baud operation, automatic operation of our full screen editor (allowing fill-in form messages), and a new ProDOS version. We have also released *Talking TermExec*, a special version for vision impaired users, which echoes all screen text through an Echo Speech Synthesizer.

Pat O'Neil, Chairman
Exec Software
201 Waltham Street
Lexington, MA 02173

## Medicine by Modem

Dear Editor:

Michael S. Davidson's article on software for health and fitness in the March 1985 issue of *Creative Computing* was a thorough and accurate review of a poorly understood application of computer technology.

We feel that Mr. Davidson's article might be enhanced by mention of on-line telecommunications resources for health and fitness, such as HealthNet.

Available on CompuServe (go HNT). HealthNet is a multi-faceted health information resource containing a reference library on diseases, drugs, symptoms, and more. There are newsletters, questions and answers, and a personal feedback utility, as well as other features. The resource is updated on an ongoing basis, with all material written by physicians. It is our feeling that only through telecommunication can a user have access to current information whenever it is needed, and with a breadth unlikely on a disk-limited program (the current CompuServe library is over 3Mb and growing).

Richard Gross, M.D., F.A.C.P.
HealthNet
4611 North Oakland Ave.
Milwaukee, WI 53211

## Two-Year Translation

Dear Editor:

I have translated the "Micro-World Dynamics" program in the May 1983 *Creative Computing* from Atari Basic to Applesoft Basic. My version prints to the Apple Dot Matrix Printer and will have to be altered slightly for different printers.

Readers who would like a listing of the Applesoft version should send me a self-addressed, stamped envelope.

Jim Tankard
3003 Cherry Lane
Austin, TX 78703

# NOTICES

## Juki Address

In our review of the Juki 6300 last month, we listed Juki's consumer office instead of the main office. The address and phone number: Juki Office Machines Corp., 299 Market St., Saddle Brook, NJ 07662. (201) 368-3666.

## Modem Price Change

Just after we went to press with the May 1985 issue, US Robotics dropped the price of its Courier and Microlink 2400-baud modems from $895 to $699. Contact US Robotics, 1123 W. Washington Blvd., Chicago, IL 60607. (312) 733-0497. ■

# BY THE YEAR 2000, THE WORLD MAY CATCH UP WITH THE WAY COMPUSERVE'S ELECTRONIC MALL™ LETS YOU SHOP TODAY.

**Presenting the computer shopping service that delivers discount prices, name-brand merchandise, and in-depth product information.**

To make your computer even more useful, join CompuServe and shop in our Electronic Mall. Easy enough for beginners, it's open 24 hours a day, 7 days a week. And it offers a wide range of goods and services from nationally known stores and businesses including Bloomingdale's, Waldenbooks, American Express and Commodore.

**CompuServe's Electronic Mall™ lets you shop at your convenience in all these departments:**

The Auto Shop, Book Bazaar, Financial Mart, Leisure Center, Merchandise Mart, Newsstand, On-Line Connection, Personal Computer Store, Record Emporium, Specialty Boutique and Travel Agency.

**Take the CompuServe Electronic Mall 15-Minute Comparison Test.**

*What you can do in 15 minutes shopping the Electronic Mall way.*

- Access descriptions of the latest in computer printers, for instance.
- Pick one and enter the order command.
- Check complete descriptions of places to stay on your next vacation.
- Pick several and request travel brochures.
- Access a department store catalog and pick out a wine rack, tools, toys...anything!
- Place your order.

*What you can do in 15 minutes shopping the old way.*

- Round up the family and get in the car.

**The Electronic Mall—A Valuable Addition to the Vast World of CompuServe.**

CompuServe Information Services bring you information, entertainment, personal communications and more.

You can access CompuServe with almost any computer and modem, terminal or communicating word processor.

To buy a CompuServe Subscription Kit, see your nearest computer dealer. To receive our informative brochure, or to order direct, call or write:

**CompuServe**

Information Services, P.O. Box 20212,
5000 Arlington Centre Blvd., Columbus, OH 43220
**800-848-8199**
In Ohio call 614-457-0802

An H & R Block Company

The Electronic Mall™ is a service of CompuServe Inc. and L. M. Berry & Company

CIRCLE 150 ON READER SERVICE CARD

# For everyone who ever tried doing five things at once

**The perfect computer program for someone as busy as you. It lets you keep several other programs working at once.**

Do you ever go in so many directions so fast not even a computer can keep up with you?

Well, now an IBM Personal Computer can—thanks to IBM TopView.

TopView is a new kind of software that lets you switch between other programs as quickly as you can change your mind, even run several programs at the same time.

Once you load TopView into your computer, you load the other programs you use most—as many as your computer's memory will permit.

After that, the greatest distance between two programs is just a couple of keystrokes, or (optional) mouse moves.

There's no waiting and a lot less diskette swapping.

But when you're *really* busy is when TopView really shines, letting you do many jobs simultaneously.

For example, you can print a letter, while you search a file, while you analyze a spreadsheet, while your clock/calendar reminds you that your automatic dialer is about to place a call for you.


# ...IBM presents TopView.

And you can see everything through on-screen "windows" and control it all with easy-to-use pop-up menus.

You can even make unrelated programs work together; say a "Brand Y" spreadsheet with a "Brand Z" word processor.

But simplest of all is a certain "Brand IBM", namely the IBM Assistant Series—for filing, writing, planning, reporting and graphing.

Many other popular programs also work with TopView, and the number is growing.

Naturally, the more computer memory you have, the more TopView can help you. At least 512K is recommended.

And the price is only $149.*

Beyond that, all you need is to be the kind of person who never does a single thing all day, but who wants to do everything, at once.

To learn more, call an IBM marketing representative, or visit an IBM Product Center or Authorized IBM PC or Software Dealer.

For the store nearest you, and a free brochure, call 800-447-4700. (In Alaska and Hawaii, 800-447-0890.)

IBM

Personal Computer Software

CIRCLE 156 ON READER SERVICE CARD

*IBM Product Center price.

# BOOK REVIEWS

## Operating Systems, Basic, and Lotus 1-2-3/**Russ Lockwood**

**The Home Computer Wars** by Michael S. Tomczyk. Compute Publications, P.O. Box 5406, Greensboro, NC 27403. Softcover, 301 pages, $9.95

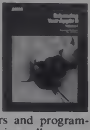

The subtitle of this book is "An Insider's Account of Commodore and Jack Tramiel." So who is Michael S. Tomczyk? Only Jack's assistant, Guy Friday, and gofer all rolled into one from April 1, 1979 to May 15, 1984.

Like a general, er, admiral, writing his memoirs after a war, Tomczyk chronicles the rise of Tramiel and Commodore. He provides the appropriate light touch in describing people, places, events, and anecdotes. Of course, everything turns up roses during his tenure, with three exceptions: a heretical corporate backstabber, a "downright rude" David Ahl who wears "glitzy black T-shirts," and pneumonia. Well, the backstabber was fired, Dave converts to become a "good personal friend," and Tomczyk recovers. End of his troubles until Jack resigns.

*The Home Computer Wars* makes good light reading for anyone interested in Commodore, Tramiel, and the battle for the low end computer market.

---

**Enhancing Your Apple II** by Don Lancaster. Howard Sams & Co., 4300 W. 62nd St., Indianapolis, IN 46268. Softcover, 268 pages, $15.95



*Enhancing Your Apple II* may sound like another general introduction to the world of peripherals, but beneath this nondescript title lies a wealth of information for hardware tinkerers and programming enthusiasts. This is a roll-up-your sleeves, hands-on tutorial on improving the performance of your Apple II+, IIe, or Franklin Ace computer and assembly language programs.

Using inexpensive components, Lancaster shows you how to interconnect various chips to modify field synch, flawlessly switch to and from lores graphics, and use video changeover switches with an RF modulator. On the software side, Lancaster leads you into mixing lo-res graphics, hi-res graphics, and text on the screen, cracking machine language code, creating 191 solid background colors, and gently scrolling images.

If this sounds interesting, you may also want to buy the companion disk of 26 programs, for $19.95.

---

**Artificial Intelligence** by F. David Peat. Baen Enterprises, 8-10 W. 36th St., New York, NY 10018. Softcover, 370 pages, $8.95

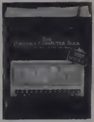
Artificial Intelligence (AI) is one of the most hyped topics in computerdom. Contrary to the wishful thinking of marketing people and venture capitalists, true AI machines are far down the road. Fortunately, F. David Peat avoids the all-too-common trap of peddling superficial visions of the future and instead concentrates on providing a history of AI research.

Most of the book examines the development of various AI tools and techniques. Yet Peat delves beneath a cursory recounting of milestones and accomplishments to describe the assumptions and methods used by researchers. He traces the efforts to decipher human patterns and ambiguities and translate them into computer logic. Speech recognition and synthesis, expert systems, robotic vision, supercomputers, and a virtual alphabet soup of acronym-named programs are covered.

Peat weaves an interesting tale of the exploits of AI researchers in their quest for a "thinking" machine. Those interested in reading a solid introduction to AI can't go wrong with *Artificial Intelligence*.

---

**The Portable Computer Book** by James E. Balmer and Mattijs Moes. Arrays Inc. Book Div., 11223 S. Hindry Ave., Los Angeles, CA 90045. Softcover, 353 pages, $19.95



*The Portable Computer Book* describes just about everything you can buy in the microcomputer marketplace—from hardware to software to telecommunications service. Computing neophytes will get a solid general introduction to computers.

However, knowledgeable users, presumably the main target of portable computer marketing, will find most of the information repetitious. The one saving grace of the book is the exhaustive capsule descriptions and reviews of just about every lap, notebook, portable, and transportable computer system. Another bright spot in an otherwise stale script is the chapter on hardware and software compatibility, a prime concern of potential portable computer buyers.

Frankly, *Creative Computing* has covered all of the big name machines and many of the not-so-big-name machines. If this is your first issue of *Creative Computing* and you have just heard of portable computers, you may want to pick this book up. Otherwise, leave it on the shelf.

---

**A Hobbyist's Guide to Computer Experimentation** by John D. Lenk. Prentice Hall, Englewood Cliffs, NJ 07632. Hardcover, 283 pages, $25.95

This is a no-nonsense book for the real technical enthusiast who wants to explore the intricasies of computer electronics. Starting with an explanation of tools and equipment, Lenk jumps right into experiments with logic gates, flip flops, circuits, displays, analog/digital converters, and microprocessors.

Home hobbyists, electronics tinkerers, people who buy Heathkits, people who buy Hero robot kits, and other do-it-yourselfers will find this book fascinating.

# BOOK BRIEFS

## Basic

**Executive Computing in Basic: The IBM Personal Computer** by Peter Mears. Holt, Rinehart, and Winston, 521 Fifth Ave., New York, NY 10175. Softcover, 257 pages, $19.95

Designed for the programming neophyte, the book teaches the fundamentals of Basic on the IBM PC. It provides step-by-step instructions for creating short inventory, payroll, and other business-related programs.

**At Home With Basic** (for Commodore 64) by Henry Mullish and Dov Kruger. Simon & Schuster, 1230 Avenue of the Americas, New York, NY 10020. Softcover, 270 pages, $12.95

With a minimum of fluff, this book takes you through the fundamentals of Commodore Basic.

**Using Microsoft Compiled Basic** by Murray Lesser. McGraw-Hill, 1212 Avenue of the Americas, New York, NY 10020. Softcover, 264 pages, $16.95

The all-inclusive guide to the Microsoft Basic compiler running under CP/M 2.2 or 1.4 is written for intermediate to advanced Basic programmers.

**Basic Atari Basic for the 400, 800, and XL Computers** by James S. Coan and Richard Kushner. Hayden Book Co., Hasbrouck Heights, NJ 07604. Softcover, 324 pages, $15.95

This rather complete book teaches Atari Basic using numerous short programming examples.

**Let's Learn Basic** by Ben Schneiderman. Little Brown & Co., 34 Beacon St., Boston, MA 02106. Softcover, 194 pages, $8.95

Written for 8- to 14-year-olds, the book teaches the fundamentals of Basic programming. Separate versions are available for the Apple II, Commodore 64, IBM PC, and Atari computers.

**Applesoft Basic Toolbox** by Larry G. Wintermeyer. Addison Wesley, Reading, MA 01867. Softcover, 514 pages, $16.95

More like a magic bag than a toolbox, this book provides a tremendous amount of information in creating Applesoft Basic programs.

**Basic Adventure and Strategy Game Design for TRS-80** by Jim Meniak. Facts on File Publications, 460 Park Ave. South, New York, NY 10016. Softcover, 260 pages, $9.95

Using TRSDOS 6.0 and the accompanying version of disk Basic, the book guides you in creating Basic games on the TRS-80. It includes two sections—adventure games and strategy games—and a line-by-line analysis of two games.

**Basic Computer Programming for Kids** by Pat Cassidy and Jim Close. Prentice Hall, Englewood Cliffs, NJ 07632. Softcover, 220 pages, $11.95

Written by two middle school teachers, *Basic Computer Programming for Kids* teaches children using TRS-80 and Apple II computers the fundamentals of Basic.

## Lotus 1-2-3

**Lotus 1-2-3 User's Handbook** by Weber Systems Staff. Ballentine Books, 201 E. 50th St., New York, NY 10022. Softcover, 326 pages, $9.95

This book teaches you to use the functions and features of *Lotus 1-2-3*. It includes numerous step-by-step examples.

**MicroRef Quick Reference Guide for Lotus 1-2-3.** Educational Systems, 1000 Skokie Blvd., Wilmette, IL 60091. Softcover, 83 pages, $16.95

If you use *Lotus 1-2-3*, buy this handy guide—it will save you hours of searching through the manual. Other guides are available for *WordStar*, *MultiPlan*, *SuperCalc*, and *VisiCalc*. I have used the excellent *WordStar* guide for over a year.

**Business Worksheets for Lotus 1-2-3** by Jack Grushcow. Reston Publishing, 11480 Sunset Hills Rd., Reston, VA 22090. Softcover, 270 pages, $16.95

This book shows you how to create a series of accounting worksheets to handle general ledger, accounts receivable, accounts payable, and payroll functions.

**Lotus 1-2-3 Simplified** by David Bolocan. TAB Books, Blue Ridge Summit, PA 17214. Softcover, 184 pages, $10.25

A fine tutorial helps you create spreadsheets and graphics with *Lotus 1-2-3*. It includes several examples.

**The ABCs of Lotus 1-2-3** by Bill Kling. Scott Foresman & Co., 1900 E. Lake Ave., Glenview, IL 60025. Softcover, 403 pages, $18.95

This how-to book leads the *Lotus 1-2-3* novice by the hand, from finding the disk drive through creating databases. It includes several examples.

**Business Graphics with Lotus 1-2-3** by William R. Osgood and Dennis P. Curtin. Curtin & London Inc., 6 Vernon St., Somerville, MA 02145. Softcover, 201 pages, $19.95

This book shows how to create *Lotus 1-2-3* graphics to analyze your business. It includes many examples and touches on basic business management principles.

## Operating Systems

**Starting With Unix** by P.J. Brown. Addison Wesley, Reading, MA 01867. Softcover, 221 pages, $12.95

This introduction to Unix explains the ideas and concepts behind the operating system and then shows how to use it.

**Inside CP/M Plus; Inside CP/M-86; Inside Concurrent CP/M** all by David E. Cortesi. Holt Rinehart and Winston, CBS College Publishing, 383 Madison Ave., New York, NY 10017. Softcover, 261 pages, $17.95

The author of *Inside CP/M* helps you master the various operating systems.

**MS-DOS User's Guide** by Paul Hoffman and Tamara Nicoloff. Osborne/McGraw-Hill, 2600 Tenth St., Berkeley, CA 94710. Softcover, 312 pages, $17.95

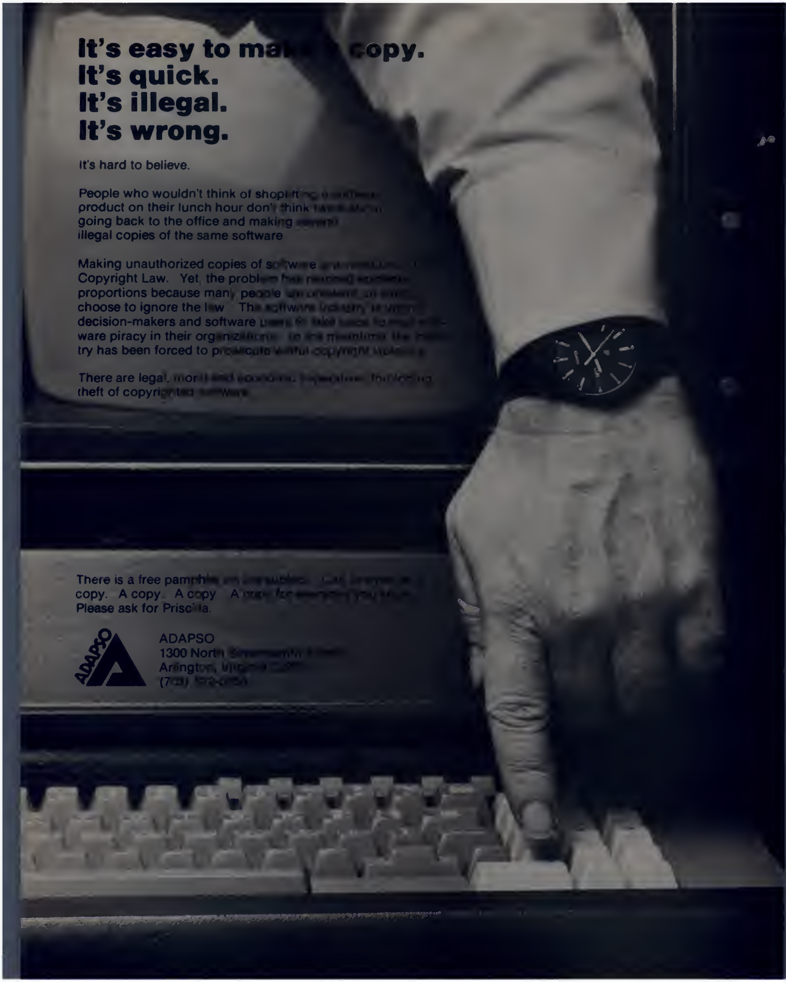
A well-done, step-by-step guide to learning the idiosyncrasies of MS-DOS and PC-DOS.

**ProDos Quick and Simple** by John G. Burdick and Peter B. Weiser. Scott Foresman & Co., 1900 E. Lake Ave., Glenview, IL 60025. Softcover, 246 pages, $19.95

This how-to book describes the features and functions of ProDos. It includes a chapter on converting DOS 3.3 files and programs to ProDos.

**Inside Commodore DOS** by Richard Immers and Gerald G. Neufeld. DataMost, 20660 Nordhoff St., Chatsworth, CA 91311. Softcover, 508 pages, $19.95

The subtitle reads "the complete guide to the 1541 disk operating system." How true. For advanced programmers only. ■


It's easy to ma copy.
It's quick.
It's illegal.
It's wrong.
It's hard to believe.
People who wouldn't think of shopl
product on their lunch hour don't think
going back to the office and making
illegal copies of the same software
Making unauthorized copies of software
Copyright Law. Yet, the probl
proportions because many people
choose to ignore the law
decision-makers and software
ware piracy in their organ
try has been forced to pr
There are legal, mor
theft of copyri
There is a free pamph
copy. A copy. A copy. A
Please ask for Priscilla.
ADAPSO
ADAPSO
1300 North
Arlington,

# Now the
# can do some

Apple's Macintosh, "the computer for the rest of us," is probably the most advanced and easiest to use computer on earth. But until now, Mac couldn't be taken seriously for word processing. Enter Microsoft Word for the Macintosh. Mac's professional word processing program.

Word runs the most popular letter quality printers. It doesn't limit your manuscripts to 10 pages or even 50 pages. Because one Word document can hold as many pages as you can fit on a disk.

And Word not only sets up footnotes, columns and special formats in a flash, it has a whole disk full of other features to make your writing go faster.

<u>Word does windows</u>.

Unique to Word is its ability to "window" up to four pieces of work on the screen at once.

So while you're typing one document, you can have pages from three others on the screen for reference. Or to cut and paste between documents quickly.

Which can save a lot of the time you'd spend opening and closing files.

<u>Key phrases at a keystroke</u>.

If you have a lot of stock paragraphs you use in your writing, Word's <u>glossary</u> feature puts them at the tip of your typing fingers. Just store the pieces of text you need and you can recall them instantly.

And if you want an alternative to mouse work, you can run your Mac the old fashioned way. Because Word gives you the option to execute commands from the keyboard.

By the way, you don't have to write off your MacWrite documents to convert to Word. It'll run them all right off the bat.

# RECREATIONAL COMPUTING

## The Challenge of Self-Reference/**Michael W. Ecker**

Greetings! Welcome to "Recreational Computing," a new column which will appear regularly in *Creative Computing.* We will play, explore, challenge, as well as form conjectures, test them, and just plain have good programming fun.

I would especially like to invite all readers to try the challenges, come up with your own solutions, and your own problems as well. They should be recreational in nature. Digit delving and other forms of "microcomputer mathemagic" in Basic are what I have foremost in mind, but I wish to hear from you. Your ideas, if used, will be acknowledged in this column. I solicit your new problems, programs, improved solutions, etc. I will also answer readers who have pertinent questions and who supply a SASE. You may write to me directly: Michael W. Ecker, Ph.D., Contributing Editor, *Creative Computing,* 129 Carol Dr., Clarks Summit, PA 18411.

Please try to keep your solutions in generic Basic (Microsoft), and as machine-independent as possible. For those who wish to send longer programs, please note that I do not have time to type in long listings, so if you have one of the following machines, magnetic media submissions are welcome: I have a TRS-80 Model 3 with 48K and two disk drives and tape, a TRS-80 Model 4P with 128K and two disk drives, and a Sanyo MBC-555 with 256K and two single-sided drives under MS-DOS 1.25 only. The Sanyo can read IBM PC Basic programs if you save them in ASCII format on one side only. I do have access to other machines, including IBM PCs, but these are less convenient.

Please also feel free to keep the editors aware of your interest so that we can see whether there is sufficient interest for an expanded column. I think you will be pleased to know that this column is partially a result of a survey taken earlier by *Creative Computing* in which you readers indicated interests beyond the ordinary business applications so prevalent in other magazines. Credit *Creative* and David Ahl for responding to your wishes. And now, off to our first problem.

Dr. Michael W. Ecker is Associate Professor of Mathematics and Computer Science at the University of Scranton in Scranton, PA.

Last year, Andy Bulfer of New Jersey wrote to me and posed the following very interesting challenge. It might not be brand new, but it is a natural one that you will enjoy. Write a program which, when run, produces an exact listing of the program itself—no more and no less. Worded that way, of course, there is an easy solution. Think about it before you read on.

Have you thought about it? The trivial solution is a one-liner:

```
10 LIST
```

but somehow that hardly seems sporting. Suppose we insist on a solution that will run on as many machines as possible (no PEEKS or POKES, CALLS, machine language subroutines, input, etc.) and which does not allow the LIST command. Can you find a solution then? Next time I will publish one of Dr. Bulfer's ingenious solutions.

> **In the world of programming, running applications is analogous to using language.**

The explanation behind the title this month lies in the analogous situation with logical puzzles. The prototype of these is Russell's Paradox. One version of this goes as follows: Sal is a barber in the town of Seville. His clients are precisely *all* the barbers of Seville who do not shave themselves; *nobody else is a client.* The question is: Who shaves Sal?

If Sal shaves himself, then he must be one of his own clients, since he shaves nobody else. That makes him, by construction, a barber who doesn't shave himself. Hence, if he shaves himself, he doesn't shave himself.

On the other hand, if Sal doesn't shave himself, he is a barber of Seville who doesn't shave himself. But that makes him one of his own clients. Hence, Sal shaves Sal. It follows that if he doesn't shave himself, then he does.

In summary, we have a paradox: he shaves himself if and only if he doesn't't!

The element of self-reference may be thought of as the culprit. Actually, the real problem lies in the inadmissible mixture of ordinary language (object language) with language about language (metalanguage). You may see this more clearly with this easier example: This sentence is false.

Is that true or false? Again, if true, then it's true that it's false, so it's false. But if it's false, then it's false that it's false, so it must be true. In other words, a paradox: it's true if and only if it's false. The problem is the intermingling of metalanguage (to judge truth or falsity) and object language (used for ordinary sentences, the ones about which judgments may be later made).

In the world of programming, running applications is analogous to using language. Editing and listing are analogous to using metalanguage (language or devices to act on the language—the listing—itself).

This programming challenge should provide some good food for thought. Next time I will show Dr. Bulfer's very interesting solution, which he wrote for an Apple computer. I should point out that, very strictly speaking, most other computer owners will not be able to solve this 100%—about 99% maybe. The reason for this is that the Basic interpreter on an IBM PC, a TRS-80, a Sanyo 550 or 555, and many other machines with Microsoft Basic, inserts an additional space in front of numbers. If you use one of these computers and have the command:

Print "10 Print (message)"

upon execution, you will get your 10 Print (message), but you will note that the first digit, 1, is printed in the second column on your screen, not the first. The listing, however, will always be printed out flush left. I doubt that we can do anything about that, however. Next time I will give the solution with the modification and indicate what to change for you more fortunate (in this one case, that is) Apple owners.

Until next month, happy recreational computing! ■

# TELETALK

## What's So Standard About RS-232?/Corey Sandler

Have you ever wondered why most medical doctors practice and practice until their handwriting (in Latin, no less!) is all but undecipherable by mere patients like us? It is all part of the process of "mystification" by which the ordinary is made to seem extraordinary, and by which we suspend all ordinary measures of what 12 minutes of someone's time and a tongue depressor are really worth.

I've decided that it is professional mystification that is also at work in the computer communications field—my final conclusion after nearly ten years of trying to figure out why something that is called the RS-232C "standard" is actually about as standardized as the Republican Party and the Supreme Soviet.

("Why, sure we sell standard RS-232C cables," the computer store dealer told me. "Which one do you want? The RTS/DCE standard? The DTE standard? The IBM male to male DB-25? The IBM female to 9-pin C-shell? The gold standard?")

In my business as a writer on microcomputer topics, I am constantly installing and trying out new pieces of hardware and software in one or another computer. If I were to connect together all of the cables in my collection of "standard" RS-232C cords, they might reach from Silicon Valley to Boca Raton—but they probably wouldn't work together.

I have recently embarked on another great search for the proper cable to connect the RS-232C output (an unusual, round female DIN plug) on my laptop portable computer to the DB-25 input on a lightweight thermal printer. So far, no luck, but then again I've only been at it for three weeks.

Anyway, I decided to go to the record books. Here's what I found: the RS-232C specification is an Electronics Industries Association (EIA) Standard, put into effect back in the dinosaur age of computing, 1969. It was written to establish, once and for always, the official way to make an interface between Data Terminal Equipment (DTE) and Data Communications Equipment (DCE) using serial digital data transmission. In most cases today, a piece of DTE is more commonly referred to as a computer; an item of DCE is a modem or a printer.

The "standard" defined the EIA position on electrical signal characteristics, the mechanical elements of the connection, and a functional assignment for interchange circuits. Table 1 lists the official pin assignments as implemented in the official 25-pin DB-25 connector.

Now, that all sounds so very neat. All of the important elements of telecommunications are there—the transmit and receive channels, communication rate and signal quality checks, and the important back-and-forth "handshaking" connections. (This is how most computers communicate. Computer A: "Are you ready to receive?" Computer B: "Yes." Computer A: "Look out, here it comes." Computer B: "Got it. Want me to read it back to you?" And so on.)

**Table 1.**

| Pin | Name of Signal | Direction |
|---|---|---|
| 1 | Earth Ground | |
| 2 | Transmitted data | To DCE |
| 3 | Received data | To DTE |
| 4 | Request to send | To DCE |
| 5 | Clear to send | To DTE |
| 6 | Data Set ready | To DTE |
| 7 | Logic ground | |
| 8 | Carrier detect | To DTE |
| 9 | Reserved | |
| 10 | Reserved | |
| 11 | Unassigned | |
| 12 | Secondary carrier detect | To DTE |
| 13 | Secondary clear to send | To DTE |
| 14 | Secondary transmitted data | To DCE |
| 15 | Transmit clock | To DTE |
| 16 | Secondary received data | To DTE |
| 17 | Receiver clock | To DTE |
| 18 | Unassigned | |
| 19 | Secondary request to send | To DCE |
| 20 | Data terminal ready | To DCE |
| 21 | Signal quality detect | To DTE |
| 22 | Ring detect | To DTE |
| 23 | Data rate select | To DCE |
| 24 | Transmit clock | To DCE |
| 25 | Unassigned | |

Therefore, you might think, any computer or modem manufacturer who claimed to adhere to the RS-232C standard would be telling you and me that we could find that good old RTS signal over there on pin 4, and the ever-popular DTR across the way on pin 20. But, no . . .

Taking a page from *Alice in Wonderland*, the EIA says that there are actually 13 standard but different implementations of the signal connections for an RS-232C interface. They have designated them with letters from A to M. But just to make absolutely certain that even that attempt at standardization is of no value, they added an Interface Type Z. What is Z? Why, it's "anything else."

We mere users get to pay outrageous prices (one local store gets 65 bucks for a three-foot "standard" cable), because it is all but impossible to have the right connection the first time.

Well, as a public service to the readers of this august publication, I'd like to let you all in on two trade secrets that just might save your job, your family life, or your computer.

The first is a wonderful little device called a Smart Cable, available from IQ Technologies Inc., 11811 N.E. First St., Suite 308, Bellevue, WA 98005. This little black box is definitely a creation from the witch doctor's back room. It sits between your basic DCE and DTE (computer and modem or printer, remember?) and somehow manages to figure out what is being sent on which wire from one device, and at the same time what is being expected on which wire on the other device. I don't understand it, but I'm quite willing to be mystified here, since it works in 95% of the cases I've tried.

And now I've been introduced to one more bit of American ingenuity: a set of fat white looseleaf binders called *Micro Match* from a company called Command Computer Corp., P.O. Box 5096, Philadelphia, PA, 19111. (215) 745-5555.

Want to know how to hook up a Novation J-Cat modem to the asyn-

chronous communications card on the IBM PC? Why, look it up in the index and you'll find that it requires a "standard" RS-232C cable with pins 2, 3, 5, 6, 7, and 8 connected straight through. You'll also find specific mode, parity, switch, and jumper settings for the computer and for the modem, as well as general advice on serial cable grounding principles, length limits, and wire types.

Want to hook up an Altos Computer to that very same Novation J-Cat modem? Why, you need the "standard" RS-232C cable with pins 1 and 7 connected straight through, pins 2 and 3 crossed in each direction, and pin 20 on the computer side connected to pin 8 on the modem side.

I wish it weren't so, but until manufacturers can get their acts straight, the *Micro Match* blueprints and indexes should be required products as all computer dealerships. And, if your office or personal setup has a regular influx of new "standard" RS-232C devices, these books should pay for themselves in aggravation relief within minutes of receipt.

### Pony Express Revisited

A stupendous battle between a couple of not-small contenders in the growing field of electronic mail utilities is in the making. Leading the pack is MCI Mail, an offshoot of the MCI long distance telephone service. Sniping from a bit back is EasyLink, from Western Union, which can draw its lineage directly back to the Pony Express. And soon to lumber onto the scene is the diversifying and hungry AT&T giant.

Speaking of the Pony Express, though, I find myself amused at the two latest services being offered by these electronic postal services.

EasyLink sent me an "Express Document," a laser-printed hand-delivered envelope it says can wing its way from a personal computer to someone's personal hands in two hours or less.

The system works like this: I type a document into the memory of my computer (mine is made by IBM), dial up EasyLink (on my modem from Code-a-Phone), going through the discount long distance utility that connects our house out in the country to New York (MCI, as a matter of fact), and link to Western Union. The folks there bounce my message off a satellite or through a cable to an office somewhere near me where it is printed out and stuffed into an envelope. And then a delivery truck from DHL Worldwide Courier Express picks up the package and heads for the hills.

Well, it works—as does a similar four-hour service from MCI Mail—but it sounds like the Pony Express to me.

And then MCI fires back with a new service that they say is the latest thing in electronic communication: MCI Mail Alert.

Alert works like this: from my computer to the long distance utility to the MCI system and there into the electronic mailbox of the person I am sending the message to. And then a friendly operator at MCI will telephone the lucky recipient (up to three calls within a two-hour period) and tell him, "You have a message in your mailbox. Why don't you sign on and read it some time?"

It sure sounds like the way telegrams are delivered these days—isn't that Western Union's business? ■

# Ten Good Reasons To Buy Sams Two New Commodore Books.


Nobody covers Commodore® like Sams. That's because nobody knows technical publishing like Sams. We've been the leading technical publisher since 1946.

We're responsible for bringing you the best-selling COMMODORE 64 PROGRAMMER'S REFERENCE GUIDE. The first and only comprehensive guide to using the Commodore 64. And that's just the beginning.

We have Commodore books that teach you how to program in BASIC, use graphics and sounds, set up a trivia data base, and repair and troubleshoot. Ten books in all.

So it only stands to reason that you can turn to Sams for the books you need on Commodore's two new computers—the Commodore 16 and Plus/4.

Our just-released COMMODORE 16 USER'S MANUAL is for intermediate users who want to go beyond the basics with their Commodore 16. THE COMMODORE PLUS/4 BOOK is a beginner's guide to mastering the Plus/4 integrated spreadsheet, word processing, graphics and file management programs.

And like all our Commodore books, our new Commodore 16 and Plus/4 books make learning fast and easy!

If you own a Commodore, now you have a dozen good reasons to buy Sams books: COMMODORE 16 USER'S MANUAL, No. 22437, $12.95, THE COMMODORE PLUS/4 BOOK, No. 22389, $16.95, and our ten popular Commodore 64 books:

- COMMODORE 64 STARTER BOOK, No. 22293, $17.95
- LEARN BASIC PROGRAMMING IN 14 DAYS ON YOUR COMMODORE 64, No. 22279, $12.95
- COMMODORE 64 TROUBLESHOOTING AND REPAIR GUIDE, No. 22363, $18.95
- COMMODORE 64 PROGRAMMER'S REFERENCE GUIDE, No. 22056, $19.95
- TOOL KIT SERIES: COMMODORE 64 EDITION, No. 22314, $9.95
- COMMODORE 64 TRIVIA DATA BASE, No. 22396, $8.95
- COMMODORE 64 GRAPHICS AND SOUNDS, No. 22278, $8.95
- COMMODORE 64 BASIC PROGRAMS (2nd Edition), No. 22402, $9.95
- MOSTLY BASIC: APPLICATIONS FOR YOUR COMMODORE 64, Book 1, No. 22355, $12.95
- MOSTLY BASIC: APPLICATIONS FOR YOUR COMMODORE 64, Book 2, No. 22356, $14.95

Look for Sams Commodore books at your local bookstore or computer dealer. Or call Operator 102 at 317-298-5566 or **800-428-SAMS.**

SAMS™

HOWARD W. SAMS & CO., INC
A Publishing Subsidiary of ITT
4300 West 62nd Street, P.O. Box 7092, Indianapolis, IN 46206

Offer good in USA only. Prices and availability subject to change without notice. In Canada, contact Copp Clark Pitman Ltd., 495 Wellington Street West, Toronto, Ontario M5V 1E9.



**CIRCLE 157 ON READER SERVICE CARD**

# Wristwatch Terminals

## The Datagraph System and PC Datagraph give timepieces a new dimension/**Joe Desposito**

A wristwatch that connects to a computer sounds like something out of a Dick Tracy comic strip. But it's for real. Seiko has coined the term datagraph (data terminal/chronograph) and introduced two products, the Datagraph System and PC Datagraph, that allow you to upload information from a base-station computer to a wristwatch.

With these products, it is possible to enter information such as phone numbers, memos, and schedules into a computer and transmit them to the watch. Then, with the press of a button, you can retrieve the information from the watch anywhere and anytime.

The Datagraph System consists of a wrist module, a controller, and a mini-keyboard. You enter information into the controller through its keyboard, press a button, and the information is transferred to the watch. Alternately, you can enter data through the mini-keyboard for transfer to the watch. The suggested retail price of this system is $340.

The PC Datagraph is a wrist terminal that connects to your personal computer through its serial port. Information is entered at the computer and then loaded into the watch. The cost of the PC Datagraph is $150. It works with the IBM PC and compatibles, the PCjr, Apple II series computers, the Commodore 64, and the Radio Shack Model 100.

### Electromagnetic Data Transmission

At first glance, the Datagraph System watch appears similar to its five-function LCD cousins. It has a stainless steel band and a face that shows day, date, and time. Four buttons reside just below the display. But inside its modest looking case is enough RAM to hold 2000 characters of data, or a full month's schedule at 20 characters per day. The problem is how to fill up that memory space with just four buttons. The solution is a controller: a package the size of a good paperback, with a Chiclet keyboard, a thermal printer, a ROM pack, and an electromagnetic transmission circuit (ETC).

To fill up the memory all you do is place the watch on the ETC (look, Ma, no connections), press the transmit button on the watch, type in the data on the controller, and signal when you are through. Simple. And reassuring to sci-fi buffs who knew all along that this was the logical way to do it.

Whatever you enter into the watch (memos or your schedule) can be sent to the printer for a hard copy. It is the high-tech way to write notes to yourself. And if you want to get fancy there are little graphics characters, like a telephone handset, wine glass, bell, and others, that you can add to a memo.

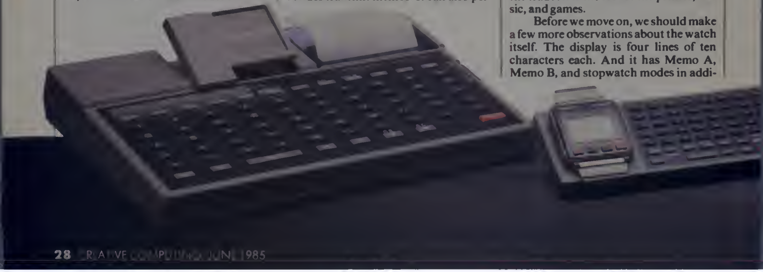
The controller can do other things besides transmit memos. It can also perform like a four-function calculator with the watch face as its display. There are a couple of problems, however. The calculator can't access the printer, and the calculator shuts off after about ten minutes of inactivity, losing whatever is in memory.

Another feature of the controller is that you can do Basic programming on it. The controller has an 8K subset of Microsoft Basic built in and either 1561 or 2922 bytes of RAM to work with. The watch is used as the display. Don't get excited though. You can't put a program into the watch and run it *sans* controller. The watch may be able to substitute for "crib sheets" through its memo function, but it can't make calculations on the run. Anyway the system is fairly slow, taking about 9.4 minutes to complete Ahl's CC Benchmark with an accuracy mark of .187805 (see *Creative Computing*, July 1984).

For those times when you have a few hours to kill, games can be loaded into the watch and played from it. Included are a horizontal version of Space Invaders, a four-man race complete with betting odds, computer concentration, and a fortune telling game called Amida's luck.

If you find that the controller is inconvenient to carry along with you, the mini-keyboard fits in a shirt pocket. But the tradeoff is the loss of the printer, Basic, and games.

Before we move on, we should make a few more observations about the watch itself. The display is four lines of ten characters each. And it has Memo A, Memo B, and stopwatch modes in addi-



# From Seiko

tion to its normal time/calendar mode. When you load the monthly schedule, it replaces Memo A and B. Only one game can be resident in the watch at a time, and any of them replaces both Memo A and B or the monthly schedule. The watch can emit an hourly time signal as well as sound a daily alarm. The controller is not needed to set the normal watch functions.

### The PC to Wristwatch Connection

The PC Datagraph foregoes electromagnetic transfer and settles for transmission through the serial port of any of a number of personal computers. The PC Datagraph we tried was for the IBM PC and compatibles.

The watch itself has a two-line by 20-character display and six buttons below it. It normally displays time, day, and date. The band is black stainless steel. To load information into the watch, a special connector attaches between it and the RS-232 port of an IBM PC.

The software included with the PC Datagraph allows you to enter 80 data entries 24 characters long. It is written in Basic and menu driven. You can enter memos, schedule alarms, weekly alarms, and world time. To navigate through your "database," you can assign a label to each memo or alarm. Once your labels are loaded into the watch, a "terminal" button jumps you from label to label. Once you find the label you want, arrow buttons step you through the memo. However, you can also set a schedule or weekly alarm, in which case the watch beeps and automatically displays the message that you entered earlier.

Setting up the watch for transmission is straightforward except for one thing—Seiko provides a cable with a male RS-232 connector. Normally, serial boards for the IBM PC also use the male connector. So we had to insert a gender changer between the two of them. Otherwise transmission went smoothly.

### Conclusions

Whether or not you can be seduced by the idea of wearing a datagraph on your wrist, there are some hard questions to answer about these products. I happen to have spent $150 on a five-function Seiko LCD some years ago and have never regretted the purchase—even when the prices came tumbling down. However, to spend $340 on the Datagraph system seems to me to border on lunacy. At $150, however, the PC Datagraph is worth considering. For me it would help clean up the wads of notes and phone numbers that I continuously stuff into my wallet. And the alarm features are just the thing to help meet appointments and avoid parking tickets, among other things. However, there may come a time when you want to load some data into the watch, but your PC is not readily available.

To sum up, I think the Datagraph idea is interesting and has some potential, but it may fall short in practice. ■

CIRCLE 401 ON READER SERVICE CARD

### Hardware Profile

**Name:** Seiko Datagraph System **Type:** Wrist terminal
**Components:** UC-2000 wrist module, UC-2100 mini-keyboard, UC-2200 controller
**Display Resolution:** 4 lines x 10 characters LCD
**Port:** Electromagnetic coupling, duplex serial system
**Documentation:** UC-2100, UC-2200 and Basic manuals
**Summary:** Extends the capabilities currently found on LCD watches to include memo and schedule storage and display **Price:** $340

**Name:** Seiko PC Datagraph **Type:** Wrist terminal
**Components:** RC-1000 Wrist terminal, RS-232 cable, software
**Display Resolution:** 2 lines x 20 characters **Port:** RS-232
**Documentation:** RC-1000, software manuals
**Summary:** Links a wristwatch to most PCs for message storage and alarm functions
**Price:** $150
**Distributor:** Hattori Corporation of America
Consumer Electronics Division
1330 West Walnut Parkway
Compton, CA 90220
(213) 603-9550

# How to avoid paying your bills.

*by Alan Greenspan*

*Alan Greenspan, Famous Economic Advisor*

## Everyone has to pay their bills, and nobody likes to do it.

You can keep file folders full of bills, drawers stuffed with grocery receipts, envelopes brimming with cancelled checks, and at the end of the month, it still takes hours to figure out just where your money has gone. Not to mention how long it takes to straighten things out at the end of the year.

Well, after years of financial consulting, I've discovered a way to avoid paying your bills: let an Apple® II Personal Computer pay them for you.

There are several advantages to letting an Apple handle your finances.

It will save you time.

It will organize everything.

It will tell you, at a glance, exactly what is going on with your money.

It will pay your bills, and never send you any.

And now, I'd like to turn the page over to those nice people at Apple, who will explain, in their own excruciating detail, just what I'm talking about."

"The other day, a prominent politician in the executive branch of our government phoned me up.

'Alan', he said to me, 'the budget is a mess.'

'No joke,' I said.

'Not that budget,' the prominent politician continued. 'My budget. My checking's overdrawn. They're threatening to disconnect my phones. I even got into a shouting match with my wife when I tried to lay off the servants.'

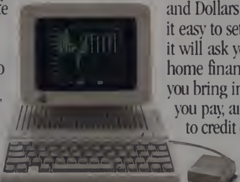
'Civil?'

'Not very. And I think I'm about to be audited. What would I show them? Who keeps receipts for embassy parties?'

At this point, we were disconnected. And although it was too late to teach proper money management to this prominent politician, there is a lesson all of us can learn from his misfortune.

## The Apple II and the Home Budget.

With software programs like The Home Accountant™ and Dollars & Sense,™ the Apple II makes it easy to set up household books. First, it will ask you some questions about your home finances. Like how much money you bring in each month, how much rent you pay, and whether you owe money to credit card companies, mortgage holders, or any other surly characters. Then, it will ask you to enter some of the bills you receive each month whose prices may vary:



*An Apple II will take care of everything from your household budget to your taxes with software programs like Dollars & Sense, The Home Accountant, and Tax Preparer* phone, utilities, and the like. Then, it will ask you where you keep your money, and for the numbers of your various checking and savings accounts.

That's really all there is to it. After that, an Apple II can automatically write checks for all your fixed expenses each month. It will also tell you what other bills you can be expecting, and when you enter their costs, an Apple II will pay them, too.

An Apple II will see to it that your checkbooks remain balanced, and that you'll know when your expenses are about to exceed your income. It can even help you plan to buy a new car. Or a home.

Or a fur-lined boat, if your budget permits.

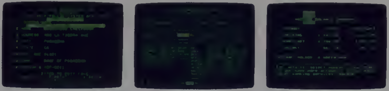
*With our Scribe® color graphics printer you can automatically print out your own checks — not to mention reports, papers, almost anything. Except money.*

## How to avoid your banker.

After the Apple II writes your checks, it can call your bank with the help of your telephone and an Apple modem. And faster than a teller can say "Next window, please," you can find out all your balances, enter deposits, see what checks have cleared, transfer money from one account to another, and even pay off some of your credit cards and other bills electronically — without ever writing a check.

So the only time you'll have to go to the bank is when you want to visit with your money, personally.

Which, when done in moderation, we can recommend most highly.



*It can manage your entire stock portfolio with programs like Dow Jones Investor's Workshop™ and Charles Schwab and Company's The Equalizer.™ It can even show you what's going on in your bank account.**

## The Apple II and making money.

An Apple II can do wondrous things for your personal finances. With several different software programs, you can become your own stockbroker. Again, by using an Apple modem, you'll gain instant access to financial news sources like *The Wall Street Journal*, *Barrons*, and the Dow Jones News/Retrieval® service. Find out what they've been saying on *Wall $treet Week*. And in most cases, get up to the minute price quotes on over six thousand stocks, options, and other securities.

*This is an Apple modem. Not much to look at, we admit. But it does let you pay bills and trade stocks by phone. It also connects your Apple II to a wealth of information services, like THE SOURCE℠ and CompuServe®.*

An Apple II lets you buy and sell securities right in your home or office, at the moment you want to make the trade. It automatically updates your portfolio and gives you detailed holding reports. It even produces charts and graphs, so you can quickly see how you and your investments are doing.

## A little tax relief.

If you become perturbed everytime the subject of doing taxes comes up, an Apple II can do them for you with programs like Forecast™ and Tax Preparer.™

It can store your records, plan for the next year, and calculate your taxes.

You'll be alerted to payments you've made over the year that may be tax-deductible. It even keeps year-round records, automatically updating totals and making corrections for you. It will even print out completed tax forms that the I.R.S. will accept.

And it can do about 10,000 other things totally unrelated to taxes or this ad. So there's no telling how far an Apple II can take you.

"Well, I think that about covers it. And what if, after all of this, you still have some money left over?

Congratulations. You're doing a lot better than the government."

# AT&T 6300

## Clash of the Titans: Round one/**Russ Lockwood**

For better or worse, the breakup of Ma Bell has forced giant AT&T to crawl out from under the monopolistic blanket of protection and into the competitive high-technology arena. AT&T has taken its size, household name, budget, and reputation for quality into the computer marketplace with the 6300, an imported Olivetti-made IBM PC compatible.

For its first foray, AT&T has done a commendable job. The 6300 is a solid IBM PC compatible. Like other desktop computers, the 6300 consists of three components: a display, detachable keyboard, and system unit housing the cpu, disk drives, and electronic innards of the system.

The Olivetti-made 6300 sports a smaller footprint than the IBM PC, which gives you a little more desktop space. Lifting off the system unit cover reveals an 8086 microprocessor running at 8 MHz. The benchmark results in Table 1 will give you an idea of the faster speed of the 6300 compared to the IBM PC. (For a detailed description of the benchmark test, see the July 1984 issue of *Creative Computing*.)

The AT&T 6300 supports an 8087 numeric co-processor, runs MS-DOS, and comes with .28K RAM (expandable to 640K), a serial port and a parallel port, and two 5.25" 360K floppy disk drives. An optional 10Mb Winchester hard disk drive can replace one of the floppy drives.

The 6300 system unit includes seven expansion slots. Note that the hard disk version uses one of the slots for the drive controller board, leaving you six expansion slots. Five of the seven slots accept the standard eight-bit expansion boards made by the host of third-party manufacturers. The other two slots are designed to accept the newer and faster 16-bit boards.

### Hardware Profile

**Name:** AT&T 6300 **Type:** Business computer
**CPU:** 16-bit 8086, 8 MHz **RAM:** 128K (expandable to 640K)
**Keyboard:** Detachable, 84 keys, slant adjustable
**Display:** 80 x 25 characters; normal graphics, 320 x 200 pixels (four colors); enhanced graphics, 640 x 400 pixels (16 colors)
**Disk drives:** Two 360K 5.25" floppy drives or one floppy and one 10Mb hard disk drive
**Ports:** One RS-232C serial and one parallel
**Dimensions:** System unit: 16.5" x 15" x 6"; Keyboard: 18.2" x 8" x 1.3"; Display: 16.7" x 13.7" x 15.2"
**Operating System:** MS-DOS **Documentation:** Looseleaf user's guide
**Summary:** Slow-selling but fast processing Olivetti-made IBM PC compatible
**Price:** 128K, graphics board, and two floppy drives $2499
**Manufacturer:** AT&T Information Systems
111 Westwood Pl.
Brentwood, TN 37027
(800) 247-1212

| | Time | Accuracy | Random |
|---|---|---|---|
| IBM PC | 24 seconds | 0.1159668 | 6.3 |
| 6300 | 8 seconds | 0.0058594 | 7.2 |

**Table 1. Ahl's Simple Benchmark Test.**

However, these 16-bit slots are not compatible with the scheme used in the IBM PC AT, which partially explains the dearth of third-party boards made specifically for the 6300. In fact, although the 6300 has been available for over a year, Thesys is one of the few companies that offers a board (see sidebar) specifically for the AT&T computer. AST Research has agreed to make communications boards and may offer additional boards in the future.

The display adapter drives both a monochrome and color monitor. Graphics resolution is 640 x 200 pixels (black and white) or 320 x 200 pixels (four-color), and text resolution is 25 lines of 80 characters. On our green-screen monochrome monitor, different colors are displayed as different shades of green. The monitor sits on a handy tilt/swivel pedestal.

AT&T also offers a graphics board that generates 16 colors (or shades of green) with a resolution of 640 x 400 pixels. It uses one of the 16-bit expansion slots. AT&T also offers a color monitor.

The detachable, slant-adjustable keyboard mimics the IBM PC keyboard with two exceptions: the Caps Lock and Num Lock keys are equipped with LEDs and raised bumps appear on the J and F keys. The tactile and aural feedback rate good to excellent.

AT&T includes an excellent set of three-ring, looseleaf manuals with the system.

## Software Compatibility

As is to be expected, the AT&T 6300 is a true IBM PC compatible and runs most off-the-shelf IBM PC software. To make a long story short, the computer runs *Lotus 1-2-3* version 1A, Microsoft *Flight Simulator*, Ashton-Tate *dBase III* and *Framework*, Borland Turbo Pascal and *Sidekick*, Hayes *Smartcom II*, and a variety of other business, education, and entertainment software.

## Fastcard

The Fastcard from Thesys is one of the few AT&T 6300-specific memory expansion boards available from third-party manufacturers. It holds 384K RAM (using 256K DRAM chips) and has a 16-bit interface. Note that you must have 256K RAM on the 6300 motherboard before installing the Fastcard.

The Fastcard also comes with Fastware utility software—a RAM disk and print spooler.

Installation is quick and simple. After removing the system unit cover and expansion slot cover, you press the board into an appropriate slot, flip a couple DIP switches, and then reassemble the 6300. The two pages of instructions supplied by Thesys are more than adequate to guide you through the procedure.

Our evaluation unit worked perfectly—first time, every time. The boot-up diagnostics recognized the extra memory immediately and we were able to partition the memory using the Fastware RAM disk.

If you are looking for a memory expansion board for your AT&T 6300, we can recommend the Thesys Fastcard. With 384K RAM, a 16-bit bus, software, and a $325 pricetag, it deserves a serious look.

Thesys Memory Products, 7345 E. Acoma Dr., Scottsdale, AZ 85260 (612) 991-7356. ■



However, we must repeat our standard caveat regarding IBM PC compatibles: try the package you want to use before you buy the computer.

The base model AT&T 6300, with 128K RAM, two 360K floppy drives, one serial port, one parallel port, and monochrome monitor costs $2495. The hard disk version, with 256K RAM, one floppy drive, one 10Mb hard disk drive, and a monochrome monitor costs $4420. The color monitor retails for $795.

## Recent Enhancements

Released in June 1984, the 6300 has seen several enhancements in 1985. The Communications Manager expansion board plugs into the 6300 and the IBM PC and features a built-in 1200/300 baud modem, simultaneous voice and data transmission, one-button dialing from a directory of up to 200 phone numbers, and AT&T 4410 and DEC VT-100 terminal emulation. The board retails for $599.

The 6300 can now compare with the IBM PC AT with the addition of a 20Mb, internal, half-height Winchester hard disk drive and a 512K RAM upgrade kit for $5620. AT&T also offers the 8087-2 numeric co-processor for $295. A two-button mouse, compatible with Microsoft *Word*, *DR Draw* and *DR Graph*, *Lotus 1-2-3*, *MultiPlan*, and *SuperCalc 3*, is available for $150.

On the software side, AT&T has released the $395 Xenix 3.0 operating system along with a $450 software development package a $150 text processing package. Other software packages include *File It!*, a $295 interactive file manager; *Informix*, a $795 relational database management system; and a $100 AT&T 513 terminal emulation program.

Software announced but not released includes the MS-DOS 3.1 operating system and a business accounting series with general ledger, accounts receivable, accounts payable, payroll, and inventory modules.

## Starlan Networking Power

The AT&T Starlan local area network links computers, workstations, terminals, and peripherals through ordinary telephone wiring. It connects MS-DOS machine to MS-DOS machine, Unix machine to Unix machine, and MS-DOS machine to Unix machine. Starlan handles up to 1200 physical connections. Interfaces will become available to connect Starlan to other net-

# Unix PC


AT&T calls the Unix PC a "desktop intelligent workstation" that "civilizes the Unix operating system while retaining its power." This multitasking, multi-user system integrates voice and data communications and offers a full mouse, pull-down menu, and windowing environment. It consists of a system unit, detachable keyboard, and monitor.

The heart of the Unix PC is a 68010 microprocessor operating at a scorching 10MHz. The 68010 provides 32-bit internal processing with a 16-bit external data bus. The big difference between the 68010 and 68000 microprocessors is the ability of the 68010 to use virtual memory, that is, to use disk space as an extension of RAM.

The Unix PC comes with 512K RAM expandable to 2Mb, one 320K floppy disk drive compatible with MS-DOS formats, one half-height 10Mb or 20Mb Winchester hard disk drive, a built-in graphics board, parallel and RS-232C serial ports, and a built-in 1200/300 baud modem. It has three expansion slots.

The 103-key detachable keyboard connects to the system unit via a 6' coiled cord. A three-button mouse, with 4' cord, connects to the keyboard. The 12" green-screen monochrome monitor sits on a tilt/swivel stand and offers a resolution of 720 x 348 pixels.

The Unix PC features *Phone Manager*, a telephone management system with electronic mail, line control, and call management capabilities.

The base unit, with 512K RAM and a 10Mb hard disk, retails for $5095. The high-end unit, with 1Mb RAM and 20Mb hard disk, sells for $6095. A 512K RAM expansion board costs $1195.

For software, the Unix System V operating system sells for $495, the development tools package retails for $395, and a utilities package costs $495.

Although the Unix PC has just been introduced, Computer Systems president James D. Edwards notes AT&T has already received orders for "several thousand" Unix PCs. ■

works, including AT&T Information Systems Network, IBM Systems Network Architecture, and Ethernet.

However, before you rush off to buy a Starlan network, note that major parts will not become available until the fourth quarter 1985 or the first quarter 1986. AT&T quotes a price of approximately $800 per connection for an eight-workstation configuration. In contrast, the IBM local area network is scheduled for release during the second quarter 1985.

### The Last Die Roll

You have probably seen the big bucks TV advertising campaign by AT&T. In one commercial, AT&T announced it has entered the "personal computer game." The commercial describes a few features of the computer and then ends with an AT&T representative sitting back and saying "It's your move." Frankly, the marketing folks should have their collective heads examined. With billions of dollars at stake, the computer industry is anything but a game. Letting other companies make their move effectively relinquishes the initiative.

According to the *Wall Street Journal*, AT&T sold only 28,500 6300s in 1984. Compare that to the estimated 1.5 million IBM Personal Computers and you can see that AT&T has a long way to go to challenge Big Blue seriously. However, James D. Edwards, president of Computer Systems for AT&T Information Systems, recently announced that the company has sold more 6300s in January and February of 1985 than all of last year. Perhaps AT&T has learned that vying for business in the competitive market is quite different from "competing" in a protected market.

IBM has already made their move with the PC AT (see December 1984 for full review) and Kaypro and Tomcat have released AT compatibles. AT&T has responded with the Unix PC (see sidebar), originally codenamed the 7300. Another machine, the 9300, is rumored to be on the drawing boards. With one new machine out and another in the offing, AT&T shows it possesses the will to compete in the personal computer market, and with 1983 sales of $64 billion (compared to $39 billion for IBM), AT&T certainly has the resources to go head-to-head with IBM. The result could be a clash of the Titans.

The 6300 is a good first effort for AT&T, although it is entering an already crowded field. It features excellent IBM PC compatibility, competitive price, and a number of enhancements to keep it even, if not one step ahead of most of the competition. AT&T is a major corporation, and its impressive record of telephone service and support should carry over to the computer side. ■

CIRCLE **403** ON READER SERVICE CARD

# Tandy 1200 HD

Winchester version of the Tandy 1000/**Russ Lockwood**

In the December 1984 issue, we reviewed the Tandy 1000, a solid IBM PC and PCjr compatible sporting a bargain price. According to press releases from Fort Worth, Tandy 1000 sales are booming, making it one of the most successful releases in Tandy history. Rather than rest on its laurels, however, Tandy has introduced a hard disk version, the Tandy 1200 HD, that is likely to be as successful as the Tandy 1000.

The 1200 HD comes with 256K RAM (expandable to 640K), a 10Mb hard disk drive, a 360K double sided, double density floppy disk drive, a parallel port, and an 84-key detachable keyboard. You can buy a display adapter board ($299) and color monitor ($549) from Tandy or purchase comparable hardware from one of a host of third-party manufacturers.

The 1200 HD supports the 8087 numeric co-processor. It offers five expansion slots instead of the seven in the IBM PC XT (the hard disk version of the PC). After installing the drive controllers, a display adapter board, and a memory board, you are left with precious few slots.

While the keyboard of the 1000 duplicates the keyboard of its big non-IBM compatible brother the 2000, the 1200 HD mimics the IBM PC keyboard with a few pleasant exceptions. All keys have English labels, the Caps Lock and Num Lock keys include LEDs, the pesky Shift and Backslash keys have been reversed, and the numeric keypad includes an Enter key. The 1200 also places a horizontal Return key over the Shift key. The tactile play of the keyboard is better than average.

Our evaluation unit included a color graphics board and the Tandy CM-2 13" RGB color monitor. In short, the lines are sharp, the colors bright, and text appears no worse nor better than on a similarly equipped IBM PC.

The hard disk drive performs flawlessly, and we were able to partition the disk, store and retrieve files, and create tree structures without a problem.

Photograph by Jeff MacWright

## Hardware Profile

**Name:** Tandy 1200 HD
**Type:** Desktop computer
**CPU:** 8088, 4.77 MHz
**RAM:** 256K expandable to 640K
**Keyboard:** Detachable, 84 keys
**Display:** 80 x 25 characters, 640 x 200 pixels
**Disk Drives:** One 360K floppy and one 10Mb Winchester
**Operating System:** MS-DOS
**Dimensions:** Keyboard: 7.7" x 1.5" x 17.8" System Unit: 19.0" x 15.3" x 5.8"
**Documentation:** Spiral bound user's guide
**Summary:** Excellent IBM PC compatible offers Winchester capacity at a competitive price
**Base Price:** $2995
**Manufacturer:** Tandy
1800 One Tandy Center
Fort Worth, TX 76102
(817) 390-3011

### Nitty Meets Gritty

Give the 1200 a resounding round of applause for running just about all the IBM PC programs we could grab. The two de facto standards of software compatibility, Microsoft *Flight Simulator* and *Lotus 1-2-3* ran perfectly, first time, everytime. Word processors *MultiMate, WordStar, pfs:Write*, and *PC Write* also ran without a hitch. The DeSmet C compiler and Borland Turbo Pascal flashed winning code upon the screen. Entertainment packages like *Sargon III* (chess), *Empire* (wargame), and *Digger* (arcade wonder) also passed the test. In short, just about every program we tried ran flawlessly. The exceptions we found were *King's Quest* (game) and about half of the Basic programs we tried.

So, while we are optimistic that the 1200 HD will run most programs written for the IBM PC, our now-standard line regarding compatibles applies: make sure the software you intend to use actually runs on the machine you intend to purchase. Heeding this simple "try before you buy" maxim can save you a great deal of post-purchase frustration.

The documentation offered the only significant disappointment in the 1200 HD package. While complete, the order in which the information is presented requires you to flip back and forth from one section of the manual to another. Explanations on the finer points of operating the hard disk also leave a lot to be desired. A good introduction to MS-DOS would be much appreciated, especially for dedicated TRS-80 users who are trading up to the IBM world.

Fortunately, the legendary support offered by Tandy can help you solve potential dilemmas. The nationwide sales and service centers will be stocking popular titles and can respond to problems quickly and, for the most part, locally.

All in all, we are impressed with the Tandy 1200 HD. It offers excellent IBM PC compatibility and a hard disk drive at a competitive price. If you are considering a PC XT, be sure to have a look at the Tandy 1200 HD, too. ■

CIRCLE 404 ON READER SERVICE CARD

# Star Micronics SD-10

A bright spot in the middle of the line/**Owen Linzmayer**

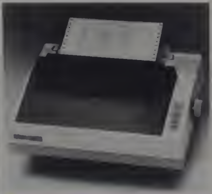
Middle of the line, product line, that is, is not normally a prestigious position. It does have its advantages, however. Perhaps the best thing is that a middle-of-the-line product offers something for everyone: more performance than the cheaper model and a lower price than the ultimate unit. Such is the case with the SD-10 dot matrix printer from Star Micronics.

Positioned smack dab in the middle of the Star Micronics dot matrix printer line, the SD-10 competes with all of its siblings. The SD-10, along with the similar SG and SR series, had its debut at the Winter Consumer Electronics Show in Las Vegas. The SD-10 is an Epson-compatible dot matrix printer offering draft, near letter quality, and graphics modes. The SG-10 is basically the same printer, only a little slower (120 cps, compared to 160 cps for the SD-10) and priced accordingly ($299, instead of $449). At the top of the line is the $649 SR-10, a 200 cps speed-demon with such business-like features as automatic single sheet feed.

These three printer series combine the Star standard and PC printer lines into one line that is compatible with many popular computers, including IBM, Apple, TRS-80, and CP/M systems. Each series is available in 15" wide-carriage versions with 16K print buffers.

The most impressive feature of the SD-10 is its wide range of text modes and pitches. In addition to printing standard characters on a 9 x 11 matrix at a blinding speed of 160 cps, the SD-10 sports NLQ, underline, italic, super/subscript, double-strike, emphasize, proportional, pica, elite, condensed and expanded modes, many of which may be used in conjunction with others to provide a vast selection of typefaces and sizes.

Star Micronics is proud of the fact that near letter quality text is standard on their entire line of dot matrix printers. I am impressed with the fine definition of the NLQ characters, and also with the speed at which they are printed. At a rate of 40 NLQ characters per second, the SD-10 is considerably faster than most standard daisywheel printers (15-25 cps). Star claims that their printers are 20% faster than printers with comparable print rates due to more efficient throughput (printing, paper handling and printhead maneuvering combined).





**Hardware Profile**

**Printer:** Star Micronics SD-10
**Type:** Dot matrix
**Feed:** Friction and tractor
**Speed:** 160 cps
**Interface:** Parallel (serial optional)
**Graphics:** 60 dots/inch (normal)-240 dots/inch (quadruple)
**Character Sets:** 8 international
**Buffer:** 2K (expandable to 6K)
**Logic Seek:** Yes, bidirectional
**Summary:** Something for everyone in this versatile printer
**Price:** $449
**Manufacturer:** Star Micronics, Inc.
200 Park Ave.
New York, NY 10166
(212) 986-6770

If you want to take advantage of all the nifty functions the SD-10 offers, you can specify your own macro control codes which save you the time and tedium of typing in long escape sequences. If you are a serious programmer, the hexadecimal dump mode will appeal to you. Once entered, this mode prints everything that is sent to the SD-10 in hexadecimal form.

In addition to almost every known text feature you could ask for, the SD-10 offers full dot-addressable graphics. In normal mode, the SD-10 prints 60 dots per horizontal inch. At the other end of the spectrum, quadruple density graphics cram an astounding 240 dots into one inch through the use of multiple passes of the printhead.

While I could continue to praise the versatility of the hardware, I would be remiss if I ignored the excellent documentation provided with the SD-10. At a healthy 240 pages, the Users Manual covers every facet of printer installation, configuration, use, and maintenance. The manual is filled with step-by-step instructions, diagrams and examples, and it is virtually impossible to think of a way in which it could be improved. It actually contains directions for connecting the SD-10 to a variety of popular computers. If you are hesitant about buying a printer because of an underlying fear that you wouldn't be able to figure it out, this manual is for you. And you technical types will be pleased to know that all the information you are looking for is found in the handy appendices.

Standard Mode
nonproportional spac:
proportional spacin
*Italic characters*
Near Letter Quality
Elite Mode
Expanded Ch
**Double Strike for dark**
Standard underline
example of $^{superscript}$
example of $_{subscript}$

**Star Micronics SD-10 sample text pitch and modes.**

As you can tell, I am thoroughly impressed with the SD-10 printer. It is a versatile unit with just about every feature you could ask for built right into the sturdy case. If you are willing to forego the higher print speed of the SD-10, you may wish to check out the less expensive SG-10. On the other hand, if the SD-10 merely whets your appetite for a faster printer with a more serious business outlook, then the SR-10 may be the printer for you. ■

CIRCLE 405 ON READER SERVICE CARD

ProModem 1200... HOT-LINE

# Our ProModem 1200 Makes Smart Modems Look Dumb


## Send Or Receive 50 Pages Of Text Without Tying Up Your Computer


No wonder Smart Modems, Cats, and Maxwells cringe when compared to our $495 ProModem 1200, an expandable 1200/300 baud modem for use with all personal computers. It costs less, but is smarter than the rest.

And when you add our $99 Communications Buffer and Alphanumeric Display options, ProModem 1200 becomes a veritable genius!

Imagine, you unplug your computer, take it home for the weekend, and while you're gone, ProModem 1200 answers the phone, collects messages up to 50 pages long, sends out electronic mail, and displays all events with the exact time of each. Thanks to ProModem 1200, expensive, hard-to-use communications software isn't needed. The communications is in the modem, and electronic mail becomes a background function, where it belongs.

## Simple To Install And Use

Our Communications Buffer is a 4 by 6 card that plugs into the ProModem 1200 motherboard. It comes with 2K of CMOS battery backed-up memory, expandable to 64K. Part of the memory is used as a dialing directory with the balance reserved for storage. For $99 more, a front panel Alphanumeric Display can be added to show time, date, and 24 status and help messages. These two powerful options can be included at time of purchase, or can be added later.

## Hayes Compatible

ProModem 1200 is Hayes compatible but that's where the resemblance ends. Our standard $495 modem includes a real-time clock/calendar. Hayes charges hundreds more for a Smart Modem with a time-base. Nor do they have electronic mail capability at any price.

ProModem 1200 contains a battery backed-up real-time clock/calendar, a large dialing directory and can send or receive messages up to 50 pages long without tying up the computer.

Send for complete details and the name of the Prometheus dealer nearest you.

The Hot Line **PROMETHEUS PRODUCTS INCORPORATED**
4545 Cushing Pkwy. • Fremont CA 94538

Call Now For Complete Info. 415/490-2370

**CIRCLE 144 ON READER SERVICE CARD**

# It's 16 Bits, But Is That Wide or What?

Many of today's small computers are called 16-bit systems, but what does that actually mean?/**Douglas A. Kerr**

Many of today's small computer systems are described as being "16-bit" systems, and they typically use the Intel 8086 or 8088 "16-bit" microprocessors. But just what does that really mean, and how are these systems different from the "8-bit" systems we have known?

## A Starting Point

Let's look at the characteristics of a typical 8-bit small computer system, one using an 8080 or Z80 microprocessor. Later, we will compare it with a typical 16-bit machine.

### Memory

The memory of the 8-bit machine is organized into locations each of which can hold eight bits of data, or one byte. The byte may represent a character, such as the letter A or the numeral 3, or it may be eight bits of an instruction in machine language or of a numeric quantity represented in one of various binary formats.

So that the central processing unit (CPU) can access a particular memory location to store a byte of data there, or to read the byte already stored there, the locations have addresses in the form of 16-bit numbers. Since $2^{16}$ is 65,536, there can be that many distinct addresses, and thus that many memory locations. This leads to the 64 kilobyte (64K) maximum memory capacity of the typical 8-bit system.

(We often describe large quantities which are powers of two as multiples of 1024, which is $2^{10}$, borrowing and stretching the scientific prefix for one thousand, kilo, abbreviated K.)

The CPU stores data in the memory, or reads it, one location at a time. Thus, only eight bits are moved during a single memory *access cycle*. Although the CPU has instructions which move binary numbers made up of 16 bits, it does this in two steps, eight bits at a time.

### Disk Storage

Data storage on either a floppy or a hard disk is also organized into 8-bit units. Transfer of data between the CPU and the disk drive is done eight bits (one byte) at a time.

### Input/Output

Human input from the console keyboard and output to the console screen or to a printer is organized as sequences of characters. The characters are represented in a 7-bit coded form known as ASCII, the American National Standard Code for Information Interchange. Each 7-bit ASCII character code is carried in an 8-bit byte. Most often, the eighth bit is a binary zero and just goes along for the ride. In some systems, the eighth bit is used to expand the repertoire of characters beyond the 128 ASCII characters to provide for special graphics.

### Machine Instructions

Regardless of the language in which the programmer works, the computer ultimately does its work through the CPU executing a series of *machine instructions*. Individually, these cause rather primitive actions, such as moving a byte from a memory location to a *register* in the CPU, or causing the CPU to add two 8-bit binary numbers, to be taken.

In a machine language program (one ready for the CPU to execute directly), the machine instructions are represented as sequences of bytes stored in memory. Some instructions require only one byte. Most require from two to four bytes, which are always stored in consecutive locations in memory.

### Data Manipulation

The 8080 or Z80 CPU has seven principal *data registers*, which are used for data manipulation. Any of these can hold eight bits, or one byte, of data. Six of these registers are grouped into pairs. Any of these three *register pairs* can be used to hold a 16-bit number. As the program does its work, the machine instructions successively cause data to be moved between the registers and memory locations, or cause various operations to be performed on the data in the registers.

The CPU also has a 16-bit register, the Program Counter, which holds the memory address where the next machine instruction begins. Since the instructions in a program are most often executed in sequence, this register is normally set automatically to the address immediately after the current instruction. However, if the current instruction is one which calls for a *jump* to another part of the program, the Program Counter is reset to the corresponding new address.

Another 16-bit register, the Stack Pointer, keeps track of the next location scheduled for use in a memory area assigned by the programmer as the *machine stack*. This area is used to store temporarily the contents of registers while they are "borrowed" by the program for other purposes.

The CPU can perform a number of arithmetic and logical operations on bi-

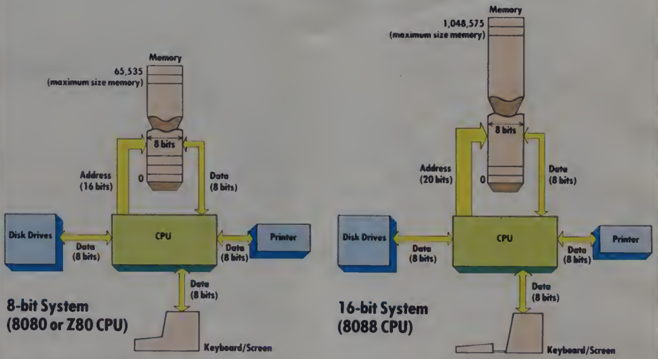



**Figure 1. Organization of typical small computers.**

nary numbers. It can, for example, add or subtract two 8-bit numbers. These functions take place in the one data register which is not paired with another, the A Register, or *accumulator*. The CPU can perform many of the same operations on 16-bit numbers. In this case, one of the register pairs is the host, the one known as HL (made up of the H and L registers).

The internal structure of the 8080 or Z80 microprocessor is such that operations on 16-bit numbers are done, in effect, eight bits at a time. For this reason, 16-bit operations take substantially more time than the same operations on 8-bit numbers.

## A 16-Bit System

Now let's look at a typical 16-bit small computer system, such as the IBM PC, based on the Intel 8088 microprocessor.

### Memory

As in the case of the 8-bit machine, the memory is organized into locations which hold eight bits or one byte of data. The CPU can still store or read only one byte at a time; when it stores or reads 16-bit numbers, it does so in two steps, eight bits at a time.

In the 16-bit machine, however, memory locations have 20-bit addresses (see sidebar). As $2^{20}$ is 1,048,576, the CPU can access up to that many locations, if the memory is in fact that large. (Since that number is 1024 x 1024, and since we treat 1024 as if it were one thousand, we call that amount of memory one megabyte, borrowing the scientific prefix for one million, abbreviated M.) It is the ability to use such large amounts of memory that is a major advantage of the 8088 microprocessor.

**The 8088 CPU can perform a wider range of arithmetic and logical functions than the 8080 or Z80.**

### Disk Storage

As in the case of the 8-bit machine, storage on floppy or hard disk is organized into units of eight bits, or one byte.

### Input/Output

Also as in the case of the 8-bit machine, input from the keyboard and output to the screen or a printer is conducted in the form of ASCII characters carried within 8-bit bytes.

### Machine Instructions

Again as in the 8-bit machine, the machine instructions used by the 16-bit CPU are coded as sequences of 8-bit bytes, from one to six bytes being required depending upon the instruction. The bytes which represent one instruction are stored in consecutive memory locations.

The 8088 CPU, however, has a valuable feature called *instruction prefetch*. While the CPU is executing one instruction, it brings from memory the next several bytes (which we would expect to include the next instruction) and places them in a special "pipeline" buffer within the CPU. In this way, when the time comes to work on the next instruction, it is already close at hand. This significantly speeds up the operation of the system.

Of course, if the current instruction requires a jump to an instruction other than the next one in sequence, the information in the pipeline is useless: the required instruction is somewhere else in memory. In that case the pipeline is emptied, the bytes of the instruction are brought in from the new locations, and the pipeline is refilled with subsequent bytes.

# IF ANY 3M, MAXELL, OR DYSAN FLOPPY DISK FAILS, WE'LL REPLACE IT WITH A NEW VERBATIM DISK. FREE.

Most floppy disks come with a guarantee; if they ever fail, the manufacturer will send you a brand new one. But let's face it; if a particular brand of floppy disk ever loses your data, you might not want another one of theirs.

That's why Verbatim is offering a very special guarantee: If you buy a 3M, Maxell, or Dysan floppy disk — and it fails — we will replace it with a brand new Verbatim disk. Free. Why are we making this offer? Because we think it's time you use a floppy disk you can always count on. Verbatim.




## VERBATIM. YOU CAN COUNT ON US.

Mail your failed 8", 5¼", or 3½" disk in its original envelope, along with your name and address, and the brand and model of your computer system, to: Verbatim Offer, P. O. Box 7306, Clinton, IA 52736. Limit one refund per name and address. Offer limited to the first 100,000 3M, Maxell, or Dysan failed disks received. Offer expires October 1, 1985. Void where prohibited by law. Offer rights are not assignable or transferable.

CIRCLE 143 ON READER SERVICE CARD

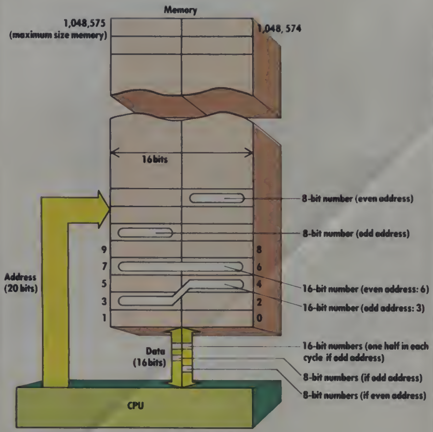



**Figure 2. Memory organization with the 8086 CPU.**

### Data Manipulation

The 8088 CPU has eight principal data registers, each capable of holding a 16-bit number. Each is divided into two portions, either of which can be used to hold an 8-bit number (one byte).

The 8088 CPU can perform a wider range of arithmetic and logic functions than the 8080 or Z80. For example, it can directly perform multiplication and division of 8- or 16-bit binary numbers, important functions in the multiplication and division of decimal numbers. With the 8080 or Z80, these functions must be performed by long sequences of program steps which involve addition or subtraction of the binary numbers, plus shifting the bits of a number left or right to multiply or divide it by powers of two—in effect, doing "binary long multiplication" (or division).

All arithmetic and logic operations can be performed on either 8- or 16-bit numbers. Most operations can be performed in any register which is convenient, not just in certain ones, as in the 8-bit machine. In addition, arithmetic and logical operations can be performed on numbers stored in memory locations without first bringing them into a CPU register. The internal structure of the CPU performs 16-bit operations just as quickly as 8-bit ones. These features

## How does a 16-bit machine come up with 20-bit addresses?

Just how does a system that operates mainly with 8- and 16-bit numbers come up with the 20-bit address required for access to a memory location?

Suppose we identify an arbitrary region of the memory consisting of 64K ($2^{16}$) consecutive locations, including the one in which we are interested. We will call such a region a *memory segment*. We can then completely identify a particular location by giving the address at which the segment begins (called the *segment base address*) plus a 16-bit number which tells how far the location is beyond that point. That 16-bit number is called the *location offset*.

In the 8086 or 8088 CPU, the base address of the currently defined segment is specified by a number stored in a special 16-bit segment register. The segment base address is 16 times that number (and thus must be expressed in 20 bits).

When a memory location is to be accessed, the *offset* portion of its address, typically coming from one of the CPU data registers, is added to the segment base address developed from the number in the segment register. The result, also a 20-bit number, is the address of the desired location.

As long as memory operations continue to use locations in the same segment, the base address in the segment register remains constant, and addressing instructions need specify only the 16-bit offset portion of the location address.

Note that the total memory is not divided up into fixed segments starting every 64K locations. A segment can be defined as starting at any location whose address is a multiple of 16. Therefore, the programmer can define a segment that will contain all the locations used during a certain stage of program operations. In this way, the need to change the segment base address can be minimized.

The CPU actually has several segment registers. One holds the segment base address which pertains to the location of the next instruction. It augments the 16-bit register called *Instruction Pointer*, which is equivalent to the Program Counter in our 8-bit machine. A second segment register identifies the segment to be used in addresses for storing or reading data. A third one provides the segment base address for the machine stack. It augments the Stack Pointer register, which is like the one in the 8-bit machine.

By having these separate segment registers, it is possible to take the current instructions from one greatly speed most data manipulation compared to the 8-bit machine.

### The 8086 CPU

The Intel 8086 microprocessor is also used by certain modern 16-bit computer systems (like the ACT Apricot). It is almost identical in function to the 8088 with one exception: the memory used in 8086-based systems is organized into 16-bit *words* rather than the 8-bit *bytes* we have previously encountered. Nevertheless, for addressing purposes, each word is considered to be two consecutive 8-bit locations, each of which has its own 20-bit location address.

When the CPU wants to store or read an 8-bit number (one byte), it gives the 20-bit address of the location, along with an extra electrical signal which tells the memory to access only the eight bits from that location, not all 16 bits which are stored together.

When a 16-bit number is stored in memory by the CPU, it may end up in either of two situations, depending on the address assigned to it. It may occupy an entire 16-bit word, or it may occupy the second half of one word and the first half of the next.

In the first case, the CPU will store or read the entire 16-bit number in one memory access cycle, giving the address for the location of the first part of the word but signaling the memory to access the entire word. In the second case, the CPU must access the memory twice, in each case accessing only one of the two locations, joining the two returned bytes (in the case of a read) to form the entire 16-bit number.

For this reason, if a program needs to store or read a long sequence of 16-bit numbers, it is worthwhile for the programmer to arrange the address of each to be "even" so that each number cleanly occupies one memory word. If this is done, the speed of an 8086-based system, when handling 16-bit data, can be significantly greater than for an 8088-based system.

**An 8-bit machine uses 16-bit addresses, while a 16-bit machine uses 20-bit addresses.**

In the case of program instructions, this consideration does not arise. When the CPU "prefetches" additional bytes, it always does so an entire memory word (containing two consecutive bytes) at a time.

## What Does All This Mean To The User?

We have seen that a 16-bit machine works with both 8- and 16-bit data, just as an "8-bit" machine does. We have also seen that an 8-bit machine uses 16-bit addresses, while a 16-bit machine uses 20-bit addresses. And, we have seen that, with the 8088 CPU, the 16-bit machine uses an 8-bit memory. No wonder it has been hard to answer the question, "16-bit? What does that mean?"

Much more important is that the 16-bit systems offer substantial advantages to the programmer and user. Direct access to as much as one megabyte of memory, as a result of the 20-bit address structure, allows large application programs and large arrays of data to reside in memory. This minimizes the need to move program portions and data records from disk. Various other new features of the CPUs, not necessarily related to their 16-bit orientation, provide additional speed and programming power.

We now hear that 32-bit machines are coming into use in the personal/professional computer world. Let's see, will they have 32-bit memories? Maybe not. But we can be certain that they will reflect the continuing progress of the computer industry. ■

memory segment, store and read the data in another segment, and use an area in a third segment as the machine stack.

When it is necessary to address a location in a new segment for one of these purposes, the instruction must give both the offset and the new segment base address. For this reason, there are usually at least two forms of many of the machine instructions.

Fortunately, it is not always necessary for the programmer to worry about the differences, even when working in assembly language. The normal mnemonic assembly code for the instruction is the same regardless of the addressing type needed. The assembler can tell when the intended address is in a different segment from the current one and will code the proper type of instruction in the object code.

For example, if the specified operation is an unconditional jump to a memory location identified by a symbolic label, the programmer can always use the same assembly code. The assembler, however, chooses one of three types of machine instructions to perform the jump:

- If the location represented by the label is within 127 locations of the current one and within the segment whose base address is now in the instruction segment register, the assembler codes a jump instruction which specifies the new location in terms of the distance (forward or back) from the present one, stated in eight bits. This corresponds to the jump relative instruction used with the Z80 CPU. This instruction requires two memory locations, one carrying the code for the instruction (called in this case JUMP SHORT) and one carrying the distance to be jumped.
- If the location represented by the label is farther than that from the current location, but within the current segment, the assembler puts in a jump instruction which specifies the 16-bit offset portion of the new address. This instruction (called JUMP NEAR) requires three memory locations, one to identify the instruction and two to carry the offset. The base address is taken from the instruction segment register.
- If the location represented by the label is not in the current segment, the assembler puts in a jump instruction which includes both the offset address and the new segment base address (carried in another 16-bit number). This type of instruction (called JUMP FAR), therefore, requires five memory locations.

Of course, there are many different segment base addresses which could be used to accommodate the desired location. If not instructed otherwise by the programmer, the assembler uses the segment base address which was originally used when the address represented by the label was established.

This is only one example of the way that improved program development tools (such as the 8086/8088 assembler) aid the programmer in exploiting the enhanced features of the new CPUs. *—DAK*


Scrolling down Fifth Avenue.

Step beyond the limits of personal computing, and through the doors of the world's finest stores. Or right into the action on Wall Street. Browse, buy, sell or trade. Stocks, information, Maine lobster, Oregon seedlings, Italian luggage, airline tickets. Without leaving your chair.

With an Avatex™ modem, your personal computer can take you wherever you want to go, on your schedule. As far, as fast, as often as you like, at a price that won't stop you in your tracks.

Avatex gives you the power, speed and intelligence of a serious piece of communications equipment, streamlined so anyone can use it easily and productively. Immediately.

So with Avatex the possibilities are astronomical, but the price of owning one is not: Avatex 300—$64.95,* Avatex 600—$99.95,* Avatex 1200—$299.95.*

For the name of the Avatex dealer nearest you, call 800-4-AVATEX.

**Avatex™ Modems**

*The next step in personal computing.*



CIRCLE 119 ON READER SERVICE CARD

# Hello, Mr. Chips

The word bit, or straying off the data path

**John J. Anderson**

In the beginning there was the vacuum tube, and with that innovation electricity got its first real chance to become electronics. Circuit complexity translated into bulk, however, and if you wanted that new-fangled toy called a computer, you needed a building to devote to it, and the riches of Croesus to acquire it and keep it healthy.

The vacuum tube begat the transistor, and we saw it was good. Circuits of greater complexity could be designed more reliably, cooler, and in much less space. Central processing units (CPUs), the brainstems of computer circuitry, shrank to the size of mere refrigerators. And prices came down.

The transistor begat the integrated circuit, and we saw it was very good. A single chip of silicon could contain multiple transistors. There but for the grace of the integrated circuit went the aerospace advances of the sixties—things like walking on the moon. And prices came down.

But up until the end of that turbulent decade, digital IC technology was limited to arithmetic, logic, I/O controller, and memory chips. The CPU on a chip, and its ancillary development, the microcomputer, were children of the '70s.

Ironically, the first integrated circuit to closely resemble a CPU was developed in the U.S. by Intel, while under contract to a Japanese calculator company. ETI, a Japanese manufacturer of expensive desktop calculators, specified a new type of IC to spearhead a new line of machines. Marcian "Ted" Hoff, of Intel, envisioned extending ETI's specifications to include programmable characteristics. The result was the Intel 4004, which incorporated on a single chip the equivalent of more than 4000 transistors.

This was the genesis of the microprocessor. Under one cover, in a miniscule package, the business of computing now takes place. Nowadays even mini-and mainframe computers use IC-based central processing units, called microprocessors (MPUs) in place of multicomponent CPUs. One result of the MPU was the microcomputer; another was *Creative Computing*.

## Pegging Power

There are four basic criteria typically considered in judging the power of a microprocessor. They are:

**Speed**: The cycling rate at which instructions can be executed within the MPU.

**Addressable memory**: The maximum RAM size the MPU can access from a single state.

**Instruction set**: Includes both the number and complexity of instructions that can be invoked.

**Word width**: The "swatch" of bits (binary digits) upon which the MPU can act at one time.

It is impossible to put these criteria into an indisputable hierarchy, but without a doubt, word width is a very significant entity. The speed, addressable memory, and instruction set of a microprocessor are architecturally tied to its word width.

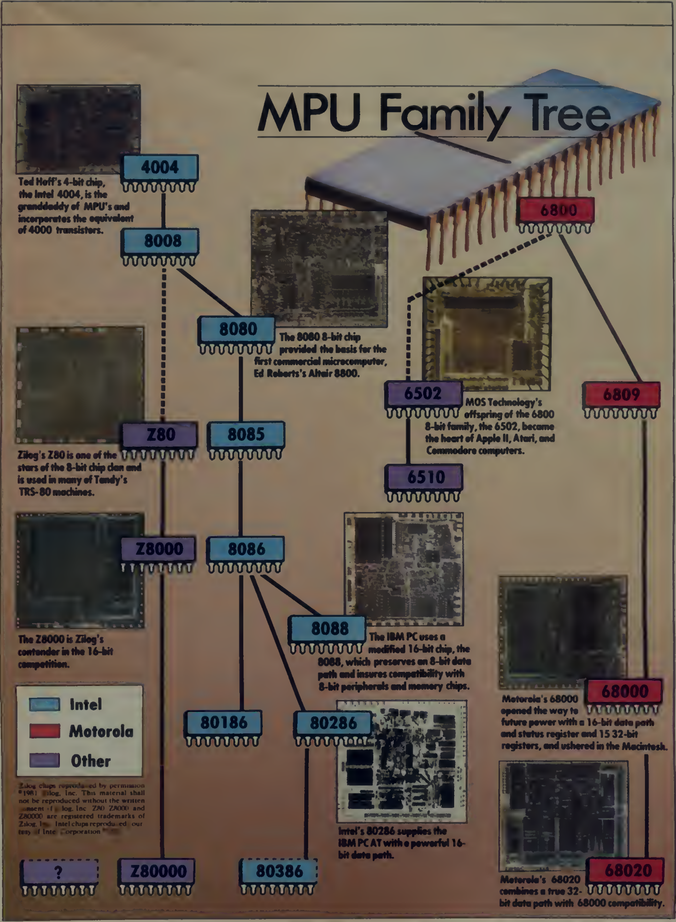
Unfortunately, the concept of word width has been popularized in a fashion that obscures rather than clarifies its importance. It is easy to state that a 16-bit MPU is twice as powerful as an 8-bit, and a 32-bit MPU twice again as powerful—easy to state, and perhaps a powerful sales tool, but somewhat incorrect. At the least, such reasoning leads to serious oversimplification.

First off, let us consider speed. A 16-bit processor running at 2 MHz is certainly not twice as powerful as an 8-bit processor that runs at 5 MHz. How much more powerful one is than the other runs us immediately into some nasty shoals. Our quantification approach becomes marooned in value judgments more likely to reflect the biases of the arguers than the merits of the arguments.

Then we may consider the natures of instruction sets. These vary among chips and especially among families of chips. You can write the same assembly language program for different kinds of microprocessors, but the code itself, and more importantly the ease of writing such code, varies greatly. Programmers tend toward vehement chauvinism when it comes to MPUs, assuredly as a direct result of the effort they have put into learning a system that works in a certain way. They may naturally resist the stress of change, even when a new slant makes things easier overall. Although we can say that the instruction set of one MPU is larger and more powerful than that of another, we cannot quantify the appeal of any one instruction set. A chip that makes one type of task easier might make another more arduous.

## Passing the Word

Quantification of chip power is made even more difficult by the fact that word width can vary, even within a single chip. Typically the term word width is used to indicate the width of the *registers* within a processor. Any and all CPUs pull information out of memory, act upon it, then return it to RAM in a process known as fetch, alter, and store. Upon the execution of a fetch, the CPU loads the word fetched into a storage register. Then a specific instruction can be



MPU Family Tree
4004
Ted Hoff's 4-bit chip, the Intel 4004, is the granddaddy of MPU's and incorporates the equivalent of 4000 transistors.
8008
8080
The 8080 8-bit chip provided the basis for the first commercial microcomputer, Ed Roberts's Altair 8800.
6800
6502
MOS Technology's offspring of the 6800 8-bit family, the 6502, became the heart of Apple II, Atari, and Commodore computers.
6809
Z80
Zilog's Z80 is one of the stars of the 8-bit chip clan and is used in many of Tandy's TRS-80 machines.
8085
6510
Z8000
8086
The Z8000 is Zilog's contender in the 16-bit competition.
8088
The IBM PC uses a modified 16-bit chip, the 8088, which preserves an 8-bit data path and insures compatibility with 8-bit peripherals and memory chips.
68000
Motorola's 68000 opened the way to future power with a 16-bit data path and status register and 15 32-bit registers, and ushered in the Macintosh.
Intel
Motorola
Other
80186
80286
Intel's 80286 supplies the IBM PC AT with a powerful 16-bit data path.
?
Z80000
80386
68020
Motorola's 68020 combines a true 32-bit data path with 68000 compatibility.

invoked to act upon data stored in that register.

Most mainframe computers make use of 32-bit registers, and as we shall see, micros are also moving quickly into the 32-bit realm. In college I occasionally had the dubious honor of programming a mainframe known as the CDC Cyber, which made use of whopping 60-bit words. I could never quite fathom any good reason for making an address register that wide. It made calculating offsets, the number of bits away from a given reference point, an easy way to lose track of reality.

Hoff's Intel 4004, the granddaddy of microprocessors, was a 4-bit machine. It could operate upon or transfer only four bits at a time. As a result, it could handle numbers but not alphabetic characters in a single "gulp." Although wider registers could be simulated through piggybacked instructions, this made programming the 4004 rather convoluted. It quickly became obvious that for alphanumeric processing, a more powerful chip was necessary. The natural step was to 8-bit words, which could handle alphabetic coding as well as a capable instruction set relatively straightforwardly.

The Intel 8008, originally developed for the Computer Terminal Corp. (now Datapoint) was introduced in 1973. It was simply an 8-bit version of the 4004. This processor was still rather Byzantine in its architecture—actually better suited as a machine controller than a general purpose MPU. Intel then followed up with an improved chip, the 8080. Although most of the design philosophy of the 8080 came directly from the 8008, its instruction set could act as a bonafide CPU. The 8080 soon became the mind of Ed Roberts' Altair 8800, generally acknowledged to be the first commercial microcomputer.

The 8080 has six general purpose 8-bit registers with a stack pointer and program counter both 16 bits wide. Like many others, the 8080 is a stack-oriented MPU, which is used for temporary storage without the need for address pointers. The *data path*, which is the number of bits that a microprocessor can fetch from or store to memory in a single swatch, is eight bits wide on the Intel 8080.

Here we encounter one of the real rubs of the width myth. The width of the internal registers of an MPU often exceeds the width of its data path. By way of analogy, we might imagine loading six-packs into a carton to make a case of beer. The case holds 24 cans of beer—therefore the address register for our Molson computer is 24 bits wide. However we will put in and lift out the cans by the six-pack, so the data path of our brew is six bits wide. If Molson made computers, it might claim it had a 24-bit beer. Moosehead would be quick to point out, however, that Molson was not a "true" 24-bit beer, as it has a six-bit data path. Doubtless as well, their marketing department would quickly point out that Moosehead is available in eight-packs.

As the 8080 has 8-bit registers and an 8-bit data path, it may be termed a "true" 8-bit processor. One might suspect that implies the existence of "false" processors, but it is better not to linger over that point.

Between 1973 and 1981, quite a bit of begetting went on in the 8-bit realm until the 8-bit processor began to yield to a new crop of 16-bit chips. We can trace the genealogy (see page 49) of two prominent families: those that trace their roots from the Intel 4004 and those that trace back to the Motorola 6800, first introduced in 1974. It should be noted, however, that in both genealogies there appear important contributions from people "outside the family."

In fact, the Z80, a second generaton 8080, and the 6502, a very close cousin to the 6800, were developed outside of Intel and Motorola, respectively. These chips went on to become the most important 8-bit processors—the ones that sowed the seeds of the microcomputer revolution. The Z80 made its way into successive generations of TRS-80 machines, while the 6502 was to form the heart of the Apple II, Atari, and Commodore computers.

## The Better Bitters

Although the heyday of 8-bit processors is now behind us, they will remain important for years to come. They are still very capable chips, each with an established core of loyal programmers, and most important, they are now dirt cheap.

They do, however, pose certain limitations. An instruction set with an 8-bit width is limited to 256 total instructions. Although on some chips prefix bytes and other devices are introduced to get around this stricture, they again make the task of programming more burdensome. Certainly, the next logical step was a 16-bit microprocessor on a chip. An instruction set with a 16-bit width is capable of 65,536 discrete instructions. As that is far more than generous, and a 9-bit instruction width is quite reasonable to imagine, remaining word width can be used for data.

As explained above, more instruc-


**The analogy is a little far-fetched, but beer bottles, six-packs, and cases can be used to illustrate some aspects of data width. Initially, each bottle (bit) comes down the assembly line (RAM) singly.**

**Before storage or shipment, however, each drops into a six-pack as it continues down the belt. We might think of this as a six-bit data width. The bottles are now moved solely in sets of six.**

**Further down the belt, six-packs are dropped in groups of four into cases. We might stretch the analogy to the point of imagining each case as a 24-bit register, as each holds four times six bottles. When finally sold, the product will again move in sets of six. So our beer has a 24-bit register, but still a six-bit path. To have a "true" 24-bit beer, we would have to sell it in 24-packs only. If that were the case, we might or might not choose to pack it in cases holding 48 or 72 bottles (two or three 24-packs). Often MPUs use registers wider than their data paths.**

tions mean a more powerful MPU. Instead of treating multiplication as recursive addition, or division as recursive subtraction, for example, a multiply or divide instruction can be added to the instruction set. (The processor may still treat the instruction recursively, but the programmer need not.) And through the addition of memory management logic, 16-bit processors can cross the address boundary of a single 64K chunk of RAM.

When, in 1981, IBM announced it would use the Intel 8088 in its first microcomputer, Intel was able to reassert itself as a major player in the microprocessor game. The 8088 is a special case in itself; it is a 16-bit processor in 8-bit clothing. Its registers are a uniform 16-bits wide, while its data path is 8-bits. The 8088 is a version of Intel's true 16-bit chip, the 8086, with special bus hardware added. This ensured that the 8088 would remain compatible with the 8-bit memory and peripheral chips that proliferated at the time it was introduced. The downside of this customization is that the 8088 is slowed down substantially by overhead transfer time. The *Creative Computing* benchmark, in fact, logged the IBM PC as significantly slower than a number of 8-bit machines with quite decent cycle rates.

The 8086 and 8088 can address up to 1Mb of RAM (in segments of 64K), and include multiply and divide instructions. They were among the first to use multiplexed address and data lines, wherein more than one signal shares a common circuit to reduce chip size and cost.

Zilog's answer to the 16-bit challenge was the Z8000. This chip might have been a much more serious contender if its introduction had not been plagued by delays, and in its early days by a lack of support. The chip is clearly superior to the 8086/8088, but in an industry in which timing is crucial, the effort misfired. Motorola's 6809 is also a powerful chip which upgraded in size and versatility the instruction set of the 6800 series in an MPU with 16-bit registers and an 8-bit data bus. It found its way into the highly underrated TRS-80 Color Computer, but not much else.

By far the most interesting Motorola entry is the MC68000, which in 1982 first levered a foot into the door of the 32-bit world. In one fell swoop, the 68000 launched Motorola right back into the fray. The data path and status register of the 68000 are 16-bits wide, but the other 15 available registers are all 32-bits. The 24-bit address bus allows fully 16 megabytes of RAM to be addressed linearly. The instruction set of the 68000 contains over 90 instructions, and the memory addressing configuration makes debugging assembly code on the 68000 much less painful than on the 8086.

Certainly the first 68000-based microcomputer to come to mind is the Apple Macintosh, and the Mac does serve as a good example of the power of the 68000—juggling programs, data, and a highly-refined user interface simultaneously. But the Mac was not the first 68000-based micro. That honor belongs to the Fortune Systems 32:16, which due to ill fortune, is no longer with us.

The 68000 does not multiplex signals, and so appears in a 64-pin package, as opposed to the 8086/8088 which is in 40-pin DIP configuration. The trade off is a bigger chip, but one that requires less external logic. Intel introduced a hybrid 8086 in 1982, called the 80186, which incorporates a substantial amount of support logic onboard—a move toward truly manufacturing a computer on a single silicon chip. The 80186 represented a significant step, offering better performance for substantially less cost than an 8086 with the requisite bevy of support chips required to drive it. Lowered chip count results not only in decreased manufacturing costs, but increased hardware reliability. The 80286 introduced by Intel last year took things a step further, and now finds itself ensconced in the muscular IBM PC AT.

There are other 16-bit processors, like the National Semiconductor 16032 and Texas Instruments TMS 9900, some with quite admirable specifications, but none of these has had much real impact on the microcomputer market. One might observe a striking parallel between the two major 8-bit contenders of the past, the Z80 and the 6502, and their combatant 16-bit progeny—Intel's 8086/8088 propped up by hordes of IBM PCs and PC clones, and the Motorola 68000 residing within the Apple Lisa and Macintosh.

## The Bit Goes On

Already, however, the field is being cleared for the next big battle. This one will be fought by the true 32-bit titans, and never has the competition been so fierce. Semiconductor manufacturers are scratching, biting, and scrambling for position in a race that again will probably result in two big winners and a slew of battered also-rans. As the ante in developing a new chip is typically over $50 million, that represents a gamble indeed.

Why a 32-bit processor, you ask?


**We can also stretch the analogy to suggest the logic of stack-oriented processing. Imagine cases of beer being stacked in a storeroom. The first cases stacked will be the last to move out of the stack, so in accounting parlance, this is a LIFO (last-in first-out) stack. If you tried to pull out a case that wasn't on the top of the stack, you would probably cause an avalanche. Hence sales are made from the top down. Many MPUs work in the same way, using registers to stack data temporarily for subsequent processing.**

The answers are as follows: speed, multitasking, multiuser capability, mini- and mainframe compatibility, the ability to tackle enormous tasks, like expert systems programming, artificial intelligence, voice recognition, and perhaps most important, Unix compatibility.

Like it or not, the microcomputer industry is rushing headlong toward the Unix operating system, and it will take a 32-bit processor to implement it in all its glory [sic]. Programmers are talking more and more about this marvelous and mysterious language cryptically called C, and even the behemoth IBM has acknowledged that its 8086/8088 software base will be effectively neutralized in a few short years. And so the race is on.

No fewer than 14 American companies have announced that they are or will be entrants in the 32-bit fracas. Intel and Motorola, the Hatfields and McCoys of the microprocessor industry, are siring the next generation of combatants. Intel is readying its 80386, which will combine Unix compatibility with PC compatibility on a single chip. Motorola has already introduced its MC68020, which is entirely compatible with the instruction set of the 68000, with a true 32-bit data path.

But it is important to note that 32-bit processors are architecturally much more independent than their ancestors. The software bases built around the 16-bit processors of Intel and Motorola are, therefore, not as likely to give those companies pole position in the 32-bit race. A dark horse has a better chance now than ever before to usurp pre-eminence in the microprocessor market.

Zilog is back and in the running with the aptly named Z80000. It of course is downwardly compatible with the Z8000. NCR is in the running with the 32-000, which packs the equivalent of 40,000 transistors on a single chip. In conjunction with an Address Translation Chip, the NCR microprocessor can address up to 300 Mb.

Also announced are entries from Inmos, Fairchild Camera, National Semiconductor, Texas Instruments, and Western Electric (no longer to be confused with AT&T). And chip manufacturers are no longer alone in their pursuits. Mini- and mainframe makers like DEC, IBM, and Data General are reverse engineering MPUs compatible with their existing machines. Even Hewlett Packard and AT&T are in the on-deck circle.

Let us not ignore Japan in the coming equation. NEC has announced it is working on a 32-bit MPU with no fewer than 700,000 transistors on board. Hitachi has announced the completion of a proprietary 32-bit chip. The timeframe announced for shipment of the Hitachi chip is 1986; for completion of NEC's superchip, 1987.

### The Racing Form

It is difficult to predict how the 32-bit race will take shape and impossible to predict the winners. But there are a few predictions that can possibly be made more safely.

As in any marathon, many of the entrants will not finish. The microprocessor industry makes for strange bedfellows, and second-sourcing has resulted in some unholy alliances indeed. To sell a chip in quantity, a manufacturer typically accepts more orders than it can fill. It authorizes another company to manufacture its chips and gives "masks" of the chip to that company so it can do so. If a chip is very popular, it may be second-sourced to multiple companies. The 8086 was, in its golden years, manufactured by no fewer than seven companies.

**No fewer than 14 American companies have announced that they are or will be entrants in the 32-bit fracas.**

Second-sourcing agreements in the 32-bit arena could be made into a soap opera for TV. Often second-sourcing is a major means of gleaning technology, and we find second-sources suddenly announcing their own chips. Marketing divisions live on Maalox, and fickleness is rampant. Fairchild had committed to second-sourcing for National, but now is pursuing design of its own proprietary CMOS 32-bit chip. Texas Instruments initially announced its own proprietary chip, but now has committed as a second-source for National. Fujitsu and Toshiba are second-sourcing for Intel. Don't be surprised when these companies break off and announce proprietary chips of their own. The bottom line is to take any and all announcements of 32-bit plans with a grain of Alka-Seltzer.

My predictions are as follows. You might be able to narrow the field down to four: the Motorola 68020 will find a niche, owing to a growing degree of loyalty to the power and elegance of the 68000 family; National Semiconductor will find itself back in the big leagues with the 32000 because of its suitability with Unix and C and its proximity to the ultra-powerful VAX minicomputer; Intel's new chip is bound to find its way into IBM's 32-bit micro, as IBM now holds 20% ownership of Intel; and the field might be big enough, at least early on, to allow for one dark horse candidate, conceivably Japanese. In the end there will be one or two survivors. And I'm not about to guess who they might be.

The race is sure to continue even from there, but at a greatly slowed pace. Although there will undoubtedly appear 64-bit microprocessors toward the end of this decade, my experience with the Cyber leaves me with the hunch that we will hit a point of diminishing returns in that realm. My guess is that development will continue much more strongly along the lines of incorporating support chips onto the MPU, and even at some point including RAM memory. Sooner or later we will rid ourselves of circuit boards entirely. Fairchild is moving in the right direction with CMOS technology—that will find a niche in the future of microprocessors and RAM technology. A day will come when we look back at today's micros as dinosaurs of power consumption. And RISC chips (for "reduced instruction set chip"), as pursued by Inmos, DEC, and HP, pose an interesting angle. Their philosophy is that conventional microprocessors are burdened by many instructions that are rarely or never used. Chips can be made faster, cheaper, and better by tailoring them more carefully.

Finally, I expect parallel processing to come into its own by the end of the decade. In our entire discussion here we have conceived of computing in a traditionally serial manner; though it may happen at incredible speed, only one instruction is executed at a time. The next major breakthrough in computing will be the advent of machines with multiple 32-bit processors, each operating in its own bailiwick, while in full communication through some hierarchical structure with the other processors onboard. What might a machine of this kind be capable of doing? Well, among other things, it just might be able to grasp the English language. Perhaps then I'll ask it what exactly makes one MPU superior to another. I'll program it to laugh. ■

# WHAT'S NEW

## The latest in hardware and software/Russ Lockwood

### GE Peripherals

General Electric has announced several additions to its line of computer peripherals.

The 3-8100 is a thermal printer with full graphics capability and a choice of 25 cps or 50 cps printing speeds. It retails for $299.95 and needs an $89.95 interface to connect with Atari, Commodore, and IBM PCjr computers.

The 3-8200 300 baud modem features acoustic and direct connection and can be powered by an AC adapter or 9-volt batteries. It retails for $119.95.

The 3-5156 cassette recorder includes a digital program indicator, variable data level controls, and interface cables for Atari and Commodore computers. It retails for $69.95.

The 13BC5509 13" composite color monitor doubles as a television set. It retails for $489.95. The 12XR5204 12" black and white monitor also doubles as a television set and costs $129.95.

**General Electric**
Electronics Park
Syracuse, NY 13221
(315) 456-2446 CIRCLE **406**
(800) 626-2000 ON READER SERVICE CARD

### Modems from Avatex

In our May 1985 issue, we ran Modem Magic, a buyer's guide to understanding, choosing, and using a modem. Since that time, Avatex has unveiled three modems: Avatex 300, a $64.95 300 baud modem; Avatex 600, a $99.95 600 baud modem; and Avatex 1200, a $299.95 1200 baud modem.

**Avatex**
2115 Ringwood Ave.
San Jose, CA 95131
(408) 288-8880 CIRCLE **408**
(800) 4-AVATEX ON READER SERVICE CARD

### Quark Winchester

Quark has introduced the QC-20, a 20Mb Winchester hard disk drive for the Apple II, III, and Macintosh computers. It can be segmented into different volumes holding different operating systems and is compatible with Apple Talk Macintosh office networking system. The QC-20 retails for $2595.

**Quark**
2525 West Evans
Denver, CO 80219
(303) 934-2211 CIRCLE **409**
(800) 543-7711 ON READER SERVICE CARD

### Kaypro AT Clone

Kaypro has released the 286i, a $4450 IBM PC AT compatible with 512K RAM, two 1.2Mb floppy disk drives, a color video display adapter, one serial port, two parallel ports, and eight expansion slots. The machine does not come with a color monitor, although one is available from Kaypro for $595. Kaypro bundles a series of MicroPro applications, including *WordStar*, with the 286i.

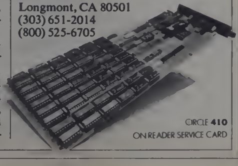
**Kaypro**
533 Stevens Ave.
Solana Beach, CA 92075 CIRCLE **407**
(619) 755-1134 ON READER SERVICE CARD

### Print Spooler and Expansion Boards

Consolink has introduced Micro-Spooler, a printer spooler with 128K RAM. It includes selectable baud rates from 50 to 19,200 and a pause function, and comes in four models: parallel to parallel ($475), parallel to serial ($485), serial to serial ($495), and serial to parallel ($485).

Consolink has also announced The Ace, a memory expansion board for the IBM PC that holds up to 384K, and the ConsoCard, a multifunction board for the IBM PC and compatibles with a clock/calendar, two RS-232 serial ports, up to 384K RAM, and RAM Disk and print spooling software. The Ace carries a retail price of $256 (64K); the ConsoCard, $360 (64K).

**Consolink**
1275 Sherman Dr.
Longmont, CA 80501
(303) 651-2014
(800) 525-6705



CIRCLE **410**
ON READER SERVICE CARD

## Educational Adventures

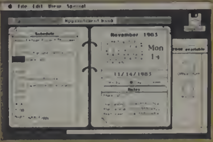
Timeworks has introduced two educational programs. *Dungeon of the Alegbra Dragon*, geared for students aged 14 and up, develops algebra skills using an adventure game format. Each peril, from trapdoors to dragons, can be outwitted by solving algebra equations.

*Cave of the Word Wizard*, geared for students aged 6 to 18, develops spelling skills. The program also uses an adventure game format and includes speech synthesis (no additional hardware required). Both programs run on the Commodore 64 and retail for $24.95 each.

Timeworks also sells *The Evelyn Wood Dynamic Reader*, a software version of the famous course to improve reading comprehension and speed. It runs on the Commodore 64 ($49.95), Apple II series ($69.95), and the IBM PC, PCjr, and compatibles ($89.95).

**Timeworks**
444 Lake Cook Rd.
Deerfield, IL 60015
(800) 323-9755
(312) 948-9200
CIRCLE 411 ON READER SERVICE CARD

## Desktop Accessories for Macintosh



Megahaus has released MegaDesk, a collection of three programs that can be moved to any Macintosh system disk. The $125 package includes an appointment calendar, application transfer command, and card file.

**Megahaus**
5703 Oberlin Dr.
San Diego, CA 92121
(619) 450-1230
CIRCLE 412 ON READER SERVICE CARD

## C64 Spreadsheet

Batteries Included has released *Calkit*, a spreadsheet for the Commodore 64. It creates up to a 99 row x 26 column spreadsheet, displays on-screen help and menus, and provides 20 ready-to-use applications, including budget planning, income tax, net worth, energy consumption, and materials estimator. *Calkit* carries a suggested retail price of $49.95.

**Batteries Included**
30 Mural St.
Richmond Hill, Ontario
M5V 1Z1 Canada
(416) 881-9941
CIRCLE 413 ON READER SERVICE CARD

## Financial Planning

*Bottomline V*, a corporate financial planning template compatible with *Lotus 1-2-3, Symphony, Multiplan, SuperCalc, PeachCalc*, and *VisiCalc*, has been introduced by Ilar Systems. The system features four modules: Historical Financial Analysis; 12-Month Sales Forecast, Budget and Cash Flow; Five-Year Forecast; and Quarterly Forecasting. It carries a suggested retail price of $295.

**Ilar Systems**
1300 Dove St.
Newport Beach, CA 92660
(714) 476-2842
CIRCLE 414 ON READER SERVICE CARD

## Educational Word Processor

Quark has released an educational edition of its Word Juggler word processor for the Apple IIe and IIc. It retains all the features of the business version, including replacement keycaps and spelling checker, and comes with teacher's guide, student handbook, and student activity disk. It must be purchased in units of four: one teacher's edition for $189 and three student versions for $100 each.

**Quark**
2525 West Evans
Denver, CO 80219
(303) 934-2211
(800) 543-7711
CIRCLE 415 ON READER SERVICE CARD

## Surge Protector

Computer Power Solutions has released Electra Guard System 12, a six-plug electronic surge protector with three levels of protection and EMI/RFI filtering. It retails for $59.95.

**Computer Power Solutions**
8800 49th St. North
Pinellas Park, FL 33565
(813) 544-8801
(800) 237-6010


CIRCLE 416
ON READER SERVICE CARD

## Enhanced Apple IIe

Apple has announced an enhanced version of the Apple IIe. The new version uses a 65C02 microprocessor and an improved character generator ROM chip. Both chips are already used in the IIc. Apple also revised two monitor ROM chips to improve mouse response, include clock support, and incorporate print spooling. Apple claims that 95% of current IIe software runs on the enhanced IIe.

The enhanced IIe retails for $895. An upgrade kit for current IIe owners sells for $70, including dealer installation.

**Apple Computer**
20525 Mariani Ave.
Cupertino, CA 95014
(408) 996-1010

CIRCLE 417
ON READER SERVICE CARD

## PCjr Expansion Board

AST Research has introduced the jrCombo, a multifunction expansion board for the IBM PCjr that features a clock/calendar, parallel port, up to 512K RAM, and SuperPak/jr software package. The jrCombo is available in three versions: with 128K RAM ($395), 256K ($695), and 512K ($1395).

**AST Research**
2121 Alton Ave.
Irvine, CA 92714
(714) 863-1333

CIRCLE 418
ON READER SERVICE CARD

# THE COMPUTER SCIENTIST

## Computerized Security Alarms/**Forrest M. Mims, III**

Some personal computers can be programmed to outperform professional security alarm systems that cost hundreds of dollars. You can exploit this ability, and your computer can help earn its keep, if you put your machine to work as a security guard while you are asleep or away from your home or business.

In this article I'll describe how to connect a computer to an array of standard intruder sensor switches, even if they are already installed. I'll also describe a working system that will indicate which sensor switch has been actuated and then generate a predetermined number of alarm beeps before automatically resetting itself. The system can be easily programmed to activate itself immediately or at a preset time. It can be reset during an alarm cycle if the actuated sensor switch has been closed. The system even includes a delay feature that allows time for an occupant to enter the protected building and deactivate the alarm before it sounds.

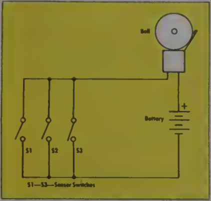



**Figure 1. Basic open-circuit security alarm.**

### Security Alarm Basics

Before discussing how to use a computer as the nerve center for a sophisticated security alarm system, let's review a few basics about electronic intruder detection devices. There are three principle categories of such devices: direct contact, indirect contact and noncontact.

Direct contact alarm systems employ sensor switches that must be physically touched or moved by an intruder. Concealed trip wires and floor switches are examples of direct contact sensors.

Indirect contact alarm systems use sensor switches that are attached to a door, window or other object likely to be moved by an intruder. They include magnet switches, vibration sensors, and window foil.

Noncontact alarm systems are actuated by the mere presence of an intruder. Some detect the presence of a person by means of the infrared radiation the human body emits. Others detect intruders by means of a beam of microwaves, near-infrared, or ultrasound.

> **With the proper interfacing, virtually any computer can be used as a controller for a security alarm system.**

The high tech aspect of noncontact alarm systems is appealing, particularly since some of these systems are incredibly sensitive. For instance, I once tested an ultrasonic intrusion alarm that could be triggered by the movements of my chest caused by breathing. It is this high degree of sensitivity, however, that sometimes makes noncontact systems susceptible to false triggering. Moreover, noncontact systems are generally much more expensive than systems that use direct or indirect contact switches. Also, alarm systems that use switch sensors can protect the perimeter of a building and provide a warning before an actual penetration has been completed. A noncontact system inside a room may provide a warning only after an intruder has broken into the protected area.

All three categories of alarm systems can be monitored by a central control box or by a personal computer. Two connection methods are possible: open and closed circuit.

Figure 1 shows a basic open circuit security alarm. The sensors are depicted as an array of parallel connected switches, each of which is normally open (off). When one or more of the switches are closed (on), the circuit between the battery and the bell is completed, and the bell sounds an alarm. Though the open circuit configuration is very simple, it can be easily disabled simply by cutting one of the wires between the bell and the sensors or the battery.

Figure 2 shows a basic closed circuit security alarm. In this circuit, the sensor switches, which are normally closed, are connected in series with one another. When S4 is pressed momentarily, the relay armature is pulled down. If one of the sensor switches is opened, the relay armature is pulled up, thereby switching

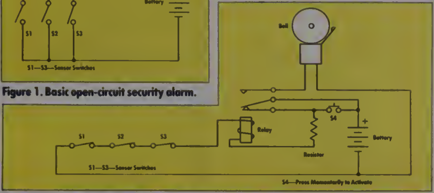



**Figure 2. Basic closed-circuit security alarm.**

on the alarm bell. The resistor limits the current through the relay coil to reduce the standby power consumption of the circuit to a minimum.

The closed circuit alarm requires a continuous source of current to activate the relay. Nevertheless, it is generally a better choice than the open circuit configuration. Both open and closed circuit alarm systems can be used in conjunction with a computer.

## Selecting a Computer

With the proper interfacing, virtually any computer can be used as a controller for a security alarm system. Computers equipped with joystick ports, however, are the easiest to adapt for this purpose. Interfacing external circuits through joystick ports has been discussed in this column when it appeared in *Computers and Electronics* magazine.

Briefly, most personal computers use one of two basic kinds of joysticks. Absolute joysticks include a pair of mechanically linked potentiometers that provide the input to an analog-to-digital converter that causes an on-screen cursor to follow the position of the joystick handle. Rate joysticks incorporate an array of four or more switches that cause an on-screen cursor to move in the direction the joystick handle is pushed.

Low-cost computers designed to work with rate joysticks include models made by Atari and Commodore. The discontinued TI 99/4 and Coleco Adam, both of which can be purchased at bargain prices, also use rate joysticks.

In the March 1984 installment of this column in *Computers and Electronics*, I described how to use the Adam as an open circuit intrusion alarm controller simply by connecting individual sensor switches directly to each of the four switches in the two joysticks. The driver program for this application was very brief. Presumably the techniques presented in that column can be applied directly to other computers that use switch-style rate joysticks.

An intrusion alarm system designed around a rate joystick port requires separate wiring for each sensor switch. A much better approach is to use a computer with absolute joystick ports. This kind of computer can often be connected directly to an existing closed-circuit network of series-connected, normally-closed sensor switches.

An important advantage of an alarm system designed around a computer with absolute joystick ports is that the system can indicate which sensor switch has been triggered. This is accomplished simply by connecting an inexpensive resistor across each sensor switch. Normally, the joystick port "sees" a short circuit. When one of the sensor switches is opened (triggered), the resistor of that switch is connected across the joystick port. If each switch is connected to a resistor having a different value, the computer can easily determine which switch has been opened. I don't know if this is a new idea, but it certainly works well.

Among the most economical computers that use absolute joysticks are Radio Shack's line of Color Computers. Other machines using absolute joysticks include the Apple II family, the IBM PC family, and IBM clones like the Tandy 1000. These machines utilize different methods to interface the potentiometers in the joysticks with the analog-to-digital conversion circuits in the computer. Therefore, there is no single method of implementing a security alarm system for all these machines.

## A Closed Circuit Sensor Network

Figure 3 shows a basic sensor network for a closed circuit alarm system designed around a computer with absolute joystick ports. The only difference between this sensor network and the kind used by conventional security alarms is the presence of the resistors (R1-R5) across each sensor switch and the single resistor (R6) across the network.

When all the sensor switches are closed, the resistance appearing across the joystick port is only that of the sensor wires (perhaps a few ohms). If, say, S3 is opened, then the parallel resistance of R3 and R6 is placed across the joystick port.

The system will work without R6.

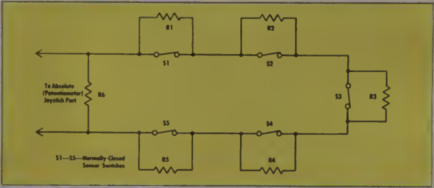



**Figure 3. Sensor network for closed-circuit computer security system.**

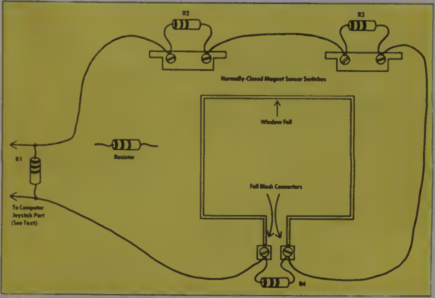



**Figure 4. Basic resistor-bypassed sensor system for computer security alarm.**

But R6 permits it to detect when the wire to the sensors has been cut or disconnected. It should be placed as close as possible to the computer. Normally, R6 is shorted by the network of closed sensor switches. Should one of the sensor wires be cut, however, the short is removed, and R6 appears across the joystick port.

Figure 4 is a pictorial representation of a three-sensor version of Figure 3. The magnet switches are usually used to protect doors and windows. The switch is mounted in a fixed position on the door or window frame as shown in Figure 5. The magnet is installed on the moving door or window. When the door or window is closed, the magnet is adjacent to the switch and the switch is closed. When the magnet is moved away from the switch, the switch opens, thereby triggering the alarm.

The window foil shown in Figure 4 is self-adhesive aluminum foil tape that is attached around the perimeter of vulnerable windows. Contact with the foil is made by means of stick-on connectors that adhere to window glass.

It is important to know that several different methods are used for interfacing potentiometer-style joysticks with computers. In the method used by the Apple II and IBM PC, for instance, the joystick simply supplies a variable resistance to the computer. The joysticks used by Radio Shack's CoCo family, however, serve as variable voltage supplies. The joystick sockets on the computer supply +5 volts and ground to the fixed (stator) terminals of each of the two potentiometers in the joysticks. This arrangement allows the pots to function as voltage dividers. As their wiper contact (rotor) is rotated, the voltage appearing at the center terminal of each pot ranges from near ground to near 5 volts.

Figure 6 shows how the sensor network in Figure 3 can be connected to the two basic kinds of potentiometer-style joystick ports. No change is required to connect the network to a PCjr-style variable resistance port. To connect the network to a variable voltage port like the one used in the CoCo family, it is necessary to add an additional resistor (R) to form a voltage divider. A suitable value for R would be the same value as the resistance of the joystick pots (100,000 ohms for the CoCo).

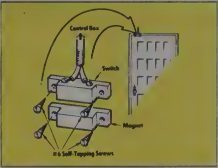



**Figure 5. How magnet sensor switches are installed.**

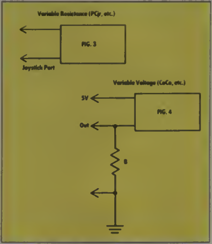



**Figure 6. How to connect sensor network to absolute joystick ports.**

## A Do-It-Yourself Computer Sentry System

For the purpose of this column, I have designed a closed circuit security alarm system around the IBM PCjr. This computer has a pair of absolute (potentiometer) joystick ports. It also has a built-in clock that can be used to activate the alarm system automatically at the present time. The basic principles of this system can be applied to other machines that use absolute joysticks, especially Radio Shack's CoCo family, Apple II family, and IBM-compatible clones.

Figure 7 identifies the connection pins of the non-standard, Berg-type joystick socket on the back of a PCjr. You can better understand how the potentiometers inside the joystick function by referring to the circuit diagram in Figure 8.

If you can't find a Berg-type plug at a computer store, you can make direct connections to the pins in the socket with a wire-wrapping tool. Or you can do as I did and install a miniature phone jack in a PCjr joystick and connect it across the leads to the x-axis potentiometer. Cut one of the wires to the potentiometer.

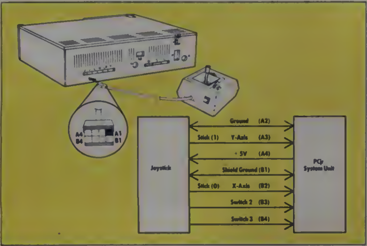



**Figure 7. PCjr joystick connections.**

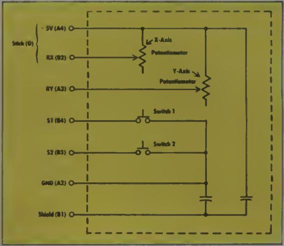



**Figure 8. Internal circuitry of PCjr joystick.**

Use a jack with a built-in switch, and wire the switch between the cut joystick connection and the potentiometer. This will allow the joystick to function normally when the plug to the alarm system sensors is removed.

To test the PCjr as an intrusion alarm controller, I connected a 100′ extension cord to a joystick with a phone jack connected across the x-axis potentiometer (STICK (0) when the joystick connector is plugged into the left joystick connector on the back of the computer). I then connected a 100,000-ohm resistor across the joystick leads (R6 in Figure 3 or R1 in Figure 4). A resistance substitution box was connected across a switch installed at the far end of the extension cord. The cord was strung throughout my office and shop to pick up stray electrical noise that might be present in a real system.

This simple program in Listing 1 tells the PCjr to read the value of STICK (0).

When the sensor switch was opened, the resistance values I tried yielded the joystick values in Table 1 (values may differ for other PCjr's).

Once you know the joystick values given by various resistances, it is a simple matter to select resistors for each sensor switch in a working alarm system. For a simulated five-sensor alarm system, I selected resistors of 3300, 4700, 10000, 15000 and 22000 ohms. This leaves many unused values for additional sensors.

Listing 2 is PCjr Sentry System, a program that transforms the PCjr into a relatively sophisticated alarm system controller. The program assumes one sensor (1) is installed at the principle door of the protected area and asks if the alarm response to this sensor is immediate or delayed. Selecting a delayed response provides time for the occupant to open the door and deactivate the program before the beeper sounds.

The program then gives the current time and asks the user to select the time the alarm system is to become active. Selecting a time a few minutes ahead of the current time will give the occupant a chance to exit the building before the alarm system is activated. Alternatively, the system can be activated immediately, simply by pressing ENTER, if the occupants are not planning to leave.

When the system is activated, the screen displays:

SENTRY SYSTEM NOW ACTIVATED
PRESS R TO RESET
SYSTEM STATUS:
SYSTEM NORMAL. ALL SENSORS SECURE.

When one of the sensor switches is opened, the screen displays the number of the triggered switch. If, for instance, sensor switch 5 is opened, the screen will display:

SYSTEM STATUS:
SENSOR 5 IS OPEN!

The computer will then begin beeping the number of times given in line 870. I used 10, but any number can be substituted. If the sensor switch is still open after the specified number of beeps, another cycle of beeping is begun. Momentarily pressing R (reset) will halt the beeping and cause the program to be resumed, but only if the sensor switch has been closed. If R is held down for a second or so, the beeping will stop and the program will reset even though the switch is open. However, running the program again without closing the triggered switch will cause another beep cycle.

Though the program might seem long, its operation is straightforward. Lines 10 through 390 comprise the main program, and the remaining lines are the subroutines.

The key portion of the main program is in lines 320 through 380. These lines sample the five sensor switches and call the relevant subroutine if an opened switch is detected. The "greater than/less than" values in these lines were determined with the help of the table of joystick values for various resistances.

Lines 410 through 740 form the subroutines that respond to a broken sensor wire or triggered sensor switch and update the system status.

Lines 760 through 840 form the delay subroutine that determines the time before the beeper sounds after sensor 1 is triggered. For test purposes, use a two-second delay (see lines 790 and 800). To provide plenty of time to exit the protected building, use a delay of 60 seconds or so.

Finally, lines 860 through 930 form the beep subroutine. Line 880 determines the number of beeps per cycle the system generates when a sensor is triggered.

**Listing 1.**

```
10  'STICKOUT
20  CLS
30  X=STICK(0)
40  LOCATE 15,15
50  PRINT "X=";X
60  GOTO 30
```

**Table 1.**

| Resistance (ohms) | Joystick Value | Resistance (ohms) | Joystick Value |
|---|---|---|---|
| 680 | 3 | 33,000 | 32 |
| 1,000 | 4 | 47,000 | 41 |
| 1,500 | 4 | 68,000 | 52 |
| 2,200 | 5 | 100,000 | 66 |
| 3,300 | 6 | 150,000 | 75 |
| 4,700 | 8 | 220,000 | 87 |
| 6,800 | 10 | 330,000 | 97 |
| 10,000 | 14 | 470,000 | 103 |
| 15,000 | 19 | 680,000 | 111 |
| 22,000 | 24 | 1,000,000 | 114 |

**Listing 2.**

```
10 'PCjr SENTRY SYSTEM
20 'COPYRIGHT 1985 BY FORREST M. MIMS III
30 CLS
40 PRINT "             PCjr SENTRY SYSTEM"
50 LOCATE 4,12:PRINT "CONNECT SENSOR CABLE TO JOYSTICK PORT 1."
60 X=STICK(0)
70 LOCATE 7,12:PRINT "SENSOR VALUE: ";X
80 PRINT ""
90 PRINT "PRESS ANY KEY IF SENSOR VALUE CORRECT."
100 K$=INKEY$:IF K$="" THEN 60 ELSE 110
110 CLS
120 LOCATE 10,1:PRINT "SENSOR 1 ALARM RESPONSE:"
130 LOCATE 12,1:PRINT "IMMEDIATE (I) OR DELAYED (D)?"
140 D$=INKEY$
150 IF D$="D" OR D$="d" THEN 170
160 IF D$="I" OR D$="i" THEN 170 ELSE 140
170 LOCATE 14,1:PRINT "THE CORRECT TIME IS ";TIME$
180 LOCATE 16,1:PRINT "SELECT TIME SYSTEM IS TO BECOME ACTIVE."
190 PRINT "BUT DO NOT ENTER TIME YET."
200 PRINT "PRESS ANY KEY TO CONTINUE."
210 C$=INKEY$:IF C$="" THEN 210 ELSE 220
```

*(continued on page 64.)*

## Designing Your Own System

The basic techniques given in this column can be adapted for many different computers. Sensor switches and other intrusion alarm devices can be purchased at most electronic parts and Radio Shack stores.

If your computer has a cassette tape interface, you can use the built-in relay to activate an external alarm device that produces considerably more sound than the built-in beeper of the computer. The PCjr and CoCo, for instance, include MOTOR commands to switch a cassette recorder on and off.

As for the program, depending upon the capabilities of your computer, you can easily expand Listing 2 to include many extra features. For example, many more sensor switches can be added to the five in the program. The computer can store in RAM or on disk the time a sensor switch is triggered and the time it is closed. Adding voice synthesis will permit the computer to announce which sensor has been triggered.

Here are a few pointers and precautions you should consider before you install a security alarm system. First, it is wise to read more about the subject before proceeding. Some companies that make security electronic devices publish brochures, and there are a number of helpful books on the subject. John E. Cunningham, for example, has written *Security Electronics* and *Electronic Intrusion Alarms*, both published by Howard W. Sams.

If you assemble a computerized alarm system, it is important to make sure stray electrical signals entering the sensor network don't cause false triggering. It is also important to make sure the sensor wires don't come in contact with live electrical wires. Incidentally, you should be aware that some computer companies might not honor the warranty on a machine that is connected to an "unauthorized" peripheral such as a homebrew security alarm.

Finally, remember that security alarms are installed for serious reasons. No electronic surveillance system is perfect, especially those that require a continuous power supply. As for reliability and immunity from embarrassing false alarms, a homebrew computer security system is only as reliable as your ability to design and install it. That is why Listing 2 is merely suggested as a model program which you should carefully test and evaluate before using it or a similar program to protect a home or office. ■

**Listing 2.** *(continued)*

```
220 LOCATE 20,1:PRINT "ENTER TIME TO ACTIVATE SYSTEM OR PRESS"
230 PRINT "ENTER TO ACTIVATE SYSTEM IMMEDIATELY."
240 LOCATE 23,1: INPUT "ACTIVATE SYSTEM AT (00:00:00):";START$
250 IF START$<TIME$ THEN GOTO 260 ELSE 250
260 CLS
270 LOCATE 1,1:PRINT "SENTRY SYSTEM NOW ACTIVATED."
280 LOCATE 3,1: PRINT "PRESS R TO RESET."
290 R$=INKEY$
300 IF R$="R" OR R$="r" THEN GOTO 10
310 X=STICK(0)
320 IF X<5 THEN GOSUB 420          :'ALL SENSORS SECURE
330 IF X>105 THEN GOSUB 460        :'SENSOR CABLE CUT
340 IF X >4 AND X<8 THEN GOSUB 510 :'SENSOR 1
350 IF X>7 AND X<11 THEN GOSUB 570 :'SENSOR 2
360 IF X>10 AND X<16 THEN GOSUB 620:'SENSOR 3
370 IF X>15 AND X<21 THEN GOSUB 670:'SENSOR 4
380 IF X>20 AND X<27 THEN GOSUB 720:'SENSOR 5
390 GOTO 270
400 '
410 'SENSOR SUBROUTINES:
420 LOCATE 8,1: PRINT "SYSTEM STATUS:"
430 LOCATE 10,1:PRINT "SYSTEM NORMAL.  ALL SENSORS SECURE."
440 RETURN
450 '
460 LOCATE 10,1:PRINT "SENSOR CABLE CUT OR DISCONNECTED!  "
470 GOSUB 860
480 RETURN
490 '
500 'SENSOR 1:  3300 OHMS
510 LOCATE 10,1:PRINT "SENSOR 1 IS OPEN!                       "
520 GOSUB 760:'DELAY SUBROUTINE
530 GOSUB 860
540 RETURN
550 '
560 'SENSOR 2:  4700 OHMS
570 LOCATE 10,1: PRINT "SENSOR 2 IS OPEN!                      "
580 GOSUB 860
590 RETURN
600 '
610 'SENSOR 3: 10000 OHMS
620 LOCATE 10,1: PRINT "SENSOR 3 IS OPEN!                      "
630 GOSUB 860
640 RETURN
650 '
660 'SENSOR 4: 15000 OHMS
670 LOCATE 10,1: PRINT "SENSOR 4 IS OPEN!                      "
680 GOSUB 860
690 RETURN
700 '
710 'SENSOR 5: 22000 OHMS
720 LOCATE 10,1:PRINT "SENSOR 5 IS OPEN!                       "
730 GOSUB 860
740 RETURN
750 '
760 'DELAY SUBROUTINE (SENSOR 1 ONLY):
770 IF D$="D" OR D$="d" THEN 800 ELSE RETURN
780 'TIMER (N): N=DELAY IN SECONDS
790 'USE N=2 (2-SECOND DELAY) TO TEST SYSTEM
800 ON TIMER (2) GOSUB 830
810 TIMER ON
820 GOTO 820
830 X=STICK(0)
840 IF X>4 AND X<8 THEN 860 ELSE 290
850 '
860 'BEEP SUBROUTINE
870 FOR Z=1 TO 10: 'NUMBER OF BEEPS
880 FOR Q=1 TO 200:NEXT Q
890 BEEP
900 R$=INKEY$
910 IF R$="R" OR R$="r" THEN RETURN
920 NEXT Z
930 RETURN
```

CIRCLE 122 ON READER SERVICE CARD



CIRCLE 127 ON READER SERVICE CARD



CIRCLE 151 ON READER SERVICE CARD

# A Confusion of Sorts

How many passes does it *really* take to sort a list?/**Albert Nijenhuis**

They say that you can't sort a list of N objects in less that N log N operations, but I'll show you how. Sounds familiar? Not many years ago, there was a similar-sounding challenge: "You can't trisect an angle." Many man-years have been spent trying to disprove that one, and if the debate has ended, it's because interest has waned—not because the problem has been settled in the public's mind.

Let's look briefly at the angle-trisection problem. What does it mean?

"No angle can be trisected." Well, of course, we know from geometry how to construct an angle of 30 degrees, which is one-third of 90 degrees. So, *some* angles can be trisected.

"I can trisect an angle so well no one can find any discrepancy." Again, that is not the point. Assuming perfect tools, can you divide an angle into three parts of exactly equal measure?

"I have a gadget that will perform exact trisections." Such tools (without moving parts) actually exist, and at this point it is necessary to use more precise language. The intended statement was not "You can't trisect an angle" but "You can't exactly trisect an arbitrary angle using just straightedge and compass." And that *can't* be done. That's higher math—and it's time to get back to sorting.

## Sorting Terminology

First a piece of terminology. We shall denote by N the length of a list that we want to sort, and we want to measure the amount of labor (the number of tests, or displacements, or whatever) required to do this. The expression O(N) ("Oh of N") denotes a quantity which is basically proportional to N (it has the "order of magnitude" of N). It might be 3N or 17N or 12N + 300 or 7N + log N (note that log N is much smaller than N for large values of N). On the other hand, $N^2$ is not O(N) because when N increases, $N^2$ increases faster than any constant multiple of N. Implicit in the notation O(N) is some number (any of the coefficients 3, 17, 12, or 7 above) to multiply by N. Its value is not considered "interesting" (though most people would prefer a 2 to a 100 in a labor count), because it can be highly machine-dependent. The expression O(N log N) denotes a quantity which is basically proportional to N•log N.

The debate, then, is usually centered on the question: Do we need O(N log N) comparisons to sort a list, or can we do it in O(N) comparisons?

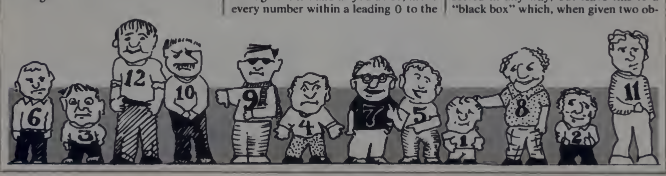
Suppose you are given a list of length N which consists of four digit numbers and which must be sorted in increasing order. I will show that I can do this with *no comparisons at all*: Pass through the list and as you do so, move every number within a leading 0 to the beginning. When done, do the same with the leading digit 1 in the remaining list, etc. When finished, the list is sorted as far as the first digit is concerned. Now, in each of the ten sublists do the same with respect to the second digit, and so on.

In this way we have sorted our list with no comparisons between members of the list at all. We have performed labor (testing of digits, displacements), and that is O(N), namely 40N, or if you are a clever programmer, only about 4N, give or take a small multiplier.

A variation on the above method uses an array of size 10,000, one place for each of the possible occurrences in the list, and uses it in some fashion (many variations exist) to sort the list in a relatively simple way, again in O(N) labor, with no comparisons at all.

These comments are intended to illustrate that if there is to be any meaning to the O (N log N) story, some more precise definitions are needed.

First of all, the statement concerns comparisons, not displacements—although many comparisons result in displacements, of course. Second, we mean honest comparisons with no tricks, such as testing digits or calculating an address from the value. To put it another way, the sorting method itself should not examine the objects to be sorted in any way, but leave this to a "black box" which, when given two ob-



jects, say A and B, issues one of the three pronouncements: "A precedes B," "B precedes A" or "A and B may be placed in either order."

The only requirement of the black box is that it be consistent. For example, if it has made the pronouncements "A precedes B" and "B precedes C," then if confronted with A and C it must come with the pronouncement "A precedes C." (A "good" sorting method achieves its efficiency by *not* presenting A and C to the black box.)

### A Precise Definition

Given, then, a list of N objects in arbitrary order and a black box that is capable of making pronouncements on the objects in the list, what is the minimum number of calls to the black box needed to sort the list in the most unfavorable (called "worst possible") case? In this context, that minimum is O(N log N).

To show why this is so, let the list-to-be-sorted be A(1), . . . ,A(N). Sorting this list means determining a permutation of the numbers 1, . . . ,N (i.e., a rearrangement of 1, . . . ,N), which we may denote p(1), . . . ,p(N), such that A(p(1)), . . . ,A(p(N)) are in the order defined by the black box.

For example, if N = 3, A(1) = 7, A(2) = 1, A(3) = 4, then the increasing order is A(2), A(3), A(1). That is, p(1) = 2, P(2) = 3, p(3) = 1. Usually, sorting methods do not explicitly compute p(1), . . . ,p(N), but it is simple to change any method—without changing the comparisons—to produce the permutation.

Sorting a list, thus, means determining one specific permutation. (We assume that all objects in the list are distinct, else the permutation is not completely unique.) That is, we are looking for one out of N! (N factorial) permutations, because that is the number of permutations that exist. Let S denote the set of them all.

The first comparison of the method will compare, say, A(I) and A(J). Suppose the black box responds with "A(I) precedes A(J)." Then we know that in the as-yet-undetermined permutation p(1), . . . ,p(N) the number I will have to precede J.

This one comparison has therefore, in effect, divided the set S into two sets of permutations: the set $S_1$ of "good" ones, in which I precedes J, and the "bad" ones, in which J precedes I. We could make a list of the permutations that belong to $S_1$ if we cared to do so.

Next, another comparison is made and it results in the same way in retaining a set $S_2$ of permutations in $S_1$ and rejecting the others. This process continues until we are left with a set of just one permutation—the one we wanted.

The description we have just given says nothing about the strategy by which the objects that are to be compared are chosen. That is deliberate, because the description as it now stands covers all possible strategies.

### A Best Sorting Strategy?

At this point we claim that a "best" strategy would be so designed that at the first comparison between A(I) and A(J), the set $S_1$ and the set of permutations not in $S_1$ are essentially equal in size. This may go against the notion that a small set $S_1$ would more quickly lead to a single permutation. The point is, however, that another list would lead to a black box reply of "A(J) precedes A(I)," and its "good" list is the "bad" list of the case we considered. To do best in the "worst case," neither list should suffer at the hands of the other. The same argument applies to subsequent comparisons.

We see, therefore, that a "best" strategy—if such exists—will, for each comparison, cut the then current list of "good" permutations in half, or close to half. The minimum number (k) of comparisons will therefore be that number for which $n!/2^k$ is essentially 1. It cannot be exactly 1, because no factorial greater than 2! is a power of 2. That is, k is very close to $\log_2(N!)$. Again, $\log_2(N!)$ is not an integer, but the next higher integer will be the lowest value that k could have for a "worst case." We shall ignore this "next higher integer" business, because we do not worry in our count about one comparison more or less. Thus we simply conclude that any sorting method based on comparisons requires at least $\log_2(N!)$ comparisons in the worst case.

A formula, due to Stirling, gives a very good approximate formula for N!, namely

$$N! = O\left(\frac{N^{N+.5}}{e^N}\right)$$

where the constant in the O( ) is, in fact, the square root of $2\pi$, but that is irrelevant. From this it follows that:

$$\log_2(N!) = N \log_2 N - N \log_2 e + .5 \cdot \log_2 N + O(1)$$

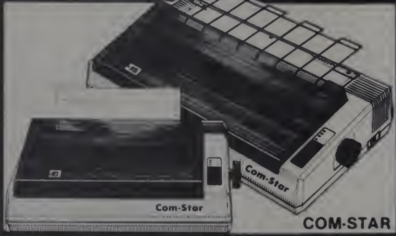
(the O(1) denotes some uninteresting almost constant quantity). It certainly follows from this that:

$$\log_2(N!) = N \log_2 N + O(N)$$

which is what this article is all about. Observe that this is only a *lower bound*. All we have shown is that, if we bisect a set of N! permutations repeatedly, this many bisections will be needed to end up with a single permutation. We have not shown that such bisections can always be achieved by comparisons of pairs of objects in our list.

The existing sorting methods of type N log N have "worst case" comparison counts of $C \cdot N \cdot \log_2 N + O(N)$, but the C is not always equal to 1 as above in our lower bound estimate. For example, a good Merge Sort has C = 1 but Heapsort has C = 2. In a sense, Heapsort "wastes" half the comparison, because half of them are never followed by an interchange. (See "How Not to be Out of Sorts II," *Creative Computing*, September 1980.) Most other popular sorting methods, such as Shell Sort and Quicksort, have only *average* comparison counts of O(N log N) but the "worst case" performance (relatively rarely encountered) is higher—$O(N^{1.5})$ or $O(N^2)$, for example. Detailed mathematical analyses of these and other methods can be found in Volume III of *The Art of Computer Programming* by D. E. Knuth. ■

# FANTASTIC COMPUTER PRINTER SALE!!!




## 10X COM-STAR*

**Tractor Friction Printer**

**130-150 CPS**

Only **$199**

List $499

- *Lowest Sale Price, Premium Quality, Tractor/Friction Printer in the U.S.A. (Best Value)*
- *High Speed 130-150 Characters Per Second* • *40, 46, 66, 80, 96, 132 line spacing*
- *Word Processing, Letters* • *Business Forms* • *Labels, Graphics, Tables* • *List Programs*
- *Fantastic Graphics* • *Print Modem Data* • *The Most Important Accessory For Your Computer*

### Premium Quality 130-150 CPS 10X COM-STAR Printer $199

10" carriage, prints 8½"x11" standard single sheet or continuous feed paper, Bi-directional, impact, dot matrix, 130-150 CPS, 9 x 9 dot matrix with double strike capability for 18 x 18 dot matrix (near letter quality), high resolution bit image, underlining, back spacing, true lower descenders with super and subscripts, prints standard, italic, block graphics, and special characters. It gives you print quality and features found on printers costing twice as much'' (Centronics Parallel Interface) (Better than Epson FX80). List $499.00. **Sale $199.00.**

### Premium Quality 150-170 CPS 15½X COM-STAR Business Printer $319.00

Has all the features of the 10X COM-STAR PRINTER plus 15½" carriage and more powerful electronics components to handle large ledger business forms! (Better than Epson FX 100) List $599. **Sale $319.00.**

## JUKI®

### 12" DAISY WHEEL PRINTER $199.00

"JUKI" Superb letter quality daisy wheel printer, 12" extra large carriage, up to 12CPS bi-directional printing, drop-in cassette ribbon, (90 day warranty) centronics parallel or RS232 serial port built in! (Specify). List $299.00. **Sale $199.00.**

## JUKI®

### Printer/Typewriter Combination *$279.00*

"JUKI" Superb letter quality, daisy wheel printer/typewriter combination. Two machines in one — just a flick of the switch. 12" extra large carriage, typewriter keyboard, automatic margin control and relocate key drop in cassette ribbon! (90 day warranty) centronics parallel or RS232 serial port built in (Specify). List $399.00. **Sale *$279.00***

## Olympia

### Executive Letter Quality $339.00 15" Daisy Wheel Printer

This is the world's finest daisy wheel printer. Fantastic letter quality, up to 20 CPS bi-directional, will handle 14.4" forms width! Has a 256 character print buffer, special print enhancements, built in tractor-feed (Centronics Parallel and RS232C Interface) (90 day warranty). List $649.00. **Sale $339.00**

## Olympia

### Printer/Typewriter Combination $439.00

Better than IBM Selectric. Superb computer printer combined with the world's finest electronic typewriter. Two machines in one, just flick the switch for up to 20 CPS printing (**300 Words per minute**) on a 15" carriage that handles up to 14 1/8" in. paper. Drop in cassette ribbon — express lift off correction, Centronics parallel interface (90 day warranty). List $749.00. **Sale $439.00.**

## • *15 Day Free Trial — 1 Year Immediate Replacement Warranty*

### PARALLEL INTERFACES

For VIC-20 and COM-64 — $59.00. Apple — $79.00. Atari — $59.00.

Add $14.50 for shipping, handling and insurance. Illinois residents please add 6% tax. Add $29.00 for CANADA, PUERTO RICO, HAWAII, ALASKA, APO-FPO orders. Canadian orders must be in U.S. dollars.
WE DO NOT EXPORT TO OTHER COUNTRIES, EXCEPT CANADA.
Enclose Cashiers Check, Money Order or Personal Check. Allow 14 days delivery, 2 to 7 days for phone orders, 1 day express mail!
VISA — MASTERCARD — C.O.D. — No C.O.D. to Canada or APO-FPO

# PROTECTO

*We Love Our Customers*

Box 550, Barrington, Illinois 60010

**312/382-5244 to order**

COM-STAR PLUS+ Print Example

ABCDEFGHIJKLMNOPQRSTUVWXYZ
ABCDEFGHIJKLMNOPQRSTUVWXYZ 1234567890

# Probability and Computers

Simulate, then analyze/**Glenda Lappan and M.J. Winter**

In the past, the study of probability in school has almost of necessity concentrated on formulas and theoretical principles. Situations were simulated by means of spinners, tossing dice and coins, and drawing colored balls out of an urn. While simulations of this sort can be very useful, making a large number of replications is time consuming.

Introducing a microcomputer allows probability to be studied in a new and exciting way. Simulation can become an important mathematical technique for the learner. An event can be replicated a large number of times to determine an empirical probability, which can then provide a check on the theoretical analysis of the problem. In fact, the analysis involved in writing an accurate simulation may form a basis for a later proof.

Many probability statements that we encounter in everyday life are empirically based—weather predictions, for example. Other probability situations, such as the odds of winning the state lottery, are theoretically analyzed. Therefore, it is important that we learn the basic theoretical ideas of probability, but also learn to appreciate the modern role of simulation in making predictive statements.

In this article we will present four probability problems, their simulations and analyses. We have found these four to be an excellent collection for illustrating the power of simulation and how empirical solutions can stimulate an interest in theoretical solutions. The four problems are of varied types.

The first illustrates a discrete situation for which it is possible to list the sample space. The second and third are both continuous—the number of possible outcomes is infinite. The second has a geometric solution, and the third uses elementary trigonometry. The last problem is discrete but has a surprising continuous extension question which leads to $1/e$.

## Problem 1: How Do You Pay Your Bill?

Mr. Jones owes Pat \$5 per week for delivering his paper. He proposes that instead of paying the \$5 in cash, each week he will let Pat reach into a sack, which contains a ten dollar bill and five ones, and draw two of the bills. Should Pat go along with Mr. Jones' scheme?

### The Simulation and Program

There are six bills in the sack, so we generate randomly an integer from 1 to 6 (line 140 below) and decide, arbitrarily, that the 1 will correspond to the ten dollar bill. If the 1 is generated, then Pat will draw a total of \$11 (line 210). If the first bill is not the \$10, there are five bills remaining. An integer from 1 to 5 is generated (line 160); again we let the 1 correspond to the \$10. We compute Pat's average weekly earnings for a 52 week period (line 230).

```
100 RANDOMIZE
110 'Average income for one year
120 P=0              :'Pat's earnings
130 FOR I=1 TO 52   :'52 weeks
140 X=INT(RND(1)*6+1)
150 IF X=1 THEN 210
160 Y=INT(RND(1)*5+1)
170 IF Y=1 THEN 210
190 P=P+2: GOTO 220:'add $2 to total
210 P=P+11          :'add $11 to total
220 NEXT I
230 PRINT "52-week average is";P/52
240 GOTO 120

52-week average is 4.942308

Sample results: 5.29, 5.65, 4.94, 4.60
```

### Observations and Analysis

The simulated results suggest an average of around \$5. Computing the long term average (expected value) is easily done by listing all the possible combinations of two bills that could be drawn from the sack. If the six bills are denoted T, 01, 02, 03, 04, and 05, the possible combinations of the two bills are

| | | | | |
|---|---|---|---|---|
| T-01 | 01-02 | 02-03 | 03-04 | 04-05 |
| T-02 | 01-03 | 02-04 | 03-05 | |
| T-03 | 01-04 | 02-05 | | |
| T-04 | 01-05 | | | |
| T-05 | | | | |

One third of these 15 combinations have a value of \$11. Two-thirds have a value of \$2. Thus the expected value of the two bills is

$$1/3*11 + 2/3*2 = 5$$

so that, in the long run, Pat will neither gain nor lose by adopting the sack method. It is a "fair" offer.

Because the sample space is small (15 elements) and because there are only two possible values of the bills, a small number of simulations will give a true picture of the expected value.

## Problem 2: Meeting for Lunch

Two friends who have unpredictable lunch hours agree to meet for lunch at their favorite restaurant whenever possible. Neither wishes to eat at that particular restaurant alone and each dislikes waiting for the other, so they agree that:

1. Each will arrive at a random time between noon and 1:00 p.m.

2. Each will wait for the other either for 15 minutes or until 1:00 p.m.

On a given day, what is the probability that the friends will meet?

**The Simulation and Program**

Each friend can arrive at any instant between noon and 1:00. If arrival at each instant is equally probable, then, since there is an infinite number of instances, the probability of arriving at any particular instant is 0. This point will cause consternation among readers who believe that they have been taught that if the probability is 0, then the event cannot occur. However, the nature of a continuous situation is that the event can actually take place as is shown in the program below, which predicts how often the two friends meet. In the program, the time within the one-hour period that each friend arrives is selected in lines 130 and 140. Line 150 tests to see if the two times are within 15 minutes (.25 of one hour) of each other. The total times they meet in N days is given by M.

```
90 RANDOMIZE
100 INPUT "Run for how many days";N
110 M=0    :'Set meetings to zero
120 FOR I=1 TO N :'Run for N days
130 F1=RND(1)   :'Arrival time friend 1
140 F2=RND(1)   :'Arrival time friend 2
150 IF ABS(F1-F2)<.25 THEN M=M+1
160 NEXT I
170 PRINT "Frequency was";M/N
```

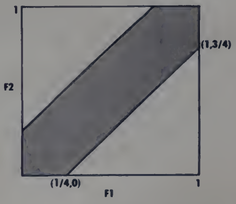
```
Run for how many days? 100
Frequency was .39
```

```
Sample results: .43. .39, .42, .45, .45
```

**Observations and Analysis**

An immediate reaction is: they will wait 30 minutes between them. That is half an hour, so the probability is .5. The simulation results strongly suggest that this reasoning is incorrect.

To analyze the problem, draw a unit (one hour) square (see below); a point, (F1,F2), within the square will represent one possible set of arrival times for Friend 1 and Friend 2. If the point lies within the shaded strip representing times 15 minutes or less apart, the friend meet.




Comparing the area of the non-shaded triangles to unity, we see that

$$2^* \text{ areas of each triangle} = 2^*(1/2)^*(3/4)^*(3/4)=9/16$$

is the proportion of time the friends do not meet. Hence 7/16 = .44 is the probability of meeting. In the continuous case, it is impossible to "list" the sample space, but it is sometimes possible to represent it with a picture.

## Problem 3: Points on the Unit Circle

Pick two points at random on the unit circle (a circle of radius 1). What is the probability that the distance between them is less the one?

**The Simulation and Program**

For readers who have studied trigonometry, the easiest way to obtain a random point on the unit circle is to generate a real number Z between 0 and $2^*\pi$, and let the point have coordinates, Z=cos(Z) and Y=(Z). (See program.) The points are selected in lines 130 and 150, and the coordinates calculated in lines 140 and 160. The distance between the points is then calculated in line 170.

```
90 RANDOMIZE
100 INPUT "Number of trials";N
105 PI=4*ATN(1)
110 C=0
120 FOR K=1 TO N
130 Z1=2*RND(1)*PI
140 X1=COS(Z1): Y1=SIN(Z1)
150 Z2=2*RND(1)*PI
160 X2=COS(Z2): Y2=SIN(Z2)
170 D=(X2-X1)^2 + (Y2-Y1)^2
180 IF D<1 THEN C=C+1
190 NEXT K
200 PRINT "Fraction when d<1:";C/N
```

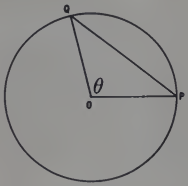
```
Number of trials? 100
Fraction when d<1: .35
```

```
Sample results: .28, .31, .42, .35
```


*"Of course you realize, Henderson, that Father Syntax is our last hope to de-bug this program!"*

**Observations and Analysis**

This is another continuous problem; the answer is unchanged if the question is worded "what is the probability the distance is less than or equal to one?" To analyze the problem, draw the unit circle and select a point P on it. Draw the radius OP. Let Q be any other point on the circle except that point diagonally opposite P. Look at the triangle QOP. If the angle QOP $< 60°$, then QP $< 1$. If the angle $= 60°$, then an equilateral triangle has been formed and QP$=1$. One third of the points on the circle are within $\pm 60°$ of OP. Hence the probability that the distance QP is less than (or equal to) one is 1/3.




Algebra students may employ the following line of reasoning: if (x,y) is on the circle, then both

$$-1 \leq x \leq 1 \text{ and } y^2=1-x^2.$$

To find (x,y) at random, we generate x between $-1$ and 1, take $y= \sqrt{1-x^2}$, and let y be negative with probability .5:

```
X=INT(2*RND(1)-1)
Y=SQR(1-X*X)
IF RND(1)< .5 THEN Y=-Y
```

When this method of selecting "random" points is used, the results are noticeably different. To see why, suppose P(x,y) is chosen this way. Then $-.5 < x < .5$ with probability 1/2, and P lies on one of the two thickened arcs, with probability 1/2. Equivalently, half the points generated will lie on the arcs. The central angle, 0, subtended by each arc is 60°, i.e., the arcs together form 1/3 of the unit circle. If half the points chosen lie on one third of the circle, then the points are not "picked at random."


## Problem 4: Catching the Counterfeiter

You, the ruler of the kingdom of Wellsall, suspect that your treasurer is robbing you by substituting counterfeit coins for gold ones. The coins are packed 25 to a bag, and, in fact, the treasurer is placing one false coin in every bag. You command the treasurer to bring in 25 bags of coins. From each bag you select one coin; the coins are then analyzed. What is the probability that you will find a false coin?

Change both 25's to 50. What is the probability now? Change both 25's to 100. What is the probability now?

**The Simulation and Program**

We will replicate the "trial" of the counterfeiter several times (N, line 100) (See below). For each trial we examine 25 bags (line 180). For each bag we must select a coin. We select a coin by generating a random number from 1 to 25 (line 140); if the number generated is 12, we have found a false coin. One false coin will prove the guilt of the treasurer, so the trial is terminated (line 150) and the treasurer dispatched.

```
90 RANDOMIZE
100 INPUT "Number of trials";N
110 D=0 :'D means treasurer detected
120 FOR I=1 TO N
130 FOR J=1 TO 25
140 P=INT(RND(1)*25+1)
150 IF P=12 THEN 180   :'Bad coin
160 NEXT J: GOTO 190
180 D=D+1
190 NEXT I
200 PRINT "Detection probability:";D/N
```

```
Number of trials? 100
Detection probability: .62
```

```
Sample results: .59, .60, .66, .55, .64
```

**Observations and Analysis**

Your first reaction to this problem is likely to be that the treasurer is very safe. After all, there is only one false coin in each bag of 25, so the probability of being caught is about 1/25. With more coins in the bags, the treasurer should be even safer. For these students the simulated results are a shock. The probability of being caught seems to be approximately .60. Moreover, the number of coins in the bag does not appear to influence that result.

For the first bag, the probability of detecting the false coin is 1/25. This means that the treasurer has probability $(1-1/25)$ of escaping detection when bag 1 is opened. However, the probability of escaping for two bags is (24/25)*(24/25). The probability of being safe through 25 bags is:

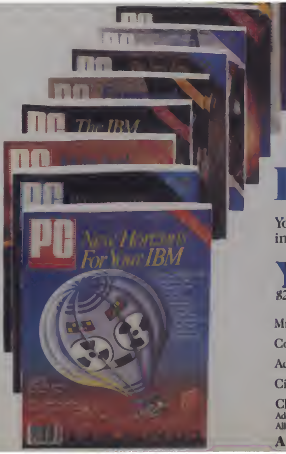
$$\left[\frac{24}{25}\right]^{25} \approx .36$$

The probability of being caught is $1-.36=.64$.

When more coins are placed in each bag, correspondingly more bags are examined. If there are N coins to a bag and N bags each have one coin removed, then the probability the treasurer escapes is

$$\left[\frac{N-1}{N}\right]^{N} = (1-1/N)^N$$

which approaches 1/e as $N \rightarrow \infty$. For large N, therefore, the probability of detection is $1-1/e=.63$. ■


PC
New Horizons For Your IBM

NO POSTAGE
NECESSARY
IF MAILED
IN THE
UNITED STATES

# BUSINESS REPLY MAIL

FIRST CLASS PERMIT NO. 66 BOULDER, COLORADO

POSTAGE WILL BE PAID BY ADDRESSEE

P.O. Box 2443
Boulder, Colorado 80321


# 26 reasons to subscribe to PC Magazine

You'll get 26 big issues a year of the most up-to-date news and technological breakthroughs affecting you and how you use your IBM PC—*at unbelievable savings!*

You'll build a professional library of insights, written by leading experts and professionals in personal computing covering the newest releases in hardware and peripherals—timely innovations in programming and applications—feedback from professionals and users like yourself on how they use their PCs to increase their productivity—and up-to-the-minute reviews of the newest releases in software.

Subscribe to *PC Magazine* for less than 85¢ an issue, only $21.97 for 26 issues and save 37% off the regular one-year rate.

Use the attached Order Card or call Toll Free

**1-800-852-5200**

8Z292


A unique concept in learning.

"Professor Pressnote invites children to play along . . .

. . . and to create their own tunes.

# IBM IMAGES

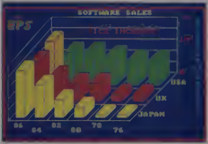
## Personal Graphics/Will Fastie

One of the things that Apple has done for all of us is raise our consciousness about graphics. The effect of the graphics capabilities of the Apple II was so great that IBM made sure graphics capability was available for the PC at the time it was introduced. With the Macintosh, Apple has commercialized the graphics-based icon, menu, and mouse scheme developed at Xerox. A plethora of *MacPaint*-like programs now exists, and the color and graphics capabilities of the PC family are rising.

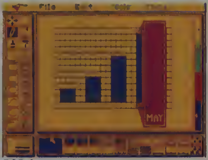
One of the first things I looked for when I got the PC was a graphics program that would allow me to build pictures. The thought of drawing with a mouse or other device was far from my mind; an etch-a-sketch program I wrote for my son was about the limit of my imagination at that time. I was quickly disappointed to discover that nothing existed, and it was to be three years before I invested in my own color display and a mouse.

In the meantime, I did finally find a program that fit my budget but allowed some drawing. Actually, *PC Crayon* was more than just a drawing program. It provided some rather sophisticated vector drawing capabilities as well as animation. I used the program successfully to design an automated ribbon-cutting ceremony for the opening of my new office. *PC Crayon* is still available, as is its big brother, *Executive Picture Show*. Both are from PC Software; *PC Crayon*, in particular, is a bargain from PC Connections.

About a year ago, *MacPaint*-like programs began to emerge for the PC family. By now, there must be at least ten products designed to satisfy the market demand. The two best known are Mouse Systems *PC Paint* and the more recent IBM PCjr *ColorPaint*. Both are good, and both have their limitations. Both have the by now mandatory Macintosh look, and both have about the same collection of features. If the truth be known, I like IBM's product better, but



**Executive Picture Show**



**PC Paint**


**PC Paintbrush**


**TelePaint**

more often use *PC Paint* because use of *ColorPaint* is restricted to the PCjr: it is a cartridge-based program.

*ColorPaint* has four significant advantages over *PC Paint*. First, it can fill an arbitrary shape after the fact. This means that a drawing can take shape and an area can be filled at any time. *PC Paint*, by contrast, can only fill the shape just after it has been drawn, a severe limitation. So, for example, *ColorPaint* can fill the intersection of two circles but *PC Paint* cannot. Second, *ColorPaint* on the PCjr can get at all 16 colors, although it is unfortunately limited to four at a time. *PC Paint* deals only with the familiar palettes of the PC, even on jr. Third, although both products support patterns, only *ColorPaint* can edit them; new patterns created by the user are saved along with the image. Fourth, *ColorPaint* commands a better selection of printers, including the IBM Color Printer.

One subtle difference between the two programs is the size and shape of the image created. *PC Paint* drawings are screen images, so they can be used effectively for presentation graphics. They do not, however, print very well. *ColorPaint* images do not fill the screen, but they are sized so that they can be printed upright (in portrait orientation) as full-sized 8 1/2" x 11" pages. In short, *PC Paint* has a screen orientation and *ColorPaint* has a paper orientation.

Once again, PCjr *ColorPaint* is the better product, but is severely limited by its restriction to the PC's little brother.

### Other Entries

Two other products that I have tried are *Draw-It* and *4-Point Graphics*. *Draw-It* looks particularly interesting because of its low price ($29.99) and because it is published as a book (presumably for retail in book stores) by Paperback Software International. It seems a reasonable product, but I don't feel it measures up to another program of similar cost which I will be discussing in a moment. I also felt it was slow by comparison with almost every other program I have tried. *4-Point Graphics* can only be called strange, and is not as fully featured as I think a product in this category ought to be.

Another product has impressed me and others greatly and promises to be an important player. It is Imsi's *PC Paintbrush.* Its big advantage over everybody else's product is the extensive display subsystem and printer support it provides. The installation program provides support for a long list of displays (including all the resolutions available for each one) and an equally long list of printers. I fully expect it to be the first drawing program available that will directly support the IBM Enhanced Color Display subsystem, a feat made possible by the fact that the program is device independent. In fact, pictures are stored in such a way that a particular picture can be drawn on one display system and then be correctly displayed on another system with different display characteristics. *PC Paintbrush* also supports the world of mice and joysticks, but can operate under keyboard control as well. All in all, a strong product, especially if your environment has a variety of hardware.

A product received too late for detailed examination but which looks very nice is *TelePaint* from LCS/Telegraphics. Like PCjr *Color Paint*, the program can produce an upright, 8 1/2" x 11" image. The *TelePaint* screen presentation is very good looking, giving the most Mac-like appearance of any of the products mentioned here. It is the most expensive Mac-alike of the lot, at $149, so a more careful look is required before a serious recommendation can be made. I'll let you know in a later column.

Those are the major products I have seen so far. I am quite sure there will be more and, of course, I have omitted mention of programs sold only with hardware products. However, there is one product that you will not easily hear about but that offers extraordinary function for the money. It is one of IBM's quietly marketed Personally Developed Programs called *PC Palette.*

## Personally Developed Software

A note about IBM's Personally Developed series is in order here. IBM has published a mail-order catalog, called "The Directory," that initially carried 36 products and has recently been expanded by 22 more, for a total of 58. These programs were developed by IBM employees and are marketed by IBM in a remarkably cost-effective way. Most of the programs cost less than $50 (the range is $15 to $150) and include utilities, games, and business applications (see Table 1). Some of the programs have been bundled together in "value packs" which range in price up to $195 and generally represent a substantial discount over the price of the programs purchased individually. I have had a chance to look at about 15 of the programs and have found some real gems, as well as a few that are less interesting or valuable.

"The Directory" itself is well done. It is nicely printed, with much color. Each program is described on a page that includes a brief summary of its function and capability, its operating requirements, and the price. A picture of a typical screen display is also provided. The names of the program authors are given; a very nice touch is the photographs of the authors in the table of contents. And because it is, after all, a mail-order catalog, several order forms with mailing envelopes are conveniently provided.

For the most part, these programs are good values. The better ones could not be had at twice the price if they were marketed in traditional style by typical publishers. *PC Palette*, for example, costs only $39.95 and is probably more powerful than most of the other programs I have seen in this category. What it lacks is pizzazz, but if you are trying to get some work done, you can often do without that. That is characteristic of the better programs in the series.

Another program I like is the *Backgammon* game, written by John E. Hoel. Before I used the game, I had played only a bit and could not even remember the rules. It plays a pretty strong game, of-

| | | | |
|---|---|---|---|
| **Entertainment Family** | | | |
| Backgammon | $19.95 | Roadrunner Rescue | 19.95 |
| Blackjack | 19.95 | * Scattergrams | 19.95 |
| Cryto-Mania | 19.95 | 3-K Trivia | 19.95 |
| * Crypto-Mania Puzzle Pac | 14.95 | * Trivia 102 | 19.95 |
| Kaleidascope | 14.95 | Wood Seeking | 19.95 |
| * Liptocoe | 19.95 | Zuron | 19.95 |
| * Music 101 | 19.95 | | |
| **Education Family** | | | |
| Adventures With Decimals | $24.95 | Morse Code Drills | 14.95 |
| Adventures With Fractions | 24.95 | These United States | 19.95 |
| Adventures With Negative Numbers | 24.95 | * Private Tutor Presenter 1.1 | 19.95 |
| Adventures With Decimals, Fractions and Negative Numbers | 44.95 | Algebra Tutor | 29.95 |
| | | Beyond Basic Basic | 19.95 |
| * Adventures With Whole Numbers | 24.95 | * Fortran Tutor | 19.95 |
| Matrix Madness | 19.95 | * Multiplication Tables | 24.95 |
| **Productivity Family** | | | |
| * DB/Editor/Writer | $49.95 | Phone Directory & Print Buffer On-Line | 34.95 |
| DOS File Tracker | 19.95 | | |
| * DOS File View | 19.95 | Select-A-Font | 19.95 |
| * FileCommand II | 19.95 | * Short Hand | 14.95 |
| File Facility | 19.95 | The StarProof Bridge | 14.95 |
| * INFOPC | 19.95 | STATLIB 1 | 149.95 |
| PC Pallette | 39.95 | STATLIB 2 | 149.95 |
| Personal Computer Picture Graphics | 29.95 | * SuperC | 19.95 |
| * Personal Print Control | 29.95 | Utilities I | 19.95 |
| Personal Scientific Calculator | 24.95 | Utilities II | 19.95 |
| Phone Directory On-Line | 24.95 | * Utilities III | 19.95 |
| Print Buffer On-Line | 19.95 | * Word Proof II | 39.95 |
| **Programming Family** | | | |
| * DOS Enhanced Debug | $24.95 | * Structured Assembler Translator | 34.95 |
| * Object Library Maintenance | 19.95 | | |
| **Business Family** | | | |
| Executive Phone Directory | $34.95 | * Member Services | 29.95 |
| Executive Phone Directory with message | 39.95 | Portfolio Management System | 99.95 |
| | | Project Planning and Scheduling | 149.95 |
| Executive Phone Directory build your own | 149.95 | | |
| **Value Packages** | | | |
| Assembler Programming Package | $49.95 | Math Package | 49.95 |
| Creativity Package | 62.95 | Personal Productivity Package | 74.95 |
| Family Game Package | 59.95 | Scientific Package | 194.95 |
| Family Game Package II | 49.95 | System Support Package | 54.95 |
| Fun-in Learning Package | 68.95 | Utilities Package | 56.95 |

*Programs marked with an asterisk are newly released.

**Table 1. IBM's Personally Developed Software.**

# Introducing The Single Solution To Many Problems That Can Tie Up Your Personal Computer.

# Transet 1000™ The print buffer, communications buffer, port expander, printer sharer and I/O switcher. All in one.

Anyone with a personal computer and one or more peripherals has faced the all-too-familiar dilemma. You need your computer to do an important job. But you're forced to wait for the system to finish one job (printing, communicating, whatever) before you can go on to the next one. Or you need to stop what you're doing to switch cables when you want to use another peripheral.

Wait no more. Now Hayes introduces an innovative new device that lets you perform many jobs—at the same time—independent of your computer. Transet 1000. It works with a wide range of systems and configurations. And it allows you to continually expand your system as your needs grow.

Transet 1000 frees your computer from waiting on your printer or modem—so you and your computer can go on to another task. It even lets you print out documents in pre-set formats without having to go back into your computer. At the same time, Transet 1000 can operate unattended mailbox communications—24 hours a day—even if your computer is turned off.

Two computers can share one printer with Transet 1000. Or, you can use Transet 1000 to let two computers communicate with each other.

In addition, Transet 1000 is a port expander and software-controlled I/O switcher. Now files can be easily directed and redirected to different peripherals, without physically changing cable connections.

Even while printing, Transet 1000 acts as a communications buffer and 24-hour mailbox. And I/O switching lets you route information among peripherals, without switching cables.

Transet 1000 contains a stand-alone microprocessor, and comes with 128K of memory. It operates with any RS-232C interface computer, and has optional accessory kits available for the IBM PC and PC XT, Macintosh and Apple IIc. Kits contain the necessary host cable, a user guide and menu-driven software that lets you graphically set up or customize port parameters and printing formats. Cables available for IBM PC AT, other computers and peripherals.

Like all Hayes products, Transet 1000 combines sophisticated capabilities with easy operation. Just as Hayes set the standard in personal computer communications, now Hayes is taking the lead in computer task management.

Contact your authorized Hayes dealer to see how Transet 1000 can help you get a lot more productivity

Transet 1000 allows printing on both a dot matrix printer and letter quality printer, while freeing your computer for other tasks.

out of your computer system—without tying up your computer or you.

**Hayes Microcomputer Products, Inc.**, P.O. Box 105203 Atlanta, Georgia 30348 404/441-1617


# Hayes® Transet 1000

Innovative products for enterprising people fers help just about anytime, looks good on the screen, and is easy to operate. It is a tad slow, but then it costs only $19.95. Somehow, I didn't mind the slowness, and I play better backgammon now than I did before.

If you want more information about the programs, the catalog is free for the asking (even though it shows a $4 cover price) from the address shown at the end of the article or by calling the order number.

### PC Palette

Back to graphics. I'm impressed with *PC Palette* because it is, indeed, so powerful. It is a very versatile drawing program, competitive in every respect with the better known and more expensive packages. Add to that its capability for animating presentations and its built-in graphing function, and it just seems too good to be true. But wait, there's more! Five free steak knives that can cut through tires! Oops, sorry. There is more. One of the most significant features is subtle: *PC Palette* allows you to cut a section from one drawing and add it to the one on which you are working. This function is very nice, because it means you can have a library of design elements and get them at any time. It is a feature that most other painting programs lack.

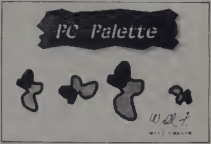



**Figure 1. This image, printed on a TI 855, shows rotation and scaling of an arbitrary shape. The leftmost "blob" is the original from which the other three were copied.**

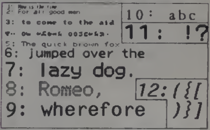



**Figure 2: The 12 PC Palette fonts. The fonts cannot be scaled, and the letters retain their orientation even when rotated.**

*PC Palette* records the "strokes" used to build a picture, instead of just holding the screen images. This allows the program to redraw the whole picture, or parts of it, in different sizes (scaling) and to rotate parts of the picture (see Figure 1). It is the storage of images as files of strokes that gives *PC Palette* its animation capability. Storage of dot images is also provided and has the advantage that the picture can be loaded and displayed much more quickly.

Shows, or automatic presentation of screen images, are controlled by a second program included with *PC Palette*. After images have been created with the drawing program, a show can be constructed by using an editor to create a file containing *PC Palette* commands. The show program reads the commands from this file and carries them out. In effect, it is just the draw program running but taking commands from a file instead of from the keyboard or mouse. Because this is the case, the show can include anything *PC Palette* can do, including animation. A demo is included on the disk with the program and can be used as a guide to learn how shows are constructed.

*PC Palette* does not have the visual appearance of *MacPaint*, as some of the other painting programs do. There are no pull-down menus, as all the options are displayed in a single menu at the bottom of the screen; the program can also be operated from the keyboard, usually by giving single-letter commands. Because a user can see everything at once, *PC Palette* is probably even easier to learn to use than some of the other products.

A few other points. Only two printers are supported: the IBM Graphics Printer and the IBM Color Printer. I think any Epson or Epson-compatible will work; my TI 855 worked just fine. The list of input devices supported is long, and can be found in Table 2. Multiple fonts are provided by the program, but I found them to be limited (see Figure 2); no capability is provided to make your own fonts.

I salute Kai-ching Chu for an excellent, full-featured program. I salute IBM for its innovative publishing operation and for making *PC Palette* so affordable. ■

**Keyboard**
**Joystick**
**Mice**
- Microsoft Mouse (serial port)
- Microsoft Mouse (parallel bus)
- Mouse Systems PC Mouse (M1 or M2)
- VisiOn Mouse

**Tablets**
- GTCO Digi-Pad 5
- Summagraphics Bit Pad One
- Koala Pad

**Other**

PC Palette allows the technical user to create a device driver for input devices other than those directly supported. The documentation explains the requirements. An example program is included with the package to promote understanding.

**Table 2. Input devices supported by PC Palette.**

**Products And Firms Mentioned In This Column:**

Draw-It ($29.95)
Paperback Software
2612 Eighth St.
Berkeley, CA 94710
(415) 644-2116

PCjr Color Paint ($99)
IBM Corp.
Box 1328
Boca Raton, FL 33432
(800) 447-4700
(305) 998-2000

PC Palette ($39.95)
IBM Corp.
Personally Developed Software
P.O. Box 3280
Wallingford, CT 06494
(800) IBM-PCSW

PC Paint ($99)
Mouse Systems Corp.
2336H Walsch Ave.
Santa Clara, CA 95051
(408) 988-0211

PC Crayon ($59.95)
Executive Picture Show ($245)
PCsoftware
9120 Gramercy Dr., Suite 416
San Diego, CA 92123
(619) 571-0981

PC Paintbrush ($139)
IMSI
1299 Fourth St.
San Rafael, CA 94901
(800) 222-4723

TelePaint ($149)
LCS/Telegraphics
261 Vassar St.
Cambridge, MA 02139
(800) 437-0036

# APPLE CART

## Home Control, CP/M, and a Flat Screen for Apple II Users/**Owen Linzmayer**

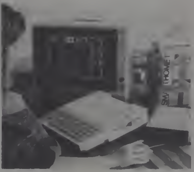
It has been said that "He who dies with the most toys wins," and in my opinion, the Apple II is one of the greatest toys ever invented. This month we take a look at some interesting gadgets that make our computers work harder for us and allow us to enjoy our computers even more.

### Home, Sweet Computerized Home

Topping this month's hit parade is the SmartHome home control system from CyberLynx of Boulder, CO. SmartHome is a wireless control/security system that you program with your computer. Turn your stereo into a turbo-charged radio alarm clock, have SmartHome switch on the hallway light if it detects smoke, install security sensors on your doors and windows, and let SmartHome dial for help if your house is being broken into—the possibilities are bounded only by your imagination.

The SmartHome Control Unit (SCU) itself is a metal box the size of a half-height external disk drive. It has its own AC power cord backed up by an internal 9-volt battery, and it interfaces with the modem port of an Apple IIc or the Super Serial card of a II. The SCU acts as a receiver of the radio signals sent to it by the various sensors (handheld transmitter, door/window, motion, and smoke). Then, according to how you have programmed the system, the SCU sends command signals through your existing house power wiring to the lamp and appliance switchers. The whole system is wireless and can be installed in a few hours. A maximum of 13 devices can be controlled on each floor of your home, but that requires the purchase of additional modules from CyberLynx.

The SmartHome Control Unit is told what to do by an installation program supplied with the system. The program is icon-driven, much like Electronic Arts' *Pinball Construction Set*. You lay out a floor plan for your house or apartment, then add icons representing appliances and sensors. Finally, you link sensors to appliances and assign commands. To turn the television on/off with the handheld transmitter, for example, simply connect the two icons together and select the toggle function. To operate correctly, though, the sensors and appliance modules must be set to send and receive individual codes. This is outlined in the manual, but the explanations are rather difficult to understand. Although the manual is replete with figures and illustrations, it lacks cohesiveness, which makes it hard to comprehend.



**You lay out a floor plan for your house or apartment, then add icons representing appliances and sensors.**

Once programmed, the SCU is disconnected from the computer, leaving it free for normal use. The SCU retains time and date information so that you can use the system to make your house look lived in while you are away on vacation. Another security option that can be added to the system is the SmartHome Alarm Center. This simulated woodgrain box is the size of a small bookshelf speaker and connects to the SCU via a very long cable. It acts as an appliance and can be activated directly by any of the sensors, or set on a time delay that allows you to disarm the alarm before it blasts you out of your socks and your neighbors out of their beds. This unit is *loud*.

I would have liked a numeric keypad on the alarm center so that you could arm/disarm the system just as you enter your secret password in an automatic banking machine. An option that is available is an automatic telephone dialer that installs within the alarm center and can be programmed to dial different numbers upon receiving specified signals from the SCU.

I enjoyed evaluating the SmartHome system and was quite pleased to find that it operated dependably in an apartment-style environment without picking up stray radio signals that could theoretically disturb the system. My main complaint involves neither the hardware nor the software, but rather, the manual. Although it is apparent that a great deal of effort went into the production of the documentation, it still suffers from insufficient examples.

If you have ever wanted to control your surroundings from the comfort of your easy-chair, or if you have felt the need for a security system, SmartHome may be everything you need in one package.

### It Can't Be Done

When the Apple IIc was first introduced back in April of 1984, Apple watchers were upset because it was a "closed system"; it didn't have slots like the rest of the II line. According to them, you wouldn't be able to expand the IIc; you couldn't add interesting peripheral cards. It is a good thing that not everyone believed them, or we wouldn't have the Z80c CP/M card from Applied Engineering.

The Z80c is a co-processor board that mounts inside the IIc and gives you the capability to run most of the popular

CP/M software packages on your IIc. Created by Gary Kildall and now licensed by Digital Research, CP/M is the most widely used microcomputer disk operating system (DOS). Designed 12 years ago to run on now-antique 8" diskettes, CP/M continues to enjoy popularity because of a large public-domain software base. Its continued existence rests largely upon the multitude of programs that are free for the asking and the price of a disk (see *Programmer's Guide to CP/M* by Sol Libes available from Creative Computing Press).

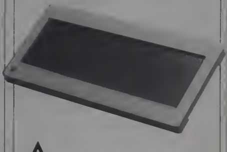
The Z80c is a small, printed circuit board that contains, among other things, a Z80 microprocessor. After following the detailed illustrated instructions for opening up your IIc, you are told to remove the 65C02 cpu chip and plug it into the empty socket on the Z80c board. Then you plug the entire board into the now-vacant 65C02 socket underneath the keyboard and, for timing purposes, connect a small jumper wire to the leg of a chip on the IIc motherboard. As I write this, it is not clear whether this installation voids the Apple warranty, but remember that if you must take your IIc in for repairs, you can remove the Z80c board without leaving a trace.

With the Z80c board installed, the IIc can boot either CP/M-formatted disks or the standard DOS 3.3, ProDOS, and Apple Pascal disks. There is no need to specify which you are booting—the computer figures it out and uses the appropriate cpu; the presence of the Z80c board is completely transparent to most software. The Applied Engineering Z80c card permits the direct execution of 8080, 8085, and Z80 programs, including the CP/M operating system as well as all of the programs that execute in the CP/M environment.

The Z80c package comes complete with a CP/AM 4.0 system master disk that is not copy-protected. CP/AM 4.0 is "compatible with virtually all older CP/M systems. 99.9% of all programs that you will buy will require CP/M 2.2 for which CP/AM 4.0 is compatible, only better." The various system and transient commands of CP/AM are explained briefly in the documentation, and several advanced books on the subject are recommended for further reading.

I experienced no problems installing the Z80c and find it works as claimed. I was, however, initially distressed when I booted my APTEST diagnostics disk and found that the disk drives were supposedly 20000% slow. Obviously the board interferes with the diagnostics, because the drives functioned correctly. For $159, the Z80c card offers the same features as the most popular Apple II CP/M boards, yet at a better price. Although I have never been a big fan of CP/M, I must admit it does give me a certain rush seeing *WordStar* boot up on my IIc, although I refuse to learn the arcane commands of yet another word processor.

As an aside, there is one other company of which I am aware that sells a similar board for the IIc. The company is called Intellicom, and the product is the $159 Intellicard IIc Z80 software development kit. Although the boards are functionally the same, the Intellicard does not come with any software, and the manual is a scant booklet. I mention this solely for information purposes and must recommend the Applied Engineering Z80c until such time as the folks at Intellicom enhance their package.



**As is the case with all LCD screens, the most important consideration is whether the information displayed is legible.**

## Oh Say Can You See?

Introduced by Apple in April of 1984 with delivery promised for that fall, the LCD flat panel display for the IIc was finally shipped in February of this year. Was it worth the wait? In my opinion, the answer is a disappointed "no."

The flat panel display weighs two and a half pounds and, measuring 11.375" x 5.375" x 1.5", is slightly larger than the IIc keyboard. The display has runners on the bottom side which rest in the vertical slots on the top of the IIc case. Unfortunately, this mounting is not sturdy and restricts access to the reset button.

The screen is connected via a flat, insulated ribbon cable to a small, white box that screws into the video expansion port on the back of the computer. This prevents you from using an RF modulator or an RGB adapter while using the flat panel display, but you can still use the NTSC video signal from the RCA phono jack to drive a composite monitor.

The flat panel screen requires no special software and can display a full 80 columns and 24 lines of text in addition to 560 x 192 pixels (double hi-res graphics). Text characters are about the same size as normal dot matrix printer output, but because of the aspect ratio of the display, graphics take on a strange, stretched appearance that hardly resembles the same image on a standard monitor.

Since the flat panel display is essentially just another viewing device, anything that can be displayed on a regular IIc monitor can be displayed on the flat panel screen; however, that doesn't necessarily mean you can read it.

As is the case with all LCD screens, the most important consideration is whether the information displayed is legible (see "High Resolution and Color Liquid Crystal Displays," p.114, February 1985). The IIc flat panel display performs adequately in this regard; Apple has incorporated a number of features to insure that both text and graphics can be seen under a wide range of lighting conditions and from many viewing angles. In addition to using a contrast control knob, you can lock the flat panel display into a number of viewing angles. A special anti-glare coating and an inverse switch which lets you alternate between dark characters on a light background and vice versa improve legibility. The one thing with which I am not comfortable, however, is that there is no border between the display area of the LCD screen and its plastic case. Thus characters at the extreme edges of the screen are often obscured by the shadows cast by the case.

The documentation supplied with the flat panel display is multi-lingual, with four pages devoted to each language. One thing the booklet warns against is leaving the display in direct sunlight or in an overheated area. I accidentally left my IIc next to the window one sunny afternoon and came back to find that one column of pixels in the display had died. Imitating Lazarus, however, they miraculously came back to life a few hours later. Apparently no permanent damage was done, but I wanted to make sure. So out came the screwdriver, and I attacked the display with curiosity and a desire to see the liquid crystal goo inside the case. What I found was eight tiny chips (each with one-hundred pins!) driving two displays that work in conjunction to give the appearance of one large screen. I guess these little connections are so fragile that occasionally they temporarily malfunction. Incidentally, the LCD panels are made in Japan by Sharp Electronics.

The IIc flat panel display costs $599, comes with a 90-day warranty, and is intended for "mobile professionals who take work home or travel frequently." Personally, I think the price is too high, especially in light of the fact that to use the IIc on the fly you must purchase a carrying case with a built-in battery pack like the $250 Discwasher Cari. Even in this configuration, the system is more appropriately described as "luggable." Unless your particular requirements demand that you use an Apple computer, you may be better off buying a truly portable TRS-80 Model 100 with its built-in 300-baud modem and adding as much RAM as possible. You'll save yourself lots of money, not to mention muscle fatigue.

Well, there you have it, a trilogy of interesting gadgets for the Apple II line. It must be gratifying for Woz to see his creation being used in ways not even he could have imagined when he was first tinkering around in that famous California garage. ■

### Firms Mentioned In This Column

Apple Computer Inc.
20525 Mariani Ave.
Cupertino, CA 95014
(408) 973-2222

Applied Engineering
P.O. Box 798
Carrollton, TX 75006
(214) 241-6060

CyberLynx Computer Products, Inc.
4828 Sterling Dr.
Boulder, CO 80301
(303) 444-7733

Discwasher
1407 N. Providence Rd.
P.O. Box 6021
Columbia, MO 65205
(314) 449-0941

Intellicom
9257 Eton
Chatsworth, CA 91311
(818) 882-8866

# COMPUTER MAIL ORDER

## AMDEK

| | |
|---|---|
| 300 Green | $129.00 |
| 300 Amber | $139.00 |
| 310 Amber IBM-Plug | $169.00 |
| 300 Color/Audio | $239.00 |
| Color 500 Composite/RGB | $389.00 |
| Color 600 Hi-Res (640x240) | $399.00 |
| Color 700 Hi-Res (720x240) | $499.00 |
| Color 710 Long Phosphor | $579.00 |

## BMC

| | |
|---|---|
| 9191U Color | $179.00 |

## NAP

| | |
|---|---|
| 12" Amber/Green Composite | $99.99 |
| 12" Amber/Green TTL (ea.) | $119.00 |

## NEC

| | |
|---|---|
| JB 1260 Green | $79.99 |
| JB 1201 Green | $129.00 |
| JB 1205 Amber | $129.00 |
| JC 1215 Color | $229.00 |
| JC 1216 RGB | $379.00 |
| JC 1460 Color | $269.00 |
| JC 1410 RGB | $669.00 |

## PRINCETON

| | |
|---|---|
| MAX-12 Amber | $169.00 |
| HX-12 RGB | $469.00 |
| SR-12 RGB | $629.00 |
| Scan Doubler Board | $199.00 |

## TAXAN

| | |
|---|---|
| 115 12" Green Mono | $99.99 |
| 116 12" Amber Mono | $99.99 |
| 121 Green TTL | $139.00 |
| 122 Amber TTL | $149.00 |
| 210 Color RGB | $239.00 |
| 400 Med-Res RGB | $299.00 |
| 410 Hi-Res RGB | $339.00 |
| 420 Hi-Res RGB (IBM) | $429.00 |
| 440 Ultra Hi-Res RGB | $589.00 |

## QUADRAM

| | |
|---|---|
| 8400 Quadchroma | $479.00 |
| 8410 Quadchroma II | $469.00 |
| 8420 Amberchroma | $179.00 |

## ZENITH

| | |
|---|---|
| ZVM 122 Amber | $89.99 |
| ZVM 123 Green | $89.99 |
| ZVM 124 IBM Amber | $149.00 |
| ZVM 130 Color | $279.00 |
| ZVM 131 Color | $299.00 |
| ZVM 133 RGB | $429.00 |
| ZVM 135 RGB/Color | $459.00 |
| ZVM 136 RGB/Color | $599.00 |

## PRACTICAL PERIPHERALS

| | |
|---|---|
| Graphcard | $79.99 |
| Serial Card | $99.99 |
| Microbuffer II + | $169.00 |
| Microbuffer 32K | $189.00 |

## QUADRAM

| | |
|---|---|
| Microfazer | from $139.00 |
| Efazer (Epson) | from $79.99 |

## Orange Micro

| | |
|---|---|
| Grappler CD (C64) | $99.99 |
| Grappler + (Apple) | $89.99 |
| Grappler 16K + (Apple) | $169.00 |

## DIGITAL DEVICES

| | |
|---|---|
| Ape Face (Atari) | $49.99 |
| U-Print A (Atari) | $54.99 |
| U-A16/Buffer (Atari) | $74.99 |
| U-Call Interface (Atari) | $74.99 |
| U-Print C (C64) | $49.99 |
| P-16 Print Buffer | $74.99 |

## MPP MICROBITS

| | |
|---|---|
| MB1150 Parallel (Atari) | $79.99 |
| MPP-1150 Parallel (Atari) | $69.99 |
| MP-1150XL (Atari 1200XL) | $69.99 |
| MicroStuffer 64K Print Buffer | $109.00 |

## AXIOM

| | |
|---|---|
| AT-100 Atari Interface Printer | $159.00 |
| AT-550 Atari Dual Mode | $259.00 |
| GP-100 Parallel Interface | $189.00 |
| GP-700 Atari Color Printer | $489.00 |
| GP-550 Parallel Printer | $269.00 |

## CITIZEN

| | |
|---|---|
| MSP-10 (80 col) | $349.00 |
| MSP-15 (132 col) | $539.00 |
| MSP-20 (80 col.) | $569.00 |
| MSP-25 (132 col.) | $729.00 |

## C.ITOH

| | |
|---|---|
| Prowriter 7500 | $219.00 |
| Prowriter 8510P | $299.00 |
| Prowriter 1550P | $469.00 |
| Son of Starwriter A10P | $459.00 |
| Hot Dot Matrix | $459.00 |
| F10-40P Starwriter | $869.00 |
| F10-55 Printmaster | $1049.00 |

## COMREX

| | |
|---|---|
| ComWriterII Letter Quality | $399.00 |

## DIABLO

| | |
|---|---|
| D25 | $599.00 |
| 630 API Letter Quality | $1549.00 |

## CORONA

| | |
|---|---|
| Lazar LP-300 | $2799.00 |

## daisywriter

| | |
|---|---|
| 2000 | $799.00 |

## EPSON

| | |
|---|---|
| RX-80, FX-80 +, LX-80, JX-80 | CALL |
| FX-100 +, RX-100, LQ1500 | CALL |
| Homewriter 10 | CALL |

## JUKI

| | |
|---|---|
| 6100 | $399.00 |
| 6300 | $749.00 |

## NEC

| | |
|---|---|
| 8027 Transportable | $299.00 |
| 2010/15/30/50 | $699.00 |
| 3510/15/30 | $1299.00 |
| 3550 IBM | $1369.00 |
| 8810/15/30 | $1679.00 |
| 8850 IBM | $1699.00 |
| ELF 360/370 | CALL |
| PR103A · Trimode | $269.00 |
| LQ15 · Near Letter | $359.00 |
| 8025 · Wide Carriage | $469.00 |

## OKIDATA

| | |
|---|---|
| 83, 84, 92, 93, 182, 192, 193 | |
| 2410, Okimate-20 | CALL |
| Okimate 10 (Specify C64/Atari) | $199.00 |

## OLYMPIA

| | |
|---|---|
| Needlepoint Dot Matrix | $329.00 |
| Compact RO | $339.00 |
| Compact 2 | $369.00 |

## Panasonic

| | |
|---|---|
| KX1090 | $199.00 |
| KX1091 | $279.00 |
| KX1092 | $409.00 |
| KX1093 | $599.00 |

## QUADRAM

| | |
|---|---|
| Quadjet | $749.00 |

## SILVER-REED

| | |
|---|---|
| 400 Letter Quality | $279.00 |
| 500 Letter Quality | $329.00 |
| 550 Letter Quality | $429.00 |
| 770 Letter Quality | $779.00 |

## star

| | |
|---|---|
| SG10 (120 cps) | $239.00 |
| SG15 (120 cps) | $399.00 |
| SD10 (160 cps) | $359.00 |
| SD15 (160 cps) | $479.00 |
| SR10 (200 cps) | $499.00 |
| SR15 (200 cps) | $639.00 |
| Powertype Letter Quality | $319.00 |

## TOSHIBA

| | |
|---|---|
| 1340 (80 column) | $599.00 |
| 1351 (132 column) | $1199.00 |
| P351 | $1299.00 |

## ZENITH

| | |
|---|---|
| PC-150 Desktop | CALL |
| PC-160 Portable | CALL |

## COLUMBIA

| | |
|---|---|
| 2220 Dual Portable | $1999.00 |
| 4220 Dual Desktop | $1999.00 |

## SANYO

| | |
|---|---|
| MBC 550-2 Single Drive | $699.00 |
| MBC 555-2 Dual Drive | $969.00 |
| MBC 775 Portable | CALL |
| MBC 511 10 meg | CALL |

## AT&T

| | |
|---|---|
| Safari | CALL |
| 6300 | CALL |

## corona

| | |
|---|---|
| PPC22 Dual Portable | $1599.00 |
| PPCXTA 10 meg Portable | $2799.00 |
| PC40022 Dual Desktop | $2199.00 |

**IBM PC SYSTEMS Configured to your specifications. Call for Best Price!**

## NEC PC-8800 System

NEC - 8800 CPU
NEC - 8831 Dual Drives
NEC - 1460 RGB Monitor
NEC - 15LQ Printer
**$1399.00**

## IMSI

| | |
|---|---|
| PC Paintbrush | $94.99 |

## Lotus

| | |
|---|---|
| Symphony | $429.00 |
| 1-2-3 | $299.00 |

## Hayes

| | |
|---|---|
| Please (Data Base) | $199.00 |

## Peachtree

| | |
|---|---|
| PeachPack (GL/AP/AR) | $199.00 |

## MicroPro

| | |
|---|---|
| WordStar 2000 | $239.00 |
| WordStar 2000 + | $299.00 |

## MICRORIM

| | |
|---|---|
| R Base 4000 | $249.00 |
| Clout 2.0 | $129.00 |

## MultiMate

| | |
|---|---|
| Multi Mate | $249.00 |

## MICROSTUF

| | |
|---|---|
| Crosstalk | $89.99 |

## MICROSOFT

| | |
|---|---|
| Flight Simulator | $39.99 |
| MultiPlan | $129.00 |

## ASHTON-TATE

| | |
|---|---|
| Framework | $349.00 |
| dBASE II | $299.00 |
| dBASE III | $369.00 |

## Professional Software

| | |
|---|---|
| PC Plus/The Boss | $249.00 |

## synapse

| | |
|---|---|
| File Manager (IBM) | $39.99 |

## ELECTRONIC ARTS

| | |
|---|---|
| Get Organized | $69.99 |
| Cut -n- Paste | $39.99 |
| Music Construction | $29.99 |
| One -on- One | $29.99 |
| Financial Cookbook | $34.99 |

## ALPHA

| | |
|---|---|
| Electronic Desk | $199.00 |

## BORLAND INTERNATIONAL

| | |
|---|---|
| Turbo Pascal | $39.99 |
| Sidekick | $39.99 |

## SPI

| | |
|---|---|
| Open Access | $379.00 |

## Harvard Software Inc.

| | |
|---|---|
| Harvard Project Manager | $209.00 |
| Total Project Manager | $269.00 |

## pfs: IBM/APPLE

| | |
|---|---|
| Access (NEW) | $79.99 |
| Write/Graph/File (ea.) | $79.99 |
| Report | $74.99 |
| Plan | $79.99 |
| Proof | $59.99 |
| Mac Software | CALL |

## SSI

| | |
|---|---|
| Word Perfect | $239.00 |

## Human Edge™

| | |
|---|---|
| Communication Edge | $99.99 |
| Management Edge | $119.00 |
| Negotiation Edge | $139.00 |
| Sales Edge | $119.00 |

## AST

| | |
|---|---|
| Six Pack Plus | $239.00 |
| Mega Plus II | $269.00 |
| I/O Plus II | $139.00 |
| Memory MBII | $249.00 |
| Advantage-AT | $399.00 |
| Preview Monograph | $299.00 |
| Graph Pak Mono/64K | $599.00 |
| MonoGraph Plus | $399.00 |
| 5251/11 | $799.00 |
| 5251/12 | $579.00 |
| 3780 | $639.00 |
| BSC | $499.00 |

## dca

| | |
|---|---|
| IRMA 3270 | $899.00 |
| IRMA Print | $999.00 |

## EAGLE

| | |
|---|---|
| Color | $199.00 |
| Mono | $149.00 |

## EVEREX

| | |
|---|---|
| Color Card (Graphics Edge) | $299.00 |
| Magic Card | $199.00 |

## HERCULES

| | |
|---|---|
| Graphics | $319.00 |
| Color | $169.00 |

## IDEAssociates

| | |
|---|---|
| IDEAmax - ZPR, 64K, C, S, P | $229.00 |
| IDEAmini - YPR, C, S, P | $189.00 |
| IDEAminimax - MPR 128K | $229.00 |
| IDEAshare Software | $219.00 |
| IDEA 5251 | $699.00 |

## PARADISE

| | |
|---|---|
| Modular Graphics Card | $279.00 |
| Multi Display Card | $299.00 |
| Five Pack C, S | $159.00 |

## PLANTRONICS

| | |
|---|---|
| Color Plus | $369.00 |

## TECMAR

| | |
|---|---|
| Captain - 64 | $239.00 |
| Captain Jr. 128K | $339.00 |
| Graphics Master | $469.00 |

## QUADRAM

| | |
|---|---|
| Quadboard II | $229.00 |
| Expanded Quadboard | $239.00 |
| Quad 512 + | $249.00 |
| Quad 2 Meg | $879.00 |
| Memory Board | $229.00 |
| QuadJr Exp. Chassis | $539.00 |
| QuadJr Exp Memory | $219.00 |
| QuadMemJr. | $229.00 |
| Chronograph | $89.99 |
| Parallel Card | $69.99 |
| Quadcolor I | $219.00 |
| Quadgraph | $379.00 |

## KEYBOARDS

| | |
|---|---|
| Keytronics Keyboards 5150, 5151, 5151 Jr, 5149 Jr. | CALL |

## MEMORY CHIPS

| | |
|---|---|
| 4164 RAM Chips (ea.) | $2.39 |

**1-800-233-8950**

# TANDY GRAM

## An Enhanced Keyboard and Screen Mode for the Color Computer: Part 2/Jake Commander

This month we have the final installment of Chroma-Key for the Color Computer, the first half of which appeared in the May Tandy Gram. One of the problems with covering a program in two parts like this is that the other projects get put on the back burner—like the reviews I promised. Don't kick me though; they're still coming. I especially like the look of Dotwriter 4.0 from Prosoft in California and I'm looking forward to reviewing it here. It is amazing how much TRS-80 stuff there is to write about. I'll keep doing my best to please everybody, but in the meantime, let me know what you want to read about.

Another thing I have not had much room for is the Tandy rumor mill. Hopefully, I have about enough room to get just one in, and that is the fact that Tandy has cancelled a whole bunch of their shows for 1985. Bad news that. I went to the one in New York City and found it encouraging to see actual third-party support flourishing for all models of TRS-80. Now, amidst rumors (emphasize *rumors*) of disappointing profits, Tandy has cut back on certain expenditures—the main one being shows. Well, stick at it, you guys in Fort Worth; for heaven's sake don't let Apple and IBM be the only choices open to tomorrow's computerist.

Well, back to today. Here is the second half of the listing for Chroma-Key. Once you have purged the source code of all typos, assemble the program with the name CKEY or something similar. The version I have published is for 32K, but you can make it a 16K version by changing line 130 to read 3C00 instead of 7C00. Apart from that and clearing a lower amount of memory, everything will work the same. The notes for using the program, assuming you assembled an output filename of CKEY, follow.

### Loading the Program

To load, use the CLOADM command. If required, the filename is CKEY.

Prior to loading, high memory must be protected via the CLEAR command. For the 32K version, a figure of 31744 is allowable, but this will leave no extra room for the keyboard definition table other than the predefined keys; somewhere around 31700 or less is better. For the 16K version, CLEAR 15360 is OK; but CLEAR 15300 will leave room for an extra 60 bytes.

When loaded, the program is initialized by typing EXEC followed by ENTER.

After the program has initialized, the following keyboard functions are enabled:

- Repeating keyboard with lowercase on Shift. Keys repeat automatically on being held down.
- 27 Predefined keys. Shifted A to Z and SHIFT-RIGHT-ARROW are all predefined as the Basic commands listed in Table 1.

The whole definition table can be toggled in and out of operation by hitting SHIFT-ENTER while in key definition mode. This allows typing of the entire character set without worrying about whether a particular key is redefined.

- Redefinition of keys so that a single keystroke can enter a whole word or sequence of words. The whole definition table can be saved or loaded from tape at any time.
- Screen Editor. This allows entry and editing of characters that are already on the screen. A special graphics sub-feature allows simple entry of color graphic characters.

### Key Definitions

To redefine a key, you'll need to go into key definition mode. First press BREAK. This starts a small black flashing cursor which indicates that the computer is in definition mode. This mode can only be entered while at the start of a line when at the Basic prompt. Next, press the character to be defined; this will be printed followed by an equal sign. The definition can now be entered. The ENTER key can be used as part of the definition. To end the definition, press BREAK once more; this will exit back to the Basic prompt. To remove a definition from the table, press BREAK immediately after the equal sign.

If there is no room for the definition in the table due to insufficient memory, an OM ERROR will occur, and the definition will be truncated. To overcome this problem, clear more memory via the

**Table 1.**

| Shift/ Key | Command | Shift/ Key | Command | Shift/ Key | Command |
|---|---|---|---|---|---|
| → | TAB( | i | INPUT | r | RETURN |
| a | GOSUB | j | JOYSTK( | s | STRING$ |
| b | INT( | k | CSAVE" | t | THEN |
| c | CHR$( | l | CLOAD | u | USING |
| d | DATA | m | MID$( | v | VAL( |
| e | ELSE | n | NEXT | w | RND( |
| f | LEFT$ | o | ASC( | x | STR$( |
| g | GOTO | p | POINT( | y | LEN( |
| h | RIGHT$ | q | INKEY$ | z | PRINT #-2, |

CLEAR command.

To save the definition table, press the CLEAR key. This will not clear the screen but will leave the computer waiting for another key. "O" will cause the table to be output to the cassette with a filename of KEYDEF. "I" will cause the table to be input from a cassette file of the same name. The same warning applies to memory space as described above. Sufficient memory space must exist or an OM ERROR will result and the table will be truncated.

## Screen Editor

The screen editor is entered by pressing SHIFT-BREAK. A large black cursor flashes to indicate operation in this mode. The cursor can be moved all around the screen without destroying any character it passes over. The four arrow keys are used for this purpose.

A character can be inserted at the cursor by pressing SHIFT-RIGHT-ARROW. This will open a gap for the new character.

A character can be deleted from the current cursor position by pressing SHIFT-LEFT-ARROW.

To return a line to the computer, just press ENTER. The whole line will then be input to the computer as if it were typed in from the keyboard. When initially entered, the screen editor assumes a line length of 32 characters; however, this can be changed as follows. Move the cursor to the desired line-end and press BREAK. This will start another slower-flashing cursor to indicate the line end position. To enter the line (remember Basic can't swallow more than 250 characters), move the main cursor back to the start line and press ENTER (the cursor merely has to be on the correct start line, not necessarily at the beginning of that line).

To enter graphics while in screen edit mode, just press CLEAR. This will clear a black square at the cursor position. Individual pixels can be turned on or off by pressing Q, W, A, or S, keys which affect the pixel at the top-left, top-right, bottom-left, or bottom-right respectively within the cursor block.

Initially the graphic color is white. This can be changed by pressing a number key from 1 to 8. The block will then change to the color-number pressed as described in the Color Basic manual.

Whenever the cursor is over a graphic character rather than a text character, an inverted plus sign is flashed instead of a black block. Any of the above graphic options can then be used. ■

**Color TRS-80 Chroma key listing.**

```
7E02 BD   7D9D    02290         JSR    SHKEY          ;SHFT PRESSED?
7E05 26   12      02300         BNE    CHDF           ;NO, CHK DEFINE
7E07 6D   8D 002F 02310         TST    DEFINE,PCR     ;DEFINING?
7E0B 26   0C      02320         BNE    CHDF           ;YES, PASS BREAK
7E0D 9E   88      02330         LDX    <CURS          ;CRNT CRSR
7E0F 9F   5D      02340         STX    <SEDT          ;SAVE CRSR
7E11 63   8C C6   02350         COM    <SESW,PCR      ;SW EDIT ON
7E14 9E   8A      02360         LDX    ZERO
7E16 9F   5F      02370         STX    <ENDM          ;RESET END MARK
7E18 39           02380         RTS                   ;TO KCHR
                  02390 *
7E19 86   03      02400 CHDF    LDA    #3             ;RSTR BREAK CHR
7E1B 8D   C0      02410         BSR    CHDA           ;AUTO OR DEFN?
7E1D 26   17      02420         BNE    XIT            ;YES ALREADY
7E1F E6   6D      02430         LDB    13,S           ;CAME FROM AC73?
7E21 C0   AC      02440         SUBB   #$AC
7E23 26   11      02450         BNE    XIT            ;NO
7E25 5A           02460         DECB                  ;=$FF
7E26 D7   68      02470         STB    <$68           ;ENSURE DIRECT
7E28 EB   62      02480         ADDB   2,S            ;BUF CHR CNT=1?
7E2A 27   2F      02490         BEQ    DFMODE         ;DEF CHR IF SO
7E2C      8E      02500         FCB    $8E            ;DUMMY LDX
7E2D 8D   0C      02510 CHKAUT  BSR    CHTB           ;CHR DEFINED?
7E2F 26   05      02520 CHC1    BNE    XIT            ;NO
7E31 AF   8D FFA6 02530         STX    AUTO,PCR       ;AUTO ON
7E35 4F           02540         CLRA                  ;IGNORE CHR
7E36 32   62      02550 XIT     LEAS   2,S            ;KCHR RET
7E38 35   F4      02560         PULS   B,X,Y,U,PC
                  02570 *
7E3A      00      02580 DEFINE  FCB    0              ;DEFINE-MODE FLAG
                  02590 *
7E3B 8D   A0      02600 CHTB    BSR    CHDA           ;AUTO OR DEFINE?
7E3D 26   12      02610         BNE    D7             ;NO AUTO IF SO
7E3F 30   8D FE7E 02620 CHKTBL  LEAX   KTBL+1,PCR     ;TBL PTR
7E43 6D   82      02630 C7      TST    ,-X            ;GOT DELIM?
7E45 26   FC      02640         BNE    C7             ;IF NOT
7E47 6D   82      02650         TST    ,-X            ;TBL END
7E49 27   07      02660         BEQ    E7             ;YES-NOT FOUND
7E4B 30   01      02670         LEAX   1,X            ;=>DEF CHR
7E4D A1   82      02680         CMPA   ,-X            ;SAME CHR?
7E4F 26   F2      02690         BNE    C7             ;NO TRY AGAIN
7E51 39           02700 D7      RTS
7E52 4D           02710 E7      TSTA                  ;SET NZ=NOT FOUND
7E53 39           02720         RTS
                  02730 *
7E54 6F   A2      02740 TEND    CLR    ,-Y            ;TBL END MARKER
7E56 6F   8D FFE0 02750 CLDF    CLR    DEFINE,PCR     ;DEF OFF
7E5A 39           02760         RTS                   ;TO KCHR
                  02770 *
7E5B A7   8C DC   02780 DFMODE  STA    <DEFINE,PCR    ;DEF ON
7E5E 17   FF86    02790         LBSR   KBIN           ;GET DEF CHR
                  02800 *
7E61 81   0C      02810         CMPA   #$C            ;CLEAR KEY?
7E63 1027 FE88    02820         LBEQ   OPTF           ;TAPE I/O
                  02830 *
7E67 81   0D      02840         CMPA   #$0D           ;ENTER?
7E69 26   0E      02850         BNE    CHCT           ;NO, CHK CTRL
7E6B BD   7D9D    02860         JSR    SHKEY          ;SHIFT PRESSED?
7E6E 26   E6      02870         BNE    CLDF           ;NO-IGNORE IT
7E70 A6   8C BC   02880         LDA    CHC1,PCR       ;AFTER CHKAUT
7E73 88   06      02890         EORA   #6             ;FLIP BNE/BRA
7E75 A7   8C B7   02900         STA    CHC1,PCR       ;CHANGE OPCODE
7E78 4F           02910         CLRA                  ;SEND INVLD CHR
                  02920 *
7E79 81   20      02930 CHCT    CMPA   #$20           ;CONTROL CHR?
7E7B 25   D9      02940         BLO    CLDF           ;IGNORE IF SO
7E7D 8D   C0      02950         BSR    CHKTBL         ;IN TABLE?
7E7F 26   14      02960         BNE    E8             ;IF NOT
7E81 31   80      02970         LEAY   ,X+
7E83 E6   A2      02980 B8      LDB    ,-Y            ;GOT DELIM?
7E85 26   FC      02990         BNE    B8             ;AGAIN IF NOT
7E87 20   06      03000         BRA    D8             ;CHK IF END TBL
7E89 E6   A2      03010 C8      LDB    ,-Y            ;MOVE CHR-
7E8B E7   82      03020         STB    ,-X            ;-UP TABLE
7E8D 26   FA      03030         BNE    C8             ;IF MORE IN DEFN
7E8F E6   A2      03040 D8      LDB    ,-Y            ;END TABLE?
7E91 E7   82      03050         STB    ,-X            ;MOVE UP ANYWAY
7E93 26   F4      03060         BNE    C8             ;CONT IF MORE
7E95 34   12      03070 E8      PSHS   A,X            ;DEFCHR/TBLEND
7E97 BD   A282    03080         JSR    $A282          ;PR DEFN CHR
7E9A 86   3D      03090         LDA    #'=
7E9C BD   A282    03100         JSR    $A282          ;PR EQ SIGN
7E9F C6   60      03110         LDB    #$60
7EA1 E7   9F 0088 03120         STB    CURS           ;INIT CRSR CHR
```

**Color TRS-80 Chroma key listing.** *(continued)*

```
7EA5 BD    A390     03130           JSR    $A390     ;KBD TO BUFR
7EAB 35    22       03140           PULS   A,Y       ;DEFCHR/TBLEND
                    03150 *
7EAA 24    04       03160           BCC    A9        ;NOT BREAK
7EAC 5A             03170           DECB             ;NO DEFINITION?
7EAD 27    A5       03180           BEQ    TEND      ;DELETED FRM TBL
7EAF 5C             03190           INCB             ;READJUST
7EB0 A7    A4       03200 A9        STA    ,Y        ;DEF CHR TO TBL
7FB2 25    04       03210 B9        BCS    C9        ;IF BREAK
7EB4 86    0D       03220           LDA    #$0D      ;C/R
7EB6 A7    B5       03230           STA    B,X       ;TO BUF
7EB8 30    01       03240 C9        LEAX   1,X       ;=> KBD BUF
7EBA 109C  27       03250 D9        CMPY   <MSIZE    ;GOT ROOM?
7EBD 23    0E       03260           BLS    OM        ;NO
7EBF A6    80       03270           LDA    ,X+       ;CHR FROM BUF
7EC1 A7    A2       03280           STA    ,-Y       ;TO TBL
7EC3 27    8F       03290           BEQ    TEND      ;IF END DEFN
7EC5 5A             03300           DECB             ;DONE ALL I/P?
7EC6 26    F2       03310           BNE    D9        ;CONT IF NOT
7ECB BD    A390     03320           JSR    $A390     ;MORE KBD I/P
7ECB 20    E5       03330           BRA    B9        ;TO TBL
7ECD 6F    A2       03340 OM        CLR    ,-Y       ;EMRGNCY CLR
7ECF 8D    B3       03350           BSR    TEND      ;TBL END MARKR
7ED1 7E    AC44     03360           JMP    $AC44     ;"OM ERROR"
                    03370 *
7ED4 109E  5F       03380 FEND      LDY    <ENDM     ;END MARKER
7ED7 26    06       03390           BNE    FA        ;IF SPECIFIED
7ED9 1F    10       03400 EA        TFR    X,D
7EDB CA    1F       03410           ORB    #$1F      ;ELSE SET TO EOL
7EDD 1F    02       03420           TFR    D,Y
7EDF 39             03430 FA        RTS
7EE0 8D    F2       03440 VLND      BSR    FEND      ;GET END MARK
7EE2 34    10       03450           PSHS   X         ;STRT LOC
7EE4 10AC  E1       03460           CMPY   ,S++      ;END<STRT?
7EE7 25    F0       03470           BLO    EA        ;USE EOL IF SO
7EE9 39             03480           RTS
                    03490 *
7EEA 9E    88       03500 SCNEDT    LDX    <CURS     ;CRNT CRSR
7EEC 81    03       03510           CMPA   #3        ;BREAK?
7EEE 26    03       03520           BNE    NTBR      ;NO
7EF0 9F    5F       03530           STX    <ENDM     ;=END MARKR
7EF2 39             03540 BRIJ      RTS              ;TO KCHR
7EF3 81    5E       03550 NTBR      CMPA   #$5E      ;UP ARROW?
7EF5 26    0A       03560           BNE    NTUP      ;NO
7EF7 8C    0420     03570           CMPX   #$420     ;>1ST LINE?
7EFA 25    F6       03580           BLO    BRIJ      ;NO, IGNORE
7EFC 30    88 E0    03590           LEAX   -32,X     ;UP 1 LINE
7EFF 20    26       03600           BRA    NCSR      ;SAVE CRSR
7F01 81    0A       03610 NTUP      CMPA   #$0A      ;DOWN ARROW?
7F03 26    0A       03620           BNE    NTDN      ;NO
7F05 8C    05E0     03630           CMPX   #$5E0     ;<LAST LINE?
7F08 24    E8       03640           BHS    BRIJ      ;NO, IGNORE
7F0A 30    88 20    03650           LEAX   32,X      ;DOWN 1 LINE
7F0D 20    18       03660           BRA    NCSR      ;SAVE CRSR
7F0F 81    08       03670 NTDN      CMPA   #8        ;BACK ARROW?
7F11 26    09       03680           BNE    NTBK      ;NO
7F13 8C    0401     03690           CMPX   #$401     ;>1ST CHR?
7F16 25    DA       03700           BLO    BRIJ      ;NO, IGNORE
7F18 30    1F       03710           LEAX   -1,X      ;BACK 1 CHR
7F1A 20    0B       03720           BRA    NCSR      ;SAVE CRSR
7F1C 81    09       03730 NTBK      CMPA   #9        ;FORWARD ARROW?
7F1E 26    0A       03740           BNE    NTFD      ;NO
7F20 8C    05FF     03750           CMPX   #$5FF     ;<LAST CHR?
7F23 24    CD       03760           BHS    BRIJ      ;NO, IGNR
7F25 30    01       03770           LEAX   1,X       ;FWD 1 CHR
7F27 9F    88       03780 NCSR      STX    <CURS     ;SAVE NEW CRSR
7F29 39             03790           RTS              ;GET NXT KBD CHR
7F2A 81    15       03800 NTFD      CMPA   #$15      ;SHIFT BACKWD?
7F2C 26    13       03810           BNE    NTSB      ;NO
7F2E 8D    B0       03820           BSR    VLND      ;END MARKR TO Y
7F30 8D    21       03830 CLOS      BSR    CMPR      ;FOR END CHK
7F32 27    0B       03840           BEQ    SPC       ;IF ALL CLOSED
7F34 A6    01       03850           LDA    1,X       ;GET CHR AHEAD
7F36 A7    84       03860           STA    ,X        ;STORE HERE
7F38 30    01       03870           LEAX   1,X       ;BUMP TO NXT CHR
7F3A 20    F4       03880           BRA    CLOS
7F3C 86    60       03890 SPC       LDA    #$60      ;SPACE CHR
7F3E A7    84       03900           STA    ,X        ;TO VID
7F40 39             03910           RTS              ;TO KCHR
7F41 81    5D       03920 NTSB      CMPA   #$5D      ;SHIFT FWD?
7F43 26    14       03930           BNE    NTSF      ;NO
7F45 8D    99       03940           BSR    VLND      ;END MRKR TO Y
7F47 8D    0A       03950 OPEN      BSR    CMPR      ;FOR END CHK
7F49 27    F1       03960           BEQ    SPC       ;IF END
7F4B A6    3F       03970           LDA    -1,Y      ;GET PREV CHR
7F4D A7    A4       03980           STA    ,Y        ;STORE HERE
```

```
7F4F 31   3F        03990            LEAY     -1,Y        ;1 CHR BACK
7F51 20   F4        04000            BRA      OPEN
7F53 34   10        04010 CMPR       PSHS     X           ;TO STACK...
7F55 10AC E1        04020            CMPY     ,S++        ;AND DO CMPR
7F58 39             04030            RTS
7F59 81   0D        04040 NTSF       CMPA     #$0D        ;C/R ?
7F5B 26   51        04050            BNE      GPHC        ;NO
                    04060 *END OF SCREEN EDIT*************
7F5D 1F   10        04070            TFR      X,D
7F5F C4   E0        04080            ANDB     #$E0        ;=> LINE STRT
7F61 34   06        04090            PSHS     D
7F63 17   FF6E      04100            LBSR     FEND        ;GET END MARK
7F66 1F   20        04110            TFR      Y,D         ;INTO A,B
7F68 A3   E4        04120            SUBD     ,S          ;MINUS STRT
7F6A 35   20        04130            PULS     Y           ;STRT TO Y
7F6C 2B   09        04140            BMI      AB          ;BEHIND, USE EOL
7F6E 10B3 00FA      04150            CMPD     #250        ;<250 CHRS?
7F72 25   05        04160            BLO      BB          ;YES OK
7F74 C6   F9        04170            LDB      #249        ;ELSE USE 250
7F76      8C        04180            FCB      $8C         ;DUMMY CMPX
7F77 C6   1F        04190 AB         LDB      #31         ;32 CHRS=1 LINE
7F79 5C             04200 BB         INCB                 ;OFFST CNT TO 1
7F7A 34   04        04210            PSHS     B           ;SAVE COUNT
7F7C 8E   02DD      04220            LDX      #$2DD       ;=>KBD BUFFER
7F7F A6   A0        04230 CB         LDA      ,Y+         ;CHR FROM VID
7F81 81   80        04240            CMPA     #128        ;GRAPHIC?
7F83 24   0E        04250            BHS      FB          ;NO CHNGE IF SO
7F85 81   20        04260            CMPA     #32         ;CHR<32?
7F87 24   04        04270            BHS      EB          ;NO
7F89 8B   60        04280            ADDA     #96         ;ELSE CNVRT U/C
7F8B 20   06        04290            BRA      FB
7F8D 81   60        04300 EB         CMPA     #96         ;CHR 32-95?
7F8F 25   02        04310            BLO      FB          ;CHR OK IF SO
7F91 80   40        04320            SUBA     #64
7F93 A7   80        04330 FB         STA      ,X+         ;INTO KBD BUFFER
7F95 5A             04340            DECB                 ;DONE ALL?
7F96 26   E7        04350            BNE      CB          ;CONT TIL DONE
7F98 32   66        04360            LEAS     6,S         ;ALIGN STACK
7F9A 34   10        04370            PSHS     X
7F9C 9E   5D        04380            LDX      <SEDT       ;SAVED CRSR
7F9E 9F   88        04390            STX      <CURS       ;RESTORE IT
7FA0 6F   8D FE36   04400            CLR      SESW,PCR    ;SW OFF EDIT
7FA4 35   30        04410            PULS     X,Y
7FA6 32   66        04420            LEAS     6,S         ;REALIGN STACK
7FA8 4F             04430            CLRA                 ;SETUP FOR EOL
7FA9 34   01        04440            PSHS     CC          ;FOR KBD I/P RTN
7FAB 7E   A3D2      04450            JMP      $A3D2       ;& GO THERE
                    04460 *
7FAE 81   0C        04470 GPHC       CMPA     #$C         ;CLEAR?
7FB0 26   05        04480            BNE      NC          ;NO
7FB2 C6   C0        04490            LDB      #$C0        ;WHITE BLANK
7FB4 E7   84        04500            STB      ,X          ;TO VID
7FB6 39             04510            RTS                  ;TO KCHR
7FB7 E6   84        04520 NC         LDB      ,X          ;GET CHR FROM VID
7FB9 C1   80        04530            CMPB     #$80        ;GRAPHIC?
7FBB 25   23        04540            BLO      NG          ;NO
7FBD 80   31        04550            SUBA     #$31        ;SEE IF 1-8
7FBF 25   11        04560            BLO      QC          ;NOT A NUMBER
7FC1 81   07        04570            CMPA     #7          ;>8 ?
7FC3 22   0D        04580            BHI      QC          ;NO GOOD
7FC5 48             04590            ASLA                 ;ALIGN
7FC6 48             04600            ASLA                 ;COLOR
7FC7 48             04610            ASLA                 ;BITS
7FC8 48             04620            ASLA
7FC9 34   02        04630            PSHS     A
7FCB C4   8F        04640            ANDB     #$8F        ;ZAP CRNT COLOR
7FCD EA   E0        04650            ORB      ,S+         ;NEW INFO IN
7FCF E7   84        04660 TV         STB      ,X          ;TO VID
7FD1 39             04670            RTS                  ;& IGNR CHR
7FD2 8B   31        04680 QC         ADDA     #$31        ;RSTR CHR
7FD4 C6   08        04690            LDB      #8          ;INIT GRAPHIC BIT
7FD6 31   8C 12     04700            LEAY     <QWAS,PCR   ;=>"QWAS"
7FD9 A1   A0        04710 RC         CMPA     ,Y+         ;GOT CHR?
7FDB 27   06        04720            BEQ      TC          ;YES TOGGLE PIXEL
7FDD 57             04730            ASRB                 ;NEXT PIXEL
7FDE 24   F9        04740            BCC      RC          ;MORE TO TRY
7FE0 16   FE4A      04750 NG         LBRA     CHKAUT      ;USE AS IS
7FE3 34   04        04760 TC         PSHS     B           ;PIXEL TO STACK
7FE5 E6   84        04770            LDB      ,X          ;GRAPHIC FROM VID
7FE7 E8   E0        04780            EORB     ,S+         ;FLIP PIXEL
7FE9 20   E4        04790            BRA      TV          ;BACK TO VID
7FEB      51        04800 QWAS       FCC      /QWAS/
          57 41 53
                    04810 *
          7CC1      04820            END      INIT
00000 TOTAL ERRORS
```

SAVE 25% - 75% OFF LIST !!!

#C20

# LA POINTE INC.

© 1984 by Conroy-LaPointe Inc. All Rights Reserved

## TO ORDER, CALL (800) 547-1289

## FOR YOUR IBM-PC, XT, AT or JR

### COMPUTER SYSTEMS

— Call for Details —

256K IBM - PC

360K Disk Drives by CDC

90 Day Limited Warranty By Us

SM

COMPAQ Portable. 256K, 2 360K Disk Drives — CALL

ZENITH Z150, 256K, 2 320K Disk Drives, MS DOS 2.1, 8088 Chip, 2 S/P — CALL

### HARD DISKS & TAPE BACKUP

| | List Price | Conroy Price |
|---|---|---|
| [illegible], Internal 10 meg kit | $ 895 | $ 74[illegible] |
| External 10 meg kit w/power | $1295 | $1049 |
| MF-10/10, H Disk, tape back, cont, power | $2295 | $17[illegible] |
| MICRO SCIENCE, 10 meg w/controller | $ 695 | $ 689 |
| RANA, External 10 meg w/controller | $1495 | $1[illegible] |
| Internal 10 meg w/controller | $ 995 | $ 689 |
| TALLGRASS, 25 meg disk, 55 meg tape, intf | $3680 | $31[illegible] |

### FLOPPY DISK DRIVES

CDC, Limited 30 day warranty, Call for quantity prices

| | List Price | Conroy Price |
|---|---|---|
| Full Height | | $129 |
| Half Height | | $109 |
| MAYNARD, Controller Card w/para port | $ 300 | $ 185 |
| Controller Card w/serial port | $ 310 | $ 195 |
| Sandstar Cont Card (accepts 3 modules) | $ 265 | $ 205 |
| PERFECT DATA, Head Cleaning Kit | $ 18 | $ 12 |

### OTHER HARDWARE

| | List Price | Conroy Price |
|---|---|---|
| **AST,** | | |
| SixPak Plus, 64K | | $259 |
| SixPak Plus, 256K, S/P/CC + S/W | $ 695 | $ 395 |
| SixPak Plus, 384K, S/P/CC + S/W | $ 695 | $ 465 |
| Game Port for SixPak | $ 50 | $ 39 |
| Preview™ Graphics Card w/para, 64K | $ 399 | $ 299 |
| Advantage™ Multif Bd for AT, 128K | $ 595 | $ 445 |
| I/O Plus II, S/P/CC | $ 215 | $ 150 |
| I/O Plus II, S/P/CC/G | $ 265 | $ 185 |
| I/O Plus II, 2S/P/CC/G | $ 315 | $ 215 |
| Port Kits - ser, para, or game, ea. | $ 50 | $ 39 |
| MonoGraphPlus™ P/CC (for Lotus) | $ 495 | $ 375 |
| **COMX, NEW** | | |
| EconoRAM™ Plus, 384K to 1.5 meg board, S/P/CC/G Fastrak & Spooler | | $265 |
| EconoRAM™, full 384K board | $ 295 | $ 195 |
| HAUPPAGE (HCW), 8087 Chip | $ 175 | $ 129 |
| 8087 Math Pak (Chip & softw.) | $ 295 | $ 235 |
| HAYES, Mach II Joystick | $ 45 | $ 29 |
| Mach III (PC or Jr) | $ 55 | $ 35 |
| HERCULES, Color Card w/para | $ 245 | $ 169 |
| Mono Graphics Card | $ 499 | $ 329 |
| KENSINGTON, Masterpiece™ | $ 140 | $ 99 |
| PC Saver™ Line Cord w/Filter | $ 50 | $ 35 |
| KEY TRONIC, KB5151, Std Keyboard | $ 255 | $ 185 |
| KOALA, Speed Key Tablet | $ 100 | $ 63 |
| Speed Key Tablet w/software | $ 200 | $ 115 |
| Koala Pad w/PC Design | $ 150 | $ 89 |
| **MAYNARD, SAND STAR SERIES** | | |
| Multifunction (6) Card | $ 80 | $ 79 |
| Memory Card no RAM | $ 199 | $ 139 |
| Memory Card 256K | $ 495 | $ 395 |
| Floppy Cont Card (accepts 3 modules) | $ 295 | $ 205 |
| Hard Disk I/F Module | $ 499 | $ 399 |
| Hard Disk Cable | $ 30 | $ 27 |
| Serial Port Module | $ 95 | $ 79 |
| Para or Clock Cal. Module, ea. | [illegible] | [illegible] |
| Game Adapter Module | $ 49 | $ 43 |
| Memory Module, OK | $ 122 | $ 99 |
| Memory Module 256K | $ 422 | $ 357 |

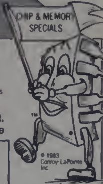
### OTHER HARDWARE

| | List Price | Conroy Price |
|---|---|---|
| MICROSOFT, Mouse (for PC) | $ 195 | $ 135 |
| Serial Mouse | $ 195 | $ 135 |
| MOUSE SYSTEMS, PC Mouse & Paint | $ 295 | $ 140 |
| PARADISE, Modular Graphics Card | $ 395 | $ 265 |
| Parallel or Serial Port, ea | $ 95 | $ 65 |
| **PERSYST, NEW** | | |
| PC/Mono Board, w/para port | $ 250 | $ 195 |
| PC/Color Graphics Bd w/light pen & I/F | $ 244 | $ 176 |
| BOB Board Color Adapter, hi res. | $ 595 | $ 465 |
| **QUADRAM,** | | |
| Quadboard 64K, to 384K, S/P/CC/G | | $245 |
| Quadboard, no RAM, expand to 384K | $ 295 | $ 225 |
| Quadboard 256K, to 384K, S/P/CC | $ 395 | $ 295 |
| Quadboard, 384K (full), S/P/CC/G | $ 795 | $ 495 |
| Quadboard II, no RAM, to 256K | $ 295 | $ 215 |
| Quadboard II, 64K, to 256K, 2S/CC | $ 395 | $ 265 |
| Quadboard II, 256K, 2S/CC | $ 595 | $ 395 |
| Quad 512 + 64K w/serial port | $ 325 | $ 245 |
| Quadcolor I, board, 4 colors | $ 295 | $ 195 |
| Upgrade Quadcolor I to II kit | $ 275 | $ 199 |
| Quadvue, board, Mono, S/P/CC | $ 345 | $ 269 |
| Quad 3278 | $1195 | $1050 |
| Quadnet VI | $2295 | $1545 |
| Quadnet IX | $1995 | $1745 |
| Quadlink | $ 495 | $ 385 |
| Quadsprint | $ 645 | $ 495 |
| TG PRODUCTS, Joystick | $ 45 | $ 29 |
| WICO, Smartboard Keyboard | $ 400 | $ 278 |

### ★ ★ FOR YOUR PC-JR ★ ★

| | List Price | Conroy Price |
|---|---|---|
| KEY TRONIC, KB5151 Jr. Keyboard | $ 255 | $ 195 |
| Numeric Keypad | $ 100 | $ 77 |
| KOALA, Touch Tablet for Jr. | $ 100 | $ 75 |
| MICROSOFT, Booster 128K w/Mouse | $ 495 | $ 339 |
| MOUSE SYSTEMS, Mouse (for Jr.) | $ 195 | $ 125 |
| QUADRAM, Expansion Chassis | $ 695 | $ 540 |
| Memory Expansion Board (128K P/CC) | $ 275 | $ 215 |
| TECMAR, Jr Captain | $ 395 | $ 325 |

CHIP & MEMORY SPECIALS



© 1983 Conroy-LaPointe Inc

★ 256K ★ CHIP KIT
**$99**
9 Each, 4256 chips 150 ns
**$79 ea.**
10 or more

★ 64K ★ CHIP KIT
**$19**
9 Each, 4164 chips
90 Day Warranty by us
**$14 ea.**
10 or more

PRICES ARE DROPPING, SO CALL!

★ ComX ★ NEW!

**EconoRAM Plus™**
**$265**
384K Multifunction RAM Board expandable to 1.5 Megabyte
Works like AST SixPakPlus™ with capacity for up to 1.5 meg, game port
Fastrak™ RAM Disk and Spooler Software

**EconoRAM™ 384K Single Function Board**
**$195**
With Fastrak™ and Spooler
Fully Compatible. 1 Year Limited Warranty
Works on DOS 1.1, 2.0 or 2.1
Prices and availability subject to change. Call

## SOFTWARE FOR YOUR IBM-PC, XT, AT or JR

### BUSINESS

| | List Price | Conroy Price |
|---|---|---|
| ASHTON-TATE, Framework | $ 695 | $ 34[illegible] |
| dBase III | $ 695 | $ 35[illegible] |
| dBase II, (req. PC-DOS & 128K) | $ 495 | $ 28[illegible] |
| ATI, Training Programs—Large Inventory | $ 75 | $ 5[illegible] |
| BPI, General Acctg. AR, AP, or PR, ea. | $ 595 | $ [illegible] |
| BRODERBUND, Bank St. Writer (PC or Jr) | $ 60 | $ 4[illegible] |
| CDEX, Training Programs—Large Inventory | $ 70 | $ 4[illegible] |
| CONTINENTAL, Ultrafile (PC) | $ 195 | $ 11[illegible] |
| Tax Advantage (PC or Jr.) | $ 70 | $ 4[illegible] |
| Property Management (PC) | $ 495 | $ 29[illegible] |
| DATA TRANS., Fontrix NEW | $ 125 | $ 7[illegible] |
| DOW JONES, Investment Evaluator | $ 149 | $ [illegible] |
| Market Manager Plus | $ 249 | $ 15[illegible] |
| Market Analyzer or Market Microscope | $ 349 | $ 21[illegible] |
| Spread Sheet Link | $ 249 | $ 15[illegible] |
| FOX & GELLER, Quickcode III | $ 295 | $ 18[illegible] |
| HARVARD, Total Project Manager | $ 495 | $ 29[illegible] |
| HOWARDSOFT, Tax Preparer '85 | $ 295 | $ 1[illegible] |
| Kit for California | $ 125 | $ 83 |
| HUMAN EDGE, Mind Prober (PC or Jr.) | $ 50 | $ 32 |
| Sales Edge or Management Edge, ea. | $ 250 | $ 159 |
| Negotiation Edge | $ 295 | $ 185 |
| KENSINGTON, Easy Link Mail Manager | $ 95 | $ 59 |
| LIFETREE, Volkswriter Deluxe | $ 295 | $ 159 |
| LIVING VIDEOTEXT, Think Tank | $ 195 | $ 105 |
| LOTUS, 1-2-3 | $ 495 | $ 309 |
| Symphony | $ 695 | $ 465 |
| MDBS, Knowledgeman | $ 500 | $ 300 |
| MECA, Managing Your Money (PC) | $ 195 | $ 125 |
| Managing Your Money Cartridge (Jr) | $ 199 | $ 179 |

### BUSINESS

| | List Price | Conroy Price |
|---|---|---|
| MICROPRO, WordStar (PC) | $ 350 | $ 18[illegible] |
| WordStar (Jr) | $ 195 | $ 11[illegible] |
| WordStar 2000 (copiable) | $ 495 | $ 29[illegible] |
| WordStar 2000 Plus (copiable) | $ 595 | $ 32[illegible] |
| WordStar Professional Plus | $ 695 | $ 39[illegible] |
| WordStar Professional, 4 Pak | $ 495 | $ 26[illegible] |
| MailMerge, SpellStar or StarIndex, ea. | $ 99 | $ 5[illegible] |
| InfoStar Plus (+ Starburst) | $ 595 | $ 31[illegible] |
| Correct Star | $ 145 | $ 7[illegible] |
| MICRORIM, RBase Clout | $ 195 | $ 13[illegible] |
| Extended Report Writer | $ 150 | $ [illegible] |
| RBase Series 4000 (New Version) | $ 495 | $ 25[illegible] |
| MICROSOFT, Spell | $ 50 | $ [illegible] |
| Multiplan (PC or Jr) | $ 195 | $ 12[illegible] |
| Chart or Project, each | $ 250 | $ 15[illegible] |
| Word | $ 375 | $ 23[illegible] |
| MONOGRAM, Dollars & Sense w/Forecast | $ 180 | $ [illegible] |
| MULTIMATE, Multimate Ver. 4.0 | $ 495 | $ 29[illegible] |
| PEACHTREE, Back to Basics | $ 395 | $ 23[illegible] |
| Peach Pak (GL/AR/AP) | $ 395 | $ 225 |
| QUE, Using 1-2-3 | $ 15 | $ 12 |
| 1-2-3 for Business | $ 15 | $ 12 |
| Using Symphony | $ 20 | $ 1[illegible] |
| SAMNA, Word Plus | $ 695 | $ 439 |
| Word III | $ 550 | $ 279 |
| SATELLITE, WordPerfect (PC) | $ 495 | $ 235 |
| WordPerfect (Jr) | $ 69 | $ 45 |
| SOFTW. ARTS, Spotlight | $ 150 | $ 95 |
| TK Solver (specify DOS) | $ 399 | $ 269 |

### BUSINESS

| | List Price | Conroy Price |
|---|---|---|
| SOFTWARE PUBL., PFS:Report | $ 125 | $ 79 |
| PFS:File | $ 140 | $ 89 |
| PFS:Write | $ 140 | $ 89 |
| PFS:Graph | $ 140 | $ 89 |
| PFS:Plan | $ 140 | $ 89 |
| PFS:Proof or PFS:Access, each | $ 95 | $ 59 |
| SORCIM, SuperCalc III | $ 395 | $ 245 |
| STONEWARE, Advanced DB Master | $ 595 | $ 375 |
| THORN EMI, Perfect Pak (Jr) (Write/Spell/Thesaurus) | $ 139 | $ 89 |
| WARNER, Desk Organizer (PC or Jr) | $ 195 | $ 125 |

### UTILITIES

| | List Price | Conroy Price |
|---|---|---|
| BORLAND, Sidekick or Toolbox, ea. | $ 55 | $ 31 |
| Sidekick (Copiable) (PC or Jr) | $ 95 | $ 50 |
| Turbo Pascal (PC or Jr) | $ 70 | $ 39 |
| Super Keys | $ 70 | $ 45 |
| 3 Pak (Pascal, Turbo Tut, Toolbox) | $ 105 | $ 65 |
| CENTRAL POINT, Copy II PC | $ 40 | $ 23 |
| COMX, Fastrak™, RAM/Disk emulator & printer spooler | | |
| For any PC/DOS or RAM Card Menu Driven | $ 100 | $ 59 |
| DIGITAL RES., CP/M-86™ (PC/XT) | $ 100 | $ 64 |
| CBASIC Compiler (CP/M-86 or PCDOS, ea) | $ 600 | $ 395 |
| DR LOGO-86 (CP/M-86) | $ 150 | $ 99 |
| FUNK SOFTWARE, Sideways | $ 60 | $ 37 |
| IBM, BASIC Cartridge (Jr) | $ 75 | $ 69 |
| HAYES, Smartcom II (Data Comm.) | $ 149 | $ 99 |
| LIFEBOAT, Lattice C | $ 500 | $ 250 |
| Dr. Halo | $ 100 | $ 50 |
| MICROSOFT, Macro Assembler | $ 150 | $ 99 |
| BASIC Compiler or C Compiler, ea | $ 500 | $ 259 |
| Business BASIC Compiler | [illegible] | $ 300 |
| COBOL Compiler | $ 700 | $ 459 |
| FORTRAN Compiler | $ 350 | $ 229 |
| PASCAL Compiler | $ 300 | $ 199 |

### UTILITIES

| | List Price | Conroy Price |
|---|---|---|
| MICROSTUF, Crosstalk XVI (PC or Jr) | $ 195 | $ 129 |
| MOUSE SYSTEMS, PC Paint | $ 99 | $ 69 |
| NORTON, Utilities (14 prgms) | $ 100 | $ 65 |
| ROSESOFT, Prokey | $ 130 | $ 79 |
| WESTERN UNION, Easy Link Mail Mngr | $ 95 | $ 59 |

### HOME & EDUCATIONAL

| | List Price | Conroy Price |
|---|---|---|
| BPI, Personal Accounting | $ [illegible] | $ [illegible] |
| CONTINENTAL, Home Accountant (Jr) | $ 75 | $ [illegible] |
| Home Accountant Plus (PC) | $ 150 | $ 9[illegible] |
| DOW JONES, Home Budget | $ 139 | $ [illegible] |
| KOALA, Graphics Exhibitor (Jr) | $ 40 | $ 2[illegible] |
| MONOGRAM, Dollars & Sense w/forecast | $ 180 | $ [illegible] |
| SCARBOROUGH, MasterType (PC or Jr) | $ 40 | $ 2[illegible] |
| Your Personal Net Worth | $ 100 | $ [illegible] |
| SIMON & SCHUSTER, Typing Tutor III | $ 50 | $ [illegible] |

PLUS: BPI, CBS, COMPREHENSIVE, DAVIDSON, HARCOURT, PBL CORP.

### RECREATIONAL

| | List Price | Conroy Price |
|---|---|---|
| BLUECHIP, Millionaire, Barron, Tycoon, ea. | $ 60 | $ 39 |
| BRODERBUND, Large Inventory In Stock | | CALL |
| ELECTRONIC ARTS, Large Inventory In Stock | | CALL |
| HAYDEN, Sargon III (Chess) | $ 50 | $ 34 |
| INFOCOM, Large Inventory In Stock | | CALL |
| Hitchhiker's Guide | $ 40 | $ 25 |
| Zork I, II, or III, ea | $ 40 | $ 25 |
| MICROSOFT, Flight Simulator (PC or Jr) | $ 50 | $ 33 |
| ORIGIN, Ultima III (PC or Jr) | $ 60 | $ 39 |
| SIERRA/ON-LINE, Ultima II (PC or Jr.) | $ 60 | $ 40 |
| SPECTRUM HOLOBYTE, Gato | $ 40 | $ 25 |
| SPINNAKER, President's Choice, Amazon, Fahrenheit, Rendezvous, Dragon, each | $ 40 | $ 25 |

**CASH-n-CARRY COMPUTER STORES, INC.**
Retail Sales only. Store prices may vary
**SAN FRANCISCO** — 550 Washington Street (at Montgomery, opposite the Pyramid). Interstate 80, to Highway 480, take Washington Street Exit. **CALL (415) 982-6212.**
**PORTLAND, OREGON** — At Park 217, Tigard at intersection of Highways 217 and 99W. **CALL (503) 620-5595.**
**SEATTLE, WASH.** — 3540 128th Ave. SE, Bellevue 98006. In Loehmann's Plaza near Factoria Square, SE of Highway 405 & 90 and at SE 38th and Richards. **CALL 641-4736.**

**OUR REFERENCES:**
We have been in computers and electronics since 1958, a computer dealer since 1978 and in computer mail order since 1980. Banks: 1st Interstate Bank, (503) 643-4678. We belong to the Chamber of Commerce (503) 228-9411, and Direct Marketing Association, call Dun and Bradstreet if you are a subscriber. Recipient of OREGON BUSINESS MAGAZINE's 1984 Enterprise Award

CONROY-LAPOINTE CARD

NO SALES TAX

**CALL (800) 547-1289**
In Oregon: (800) 451-5151

Foreign & Portland Residents Call (503) 620-9877

**QUESTIONS** (503) 620-9878 Weekdays Only

**ORDER DESK HOURS**
Mon-Fri 6am to 6pm (PST)
Saturday 10am to 4pm (PST)
(6 am here is 9 am in New York)

CIRCLE 108 ON READER SERVICE CARD

# COMMODORE'S PORT

## Speed Up Your Disk Drive; Protect Your Programs; and Check Your File Space/**Robert Alonso**

C64 owners tell me they are wondering if their machines will soon suffer the fate of the Vic 20. Many are afraid that the supply of software and hardware add-ons will dry up.

Relax, Commodore has all but sworn that your 64 will not become obsolete in the foreseeable future. The new C128 comes equipped with a C64 mode that makes it completely compatible with existing software. This compatibility will probably help Commodore sell millions of C128s and as a side benefit will provide for C64 owners a generous selection of good software. I predict that most software companies will design software run on the C64 to maximize their potential market.

In the meantime, those of you looking for a book that can really teach you some machine language should take a look at *Machine Language For The Commodore 64 And Other Commodore Computers*. It is written by Jim Butterfield, perhaps the renowned Commodore expert, and published by Brady Communications Company. The book has the standard explanations of hexadecimal, memory, and instruction sets, but what makes it unique is its detailed discussion of ROM routines and important memory locations. Another welcome feature is the presentation of all listings in one format. The book includes a listing for a monitor program in Basic loader format that allows you to type in the other listings from the book without modification. The exclusive focus on Commodore machines is also a big plus.

### Printer Interface

Another useful item for Commodore users is the Micro World Micrografix parallel printer interface. It allows you to use printers with Centronics inputs, like Epsons, with your 64 or Vic. It provides virtually complete Commodore printer emulation to diminish, if not eliminate, some of the problems encountered when trying to run prepackaged software with non-Commodore printers. Internally, it has slots available for the addition of up to three chips that upgrade the interface with a 4K RAM buffer. This is a big plus, if you don't like waiting around for the printer to finish.

For those who already have a Micrografix interface, the chips that you need to upgrade it are one 74LS10 and either one or two 6116 chips. The first is a buffer control chip, and the 6116 is a 2K RAM. You can insert them yourself, because the 6116 is a bit larger (no pun, really!) than the 74LS10. There is no way to mistake which goes where. The interface is available from Micro-W. Distributing.

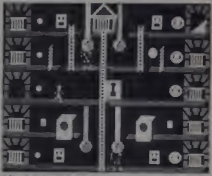
**Believe it or not, you can speed up your Commodore 1541 disk drive.**

### Doctor Creep Makes House Calls

For you gamers who prefer just to have fun with your 64s and leave programming and interfacing to others, there is a new and exciting game from Broderbund Software. It is called *The Castles Of Doctor Creep*.

*Dr. Creep*, by Ed Hobbs, is a program that seems designed to showcase the unique powers of the 64. There is a hi-res title screen (apparently done on a Koala Pad, by the way), multi-voice music with interludes that echo in different sounding instruments, what appear to be multi-color custom characters, and sprites for animation.

*Dr. Creep* is a joystick controlled adventure game with graphics. You won't ever have to type GO EAST in this game. It is, however, much more than



**The Castles of Dr. Creep**

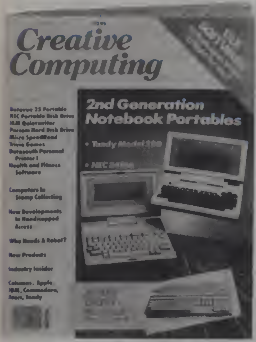
just an adventure. It is more like a puzzle, an arcade game, and an adventure all wrapped up in one neat package. There is an on-disk tutorial to step you through all the perils and responses that are available. You can save and resume a game from disk at any time, and can choose from among 13 castles with names like Freedonia, Lovecraft, Teasdale, and Parthenia. Avoid Parthenia, though; it is the most frustrating castle of them all. I can't go into details about it, but let it suffice to say that it appears infinitely regressive.

### A Faster 1541?

Believe it or not, you can speed up your Commodore 1541 disk drive. The best part of it all is that you won't have to change any chips in the drive or even open it up. Datamost has released a program called *Kwik-Load* that makes your 1541 load programs 300% faster. It's true. The disk is selling for $19.95 at most stores and comes with a very handy disk editing and disk copying utility. The disk copying utility will copy individual files or the entire disk on either a single drive or two drives at similar speeds.

Considering the price and the utility of the program this is a great buy. You should be warned, however, that *Kwik-Load* will not work with programs that load into the 4K of memory on the 64

# FREE INFORMATION SERVICE

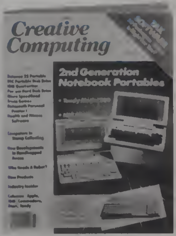



## FREE INFORMATION! QUESTIONS ANSWERED! LATEST DATA!

Here's your chance to learn more about any number of products and services described or advertised in this month's *Creative Computing*. *FREE OF CHARGE!*

Directions on reverse side.

# FREE INFORMATION SERVICE




## Free! Quick! No Obligation!

Let us forward your request for further information you'd like to receive on any number of products or services mentioned or advertised in this month's issue of *Creative Computing*. No charge or obligation! *And as easy as 1-2-3!*

**1** Clearly print/type your name/complete address on *one* of the attached reply cards.

**2** Circle the number(s) on that card which correspond to the number(s) you'll find at the bottom of the ad(s)/article(s) about which you'd like to learn more. (You'll also find these key numbers on advertised products in this month's Advertiser's Index.)

**3** Stamp and mail the card. The sooner it's sent, the quicker you'll get the literature you're after.

This is an ideal time to subscribe to *Creative Computing*—the #1 magazine of computer applications and software—and save 47%. One year, 12 issues, is just $12.97. (It's usually $24.97.) Just check the box at the bottom of the reply card...and make certain we have your complete present address.

Void after August 31, 1985

# Creative Computing

Please indicate which of the following microcomputers you currently own and/or plan to buy in the next 12 months.

| | 1 Own | 2 Plan to Buy |
|---|---|---|
| Apple | A | L |
| Atari | B | M |
| Commodore/PET | C | N |
| Digital Equipment/DEC | D | O |
| Heath/Zenith | E | P |
| IBM | F | Q |
| Radio Shack/Tandy TRS-80 | G | R |
| Texas Instruments | H | S |
| Timex Sinclair | I | T |
| Other (specify) | J | U |
| None | K | V |

**3** For what, if any, business application(s) do you use the microcomputer you currently own?________

101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125
126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150
151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175
176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200
201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225
226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250
251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275
276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300
301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325
326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350
351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375
376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400
401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425
426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450
451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475
476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500

**PLEASE PRINT CLEARLY**—Use only one card per person

NAME________ PHONE # (____)________

COMPANY________ TITLE________

ADDRESS________ APT.____

CITY________ STATE________ ZIP________

(Zip code must be included to insure delivery)

CC6853

4 ☐ **Please send me one year (12 issues) of *Creative Computing* for $12.97 and bill me. (Full one-year subscription price $24.97.)**

---

# Creative Computing

Void after August 31, 1985

Please indicate which of the following microcomputers you currently own and/or plan to buy in the next 12 months.

| | 1 Own | 2 Plan to Buy |
|---|---|---|
| Apple | A | L |
| Atari | B | M |
| Commodore/PET | C | N |
| Digital Equipment/DEC | D | O |
| Heath/Zenith | E | P |
| IBM | F | Q |
| Radio Shack/Tandy TRS-80 | G | R |
| Texas Instruments | H | S |
| Timex Sinclair | I | T |
| Other (specify) | J | U |
| None | K | V |

**3** For what, if any, business application(s) do you use the microcomputer you currently own?________

101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125
126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150
151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175
176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200
201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225
226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250
251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275
276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300
301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325
326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350
351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375
376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400
401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425
426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450
451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475
476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500

**PLEASE PRINT CLEARLY**—Use only one card per person

NAME________ PHONE # (____)________

COMPANY________ TITLE________

ADDRESS________ APT.____

CITY________ STATE________ ZIP________

(Zip code must be included to insure delivery)

CC6852

4 ☐ **Please send me one year (12 issues) of *Creative Computing* for $12.97 and bill me. (Full one-year subscription price $24.97.)**

---

# Creative Computing

Void after August 31, 1985

Please indicate which of the following microcomputers you currently own and/or plan to buy in the next 12 months.

| | 1 Own | 2 Plan to Buy |
|---|---|---|
| Apple | A | L |
| Atari | B | M |
| Commodore/PET | C | N |
| Digital Equipment/DEC | D | O |
| Heath/Zenith | E | P |
| IBM | F | Q |
| Radio Shack/Tandy TRS-80 | G | R |
| Texas Instruments | H | S |
| Timex Sinclair | I | T |
| Other (specify) | J | U |
| None | K | V |

**3** For what, if any, business application(s) do you use the microcomputer you currently own?________

101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125
126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150
151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175
176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200
201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225
226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250
251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275
276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300
301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325
326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350
351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375
376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400
401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425
426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450
451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475
476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500

**PLEASE PRINT CLEARLY**—Use only one card per person

NAME________ PHONE # (____)________

COMPANY________ TITLE________

ADDRESS________ APT.____

CITY________ STATE________ ZIP________

(Zip code must be included to insure delivery)

CC6851

4 ☐ **Please send me one year (12 issues) of *Creative Computing* for $12.97 and bill me. (Full one-year subscription price $24.97.)**

PUT STAMP HERE
THE POST OFFICE
WILL NOT DELIVER
MAIL WITHOUT
POSTAGE

**Creative Computing**
P.O. Box 13010
PHILADELPHIA, PA 19101

PUT STAMP HERE
THE POST OFFICE
WILL NOT DELIVER
MAIL WITHOUT
POSTAGE

**Creative Computing**
P.O. Box 13010
PHILADELPHIA, PA 19101

PUT STAMP HERE
THE POST OFFICE
WILL NOT DELIVER
MAIL WITHOUT
POSTAGE

**Creative Computing**
P.O. Box 13010
PHILADELPHIA, PA 19101

that begins at 49152 ($C000). It uses part of this section of memory for its own operation and temporary storage.

### Three New File Types

Datamost has released a new book, *Inside Commodore DOS* (see Book Reviews section in this issue), which discusses an otherwise undocumented file type called a DEL (delete) file. The authors give instructions on how to create a DEL file and in how to load it and have it work like a program file. However, they fail to mention two other peculiar file types that are loaded similarly. These two file types are documented, but the implementation that follows is not.

Try the following next time you have finished programming something on your 64. Instead of saving your file with just a filename, save it with a filename followed by either a ,S or a ,U:

Save Procedure:

SAVE"filename,S",8 or
SAVE"filename,U",8

Load Procedure:

LOAD"filename,S",8 or
LOAD"filename,U",8

When you save a file using this technique, you save the program that you were working on in program file format with SEQ (sequential) or a USR (user) designation in the directory header. This kind of designation in the directory is more than just cosmetic; it is a neat trick for protecting a program. The reason for this is that you can load it only with the corresponding ,S or ,U tagged after the filename. Any attempt to load the file without the addition will cause a disk error, and the computer will not load the file. If you are the only one in your house or user group who knows this trick you can then enjoy a bit of privacy for your programs.

### More DOS

The March "Commodore's Port" featured a machine language utility that counted the number of free blocks available on any disk. That short utility was written more as a demonstration of machine language than as a valuable utility. It can, however, be very useful if you are writing a database and need to know the available space on the disk before writing out any data.

The machine language program was written so that it would work on both the MSD disk drives and the Commodore 1541; I did not use any drive specific coding.

There is, however, a faster and shorter way to find out how many blocks

**Listing 1. Fast blocks free.**

```
100 REM ********************************
105 REM *                              *
110 REM *   BLOCKS FREE FOR 1541       *
115 REM *    CREATIVE COMPUTING        *
120 REM *                              *
125 REM *     BY ROBERT ALONSO         *
130 REM *                              *
135 REM ********************************
140 OPEN 15,8,15,"I0":Z$=CHR$(0)
145 INPUT#15,EN,ER$,TR,SE
150 IF EN=0 THEN 160
155 PRINT EN;ER$;TR;SE
165 ML=762:HB=INT(ML/256):LB=ML-256*HB
170 PRINT#15,"M-R"CHR$(LB)CHR$(HB)
175 GET#15,A$
180 MH=764:HB=INT(MH/256):LB=MH-256*HB
185 PRINT#15,"M-R"CHR$(LB)CHR$(HB)
190 GET#15,B$
195 BF=ASC(A$+Z$)+256*ASC(B$+Z$)
200 PRINT BF;" BLOCKS FREE."
205 CLOSE 15: END
```

are free on a disk. It is so fast that it is acceptable even in Basic. The only drawback is that it can be used only with the 1541 disk drive. It uses two memory locations which are specific to the 1541 disk drive.

I have been able to locate the corresponding memory locations on the MSD drives, but, unfortunately, they do not behave the same way. The 1541 updates the two memory locations every time any type of disk access is attempted. This is probably due to its automatic initialize feature. The MSD drives will update corresponding memory locations only when an attempt is made to read the directory. There is, thus, no advantage to using the MSD locations.

The locations for the MSD double disk drive are 1314 and 1315 for drive 0 and 1378 and 1379 for drive 1. You could insert these numbers for the values of ML and MH in lines 165 and 180 respectively. Locations 1314 and 1378 should be set equal to ML and locations 1315 and 1379 should be set equal to MH.

Listing 1 will allow you to use only one pair at a time (1314,1315 or 1378,1379). It will work without modification on the 1541 disk drive. Lines 170 and 185 are used to read the value in the memory locations specified by ML and MH. This is the standard way to read memory locations within the disk drive and is the equivalent of a PEEK command in Commodore Basic. ■

**Firms Mentioned In This Column**

Brady Communications Company
Bowie, MD 20715
(301) 262-6300

Micro-W. Distributing
1342 B Route 23
Butler, NJ 07405
(201) 838-9027

Broderbund Software
1938 4th St.
San Rafael, CA 94901
(415) 479-1170

Datamost, Inc.
19821 Nordhoff St.
Northridge, CA 91324
(818) 709-1202

# OUTPOST: ATARI

## SwapDOS: A Program to Lessen Aggravation and Waiting Time/David and Sandy Small

The Atari has a program called the Disk Operating System which you load from disk any time you start up from disk. The Disk Operating System handles everything that has to do with the disk drive. If you switch on the machine without a disk drive attached, you won't load the DOS, which means that until you turn the power off, you can't do anything with a disk drive. You can't, for instance, SAVE a Basic program to disk.

Nearly everyone I know has been caught by this once or twice—you turn the Atari on, then the disk drive. The Atari upon awakening concludes that there is no disk drive attached, so no DOS is loaded. You type in a long program, type SAVE, and the Atari doesn't know what to do.

If you get into this fix, you might try saving the program to cassette, if you have a cassette drive. Otherwise, you're out of luck; print a copy of the program, restart the machine, and type it back in.

DOS is a computer program like any other, made out of bytes, and stored on disk in the file DOS.SYS.

(How can the Atari load DOS.SYS when it doesn't know how to deal with disk drive until DOS.SYS is loaded? Good question; are you considering computer science for a career? Anyway, the Atari has the ability to do one thing with a disk drive when it turns on. That one thing is loading DOS.SYS.)

If a disk does not have the DOS.SYS file on it, you will see repeated BOOT ERROR messages on the screen; the Atari is trying to tell you that it wants to bring DOS in so it can deal with disk drives, but it can't, since DOS is not on your disk. The solution is to insert a disk with DOS.SYS on it. (Also, the DOS.SYS file might be scrozzled.)

DOS loads into "low" computer memory and stays there as long as the Atari is on. Your Basic program, and everything else, stays above DOS (see Figure 1). If you don't load DOS, you have more room for Basic (see Figure 2).

Next, let's assume you type DOS from Basic. What happens? DOS loads the Disk Utility Package, a collection of programs to deal with disks. You have seen the Utility Package many times; it enables you to format disks, look at disk directories, and the like. Its title is the DOS Menu.

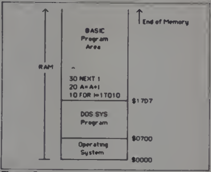



**Figure 1.**

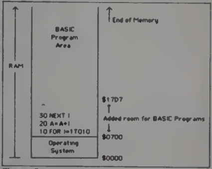



**Figure 2.**

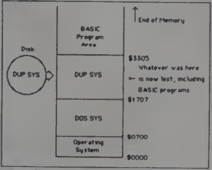



**Figure 3.**

This menu package is stored on disk in a file called DUP.SYS (short for Disk Utility Package). When you type DOS, the DOS program loads DUP into memory right above DOS, and you get the menu (see Figure 3).

The reason I have stressed the difference between DOS, the program that is in memory all the time, that handles all disk requests, and DUP, the program that is there only when you are working with the DOS menu, is that you type DOS to get to the DUP menu. Confusing, right?

Now, what if you had a Basic program stored where the DUP package loaded in? It will disappear; the DUP package writes over it in memory. This means that you can never get to the DOS menu without clobbering whatever you are working on.

The designers of the Atari have a solution: something called MEM.SAV. You create MEM.SAV with option N from the DOS menu. If you have MEM.SAV, when you type DOS, the area that the DUP package will load into is first saved to disk, saving the Basic program (or whatever) that is in that section of memory. Next, DUP is brought in, and you do whatever you want with the menu. When you exit DUP, the old memory region is read back in from disk and restored to its original state. The upshot is that you haven't lost your Basic program by going to the DOS menu.

Of course, there is a tradeoff: all this disk access really slows down access to the DOS menu. If you should get tired of this, just delete the MEM.SAV file and things will return to normal.

At this point I have a confession to make: I really dislike typing DOS. Why? It takes so long to get to the darn DOS menu, and I have done it thousands of times. Furthermore, I don't like losing whatever I was doing to get to a DOS menu, either. MEM.SAV takes *so* long that I can shave while it is beating on the disk (I tried it).

### SwapDOS

Speed, speed, speed. We computer types are obsessed with it. Otherwise why bother with a computer? However, it is not a vain obsession; time is money for people, and saving ten seconds for thousands of times really adds up. Hence, SwapDOS.

SwapDOS is a modification to the standard Atari DOS 2.0S and the Atari 800XL.

SwapDOS does two things for you: it allows you to get in and out of the DOS menu instantly, and it preserves anything you are working on when you go to the DOS menu.

By the way, other DOSes can be modified with the principles within, but don't expect SwapDOS to work with them as printed. I have commented the assembly source code listing (Listing 1) as much as possible to make it easier for you.

**I don't like losing whatever I was doing to get to a DOS menu.**

The key to SwapDOS is the design of the newer XL. There is 16K of RAM in these XLs that is generally not available to the user, although Atari never had any qualms about advertising it. It lies "under" the operating system area; you can select either the operating system or RAM to be in that memory region, by writing a 1 or 0 (respectively) to the lowest bit of PORTB, the old joystick port.

To use SwapDOS on the XL, type in the Basic program (Listing 2). This will generate an assembly language program called SWAPDOS.OBJ. Go to the DOS menu. Use option L (Binary Load), and load "SWAPDOS.OBJ"; then return to Basic.

Now, the system is ready. Type DOS. You'll be in the DOS menu in half a second. And when you exit DOS, you'll not have lost anything you were working on.

**Listing 1.**

```
            ;
            ; SWAPDOS PROGEAE.
            ; FOURTE AEEIVERSANY SPECIAL FOR
            ; CREATIVE CONPUTING'O DUTPOSTI ATAEI
            ;
            ; WORKS WITN ATANI DOS 2.D0 -ONLY-.
            ;
            ; EOT FARTICULAELY COPYNIGET
            ; OY OAVE ONALL, OE AEYDEE ELSE.
            ;
0000             *= #400B   ; EAEELESS AREA, EIDDLE OF NOWNERO
            ;
  =0000     ROEXL = B
  =0001     XL  =   1
            ;
            ; YOU EUST SET "VERSION" TO OELECT ROLL OAE AT
            ; OODO OE OOOO.
            ;
  =0001     VEEEIDN = XL
            ;---------------------------------
            ; OEGEENT #1. EOVO DUP PACKAGO TO
            ; O.O. EAN.
            ;
  =B001         .IF VERSIDN=XL
  =D3B1     PORTE =   #0301 ; OS CONTROL
  =E00B     OSNAN =   #E000
                  .ELEE
            DENAN =   #OBDD ; DEBUG ONLY
                  .ENOIF
  =D40E     ENIEN = #O40E   ; VBLANX NNI DN/DFF
  =D400     ONACTL = #D400  ; EAEDWAEE DEA CTL
            ; ENTEY POINT FROE DOS -L-OAD COEEAEO
4000        COPYDOS
            ;  SWITCE OFF INTOENUPTS. TUEE OE D.E. OAN.
40B0 A900       LDA ##00
4002 8D0E04     STA ENIEN   ; CUT OFF VOLAEX EEI'E
4005 78         OOI         ; CUT OFF IRQ'O
40B6 A900       LOA #0
400B 800004     OTA DNACTL
  =0001         .IF VEEEIOX=XL
40DB AD0102       LOA PORTB
4000 29F0         ANO ##F0  ; LOWEST OIT "OFF" OAE ON
401B 800102       ETA PORTB
                  .ENOIF
            ; XOW BLOCKNOVE DUF AEEA TO OS OAN
            ; DO COFY: (ENTEY POINT POE AROTNEN FAGO)
  =1D7C     DUFSTANT = #1D7C ; STANT DF DUF
            ; (ENTEY POINT TO COFY ANOTNEE 25A)
4012        EUTNN25A
4013 A2DD       LDX #0      ; FAGE POIRTEN
            ; (ENTNY POINT IN 256-OYTE COFY)
4015        COPYLOOP
4015 BD7C10 FROM LDA DUFSTAET.X ; PETCNEE
401B 9D0080 TO  STA OSEAN.X ; FLACEEE
4018 E8         INX
401C D0F7       BNE COPYLOOP ; VRIRR.. URTIL 256 DOOO
            ; OKAY. INC LOA/STA. ANO AEE WE DONE?
4010 0E174B     INC FNON+2  ; CNANGE "LOA" INOTNUCTION ADONEEE
4021 EE1A40     INC TO+2    ; CNANGE "STA" INSTRUCTION AOORESO
4024 AD1740     LDA FNON+2
4027 C934       CNP ##34    ; OUF EEOS AT #3305 SO TEIE IS OVEEXILL
4029 D0E8       BNO EUTEN256
            ; WE IO DONE. EWITCN OS EAE OFF. TURE ON INTOEOUPTS. VAVE
            ; BYOBYO AT THE PRETTY CAEERA.
  =BD01         .IF VERSION=XL
402B AD0103       LOA PONTB
402E D901         ONA ##01  ; LOVOST OIT "ON": RAN OFF
403B BD0103       ETA PORTB
                  .ONDIF
4033 A940       LDA ##40
4035 8D0E04     STA NNIEN   ; ENAOLE NNI'O
403B 5B         CLI         ; ENABLO IRQ'O
4039 6B         NTE          ; NETUNN TO DOS AT END OF LOAO EEGNENT
            ; COOE TO FORCE DOS LOAOER TO DO TEIO BLOCX COPY EIGET NOW
403A            *= #B202    ; DOS INIT ADOEESS
02E2 DD4D       .WORO COPYDOS
            ;-------------------------------------
            ; EEGEENT 2. FATCN TO DOS 2.BE TO TELL IT NON.OAV FILO
            ; IS OUT THENE.
02E4            *= #1873    ; DOS 2.B0 "NENSVO" LABEL
1073 A001       LOY #1      ; OSTE "POSITIVE" FLAG (EOT NINUE)
1875 AD         RTS         ; THAT'O ALL, FOLXE
            ;-----------------------------------
            ; EEGNENT 3. FATCN TO DOS 2.00 TO TOLL IT TO JUST EUN
            ; OUP IN EONORY AT DUF ONTOY POINT VS. TEYING TO LOAD
            ; OUP.EYE OFF DF DIEX.
            ; IE THE "FIXAL" LABEL
1B76            *= #17F7
17F7 4C7520     JNF #2075   ; DUP UEUAL OETRY POIET
            ;-----------------------------------
            ; EEGNENT 4. FATCE TO DOS 2.00 "WEITE NENONY TO NEN.EAV"
            ; CDDO.  THIO JUST SWAFO TNO DUF AEOA AND TEO O.E. EAN.
17FA            *= #1746    ; DOS 2.B0 "EVEITE" LABEL
            ; (ENTEY POIET FROM "LOAO IT OACX FROM EEN.OAV PILO..")
1746        SWAPIT
            ; TUEE DFF ENI'S ANO INO'E.
1746 A900       LOA #0
1740 8D0ED4     STA NNIEE
174B 78         SEI
            ;   LOA #0      ;AELSTROE NEROEIAL FIX
174C 8D0004     ETA DNACTL
  =0001         .IF VENEIDN=XL
174F AD0102       LDA PORTO
1752 29FE         AND ##FE  ; LOWEST BIT "OFF":NAN DN
1754 AD0103       STA PORTE
                  .ENOIF
            ; NESET POINTENO
1757 A91D       LDA #DUPSTANT/25A
1759 8DAB17     STA EFRON1+2
175C 8D7217     OTA STO1+2
175F A90B       LDA #OSRAN/25A
17A1 8DAF17     STA EFRON2+2
17A4 AD7A17     STA ETO2+2
            ; SWAF TEE TWO UNTIL #3400..
            ; (ENTOY POIET TO SWAF ANOTNOE 256)
17A7        SWAFLOOF
17A7 A200       LDX #0      ; INDEXEN
            ; (ENTOY POINT WEILE EWAPPING 256)
1769        SWAF256
1769 BD7C10 EFRON1 LDA DUPSTAET.X ; FETCN A EAE OYTO INTO "Y"
17AC AB         TAY
17A0 BD00E0 OFROE2 LOA OSEAN.X ; FSTCN AN OS OYTE
1770 9D7C10 STD1 ETA DUFETAET.X ; OTDEE OS BYTE INTO EAN
1773 98         TYA         ; EECDVEN OLD NAN BYTE FROM "Y"
1774 9D0000 STO2 ETA OSEAN.X ; ETOEE EAN BYTE INTO DE
1777 E8         IEX
1778 D0EF       BNE EWAF256
            ; DONE WITN 25A. INC POINTEEE.
177A EEAB17     INC EFRON1+2
1770 EE6F17     INC OFNON2+2
1780 EE7217     INC OTO1+2
1783 EE7617     INC STO2+2
            ; TEST IF DONE .. AT #3400?
17A6 AD6817     LOA OFRON1+2
1789 C934       CNF #034
178B D00A       BNE SWAFLDOF
178D 4C4219     JNF BYEBYE  ; ALL DONE; EXIT.
            ;-----------------------------------------
            ; SEGEENT 5. PATCN TO DOE 2.BE LOEEN1 LABEL, WHICE
            ; LOADE FROM NEN.EAV INTO NAE. ALL WE DO IE SWAF
            ; THE TWO NAN'E. SO JUET JNF TO OTNEN LABEL.
1790            *= #193F    ; LDNEN1
193F 4C4A17     JNF EWAPIT
            ;
            ; THIE CODE EOVEO TO EERE BECAUEE
            ; VE'NO OUT OF EDOE IE "NWRITE" AEOA.
            ;
1942        BYEBYE
            ; OS ANO NAN ANEAE ANE OWAFFEO. EXIT. ETAGE LEFT.
  =00B1         .IF VERSION=XL
1942 AD01D3       LOA PORTO
1945 0901         ONA ##01  ; LOVEST OIT "ON ": NAN OFF
1947 8D01D3       OTA PONTB
                  .ENDIF
            ;
194A A940       LDA ##40
194C 8D0E04     ETA ENIEE   ; ENI'E BACX ON
194F 58         CLI         ; IND'E BACX ON
1950 A001       LDY #1      ; OTATUS = "ALL IE EWELL"
1952 A0         RTE
            ;--------------------
            ; END OF CODE.
1953        OND
```

```
50 REM -- XL VERSIDN --
100 DPEN #1,8,0,"D1:SWAPDOS.OBJ"
110 TRAP 200
120 READ X
130 PUT #1,X
140 GOTO 120
200 CLOSE #1
210 STOP
1000 DATA 255,255,0,64,57,64,169,0,141,14
1010 DATA 212,120,169,0,141,0,212,173,1,211
1020 DATA 41,254,141,1,211,162,0,189,124,29
1030 DATA 157,0,224,232,208,247,238,23,64,238
1040 DATA 26,64,173,23,64,201,52,208,232,173
1050 DATA 1,211,9,1,141,1,211,169,64,141
1060 DATA 14,212,88,96,226,2,227,2,0,64
1070 DATA 115,24,117,24,160,1,96,247,23,249
1080 DATA 23,76,117,32,70,23,143,23,169,0
1090 DATA 141,14,212,120,141,0,212,173,1,211
1100 DATA 41,254,141,1,211,169,29,141,107,23
1110 DATA 141,114,23,169,224,141,111,23,141,118
1120 DATA 23,162,0,189,124,29,168,189,0,224
1130 DATA 157,124,29,152,157,0,224,232,208,239
1140 DATA 238,107,23,238,111,23,238,114,23,238
1150 DATA 118,23,173,107,23,201,52,208,218,76
1160 DATA 66,25,63,25,82,25,76,70,23,173
1170 DATA 1,211,9,1,141,1,211,169,64,141
1180 DATA 14,212,88,160,1,96,0
```

**Listing 2.**

```
50 REM -- NDN XL VERSIDN --
100 DPEN #1,8,0,"D1:SWAP800.DBJ"
110 TRAP 200
120 READ X
130 PUT #1,X
140 GDTO 120
200 CLOSE #1
210 STDP
1000 DATA 255,255,0,64,41,64,169,0,141,14
1010 DATA 212,120,169,0,141,0,212,162,0,189
1020 DATA 124,29,157,0,128,232,208,247,238,15
1030 DATA 64,238,18,64,173,15,64,201,52,208
1040 DATA 232,169,64,141,14,212,88,96,226,2
1050 DATA 227,2,0,64,115,24,117,24,160,1
1060 DATA 96,247,23,249,23,76,117,32,70,23
1070 DATA 135,23,169,0,141,14,212,120,141,0
1080 DATA 212,169,29,141,99,23,141,106,23,169
1090 DATA 128,141,103,23,141,110,23,162,0,189
1100 DATA 124,29,168,189,0,128,157,124,29,152
1110 DATA 157,0,128,232,208,239,238,99,23,238
1120 DATA 103,23,238,106,23,238,110,23,173,99
1130 DATA 23,201,52,208,218,76,66,25,63,25
1140 DATA 74,25,76,70,23,169,64,141,14,212
1150 DATA 88,160,1,96,0
```

**Listing 3.**

Needless to say, this is a bit of a change from the old DOS. You know, waiting forever for the DOS menu to load up. The combination of saving time and preserving my work makes this program very useful for me.

SwapDOS is meant for the XL machines; if you have an older Atari, you can see what all the fuss is about by using the alternate SwapDOS listing (Listing 3). There are limitations on the older machines, however; I use memory from \$8000-\$9400 for the swap, so if you have a Basic (or other) program much longer than 24K, or use graphics modes other than 0, it won't fly.

### How it Works

On to the details of how this works.

The problem, you recall, was when you typed DOS, a large program had to be brought into memory (DUP.SYS) where it overlaid whatever was in memory locations hex \$17D7-\$3305.

Instead, let's do things a different way. When we load SwapDOS, it makes a copy of DUP.SYS in memory and places it up under the operating system in alternate RAM memory. This does not occupy any memory you are used to using (e.g., FRE(0)). This RAM memory is difficult to use because the operating system is used so much; the operating system program must stay available in memory except under special circumstances. For instance, no interrupts can be processed when the operating system is switched out, and the character set goes away (see Figure 4).

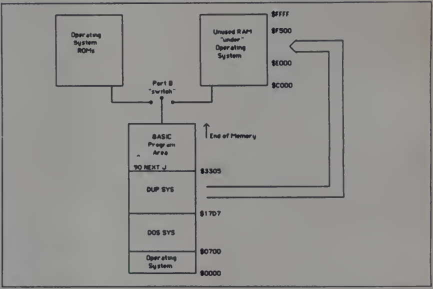



**Figure 4.**

Next, we make some selective patches to the DOS.SYS program in memory. First, we tell it that there is a MEM.SAV file active. Next, whenever it handles a DOS request, it interchanges the memory up under the operating system (\$E000-F500) with Utility Menu memory (\$17D7-\$3305). This does two things. First, whatever you were working on is saved up under the operating system. Second, the DOS utility menu is loaded nearly instantly, because the 6502 processor in the Atari is so fast.

When you exit DOS, the two are again interchanged, which brings your program back and saves the DOS menu where it can be re-used.

If you haven't done much with the Atari, this may not seem too useful. However, if you are an old hand at waiting for DOS, this program might just make your day.

Some modifications that might be a good idea:

- Load up the DUP.SYS file automatically when you power on (via AUTORUN.SYS)
- Disable the ability to create MEM.SAV and to write the DOS files.

Right now, if you write the DOS files and try to use them, after you have patched them, you won't be able to get to DOS (because nothing will have put the DOS menu up under the operating system). Perhaps a check if the files are already loaded would be in order. ■

# CREATIVE COMPUTING MART

# CREATIVE COMPUTING MARKETPLACE

**CLASSIFIED RATES:** Per Word, 15 Word Minimum. **REGULAR:** $3.50. **EXPAND-AD®:** $5.25. Ads set in all bold type at 20% premium. Ads set with background screen @ 25% premium. **GENERAL INFORMATION:** Prepayment discounts available. Payment must accompany order except credit card—Am. Ex., Diners, MC, VISA (include exp. date)— or accredited ad agency insertions. Copy subject to publisher's approval; must be typewritten or printed. First word set in caps. Advertisers using P.O. Boxes MUST supply permanent address and telephone number. Orders not acknowledged. They will appear in next available issue after receipt. Closing date: 5th of the 3rd month preceding cover date (e.g., April issue closes Jan. 5th). Send order & remittance to: Classified Advertising, **CREATIVE COMPUTING** Magazine, 1 Park Avenue, New York, N.Y. 10016. To charge your ad to a major credit card, call Lois Price at (212) 503-5115. For Customer Service, call (212) 503-4506.

### IBM AND COMPATIBLES

FREE DEMONSTRATION PROGRAMS. Send formatted diskette and return postage for eight programs. Cheapware, 4036 N. Ninth, St. Louis, MO 63147.

### INSTRUCTION

**F.C.C. COMMERCIAL RADIOTELEPHONE LICENSE. Electronics Home Study. Fast, Inexpensive! "Free" details. COMMAND, D-165, Box 2223, San Francisco, CA 94126.**

UNIVERSITY DEGREES! Economical home study for Bachelor's, Master's, Doctorate. Prestigious faculty counsels for independent study and life experience credits. Free Information-Richard Crews, M.D. (Harvard), President, Columbia Pacific University, 1415 Third St., Dept. 2D56, San Rafael, CA 94901; Toll Free: (800) 227-1617, Ext. 460; California: (800) 772-3545, Ext. 460.

### PLANS & KITS

MODULAR I/O PORT KITS ... Parallel 8-Bit Input and Output for Models I ($35), III/4 ($55), and CoCo ($50) (requires 5V supply). Send check or money order to: D&A RESEARCH, 400 Wilson Avenue, Satellite Beach, FL 32937, (305) 777-1728.

### TRS-80

Co-Co-Nut Software. Over 500 TRS-80 programs. Write/Call for price list. Site 9, Box 1, R.R. 2 Tofield, Alberta, Canada TOB 4J0. (403) 662-2415.

TYPE FAST! FasType TM, the fun and easy way to learn to type. TRS-80 III/4/4P, 39.95/disk; Network 4, 199.95 (plus 1.50 shipping). FasType TM, Box 364, Jerome AZ 86331, (602) 634-2668.

### TIMEX/SINCLAIR

TS2068 Floppy Disk Interface and CPM ... here at last. Aerco, Box 18093, Austin, TX 78760. (512) 451-5874.

SPEECH synthesizer. Timex: TS2068/1500/1000 specify. ML-program, multiple vocabularies, flexible memory requirements, very intelligible. Comes complete. Includes 273 words. Expandable. $16.95 p.p. TAD PAINTER, Box 166055, Irving, TX 75016.

### USERS GROUPS

ATTENTION PCjr OWNERS ... FREE CATALOG! Need to expand your system? Join the PCjr Group for best product selection and support. PCjr Group 1-(800) 233-2203, 4620 50th A-9, Dept. B, Lubbock, Texas 79414.

### RETAIL ROSTER/OHIO

NORTH COAST COMPUTERS. 650 Dover Center, Bay Village 44140, 216-835-4345. 100 N. Main, Chagrin Falls. Apple, Lisa, Vector Graphics, Hewlett-Packard. (216) 247-2202.

# CREATIVE COMPUTING DIRECTORY

### SOFTWARE/GENERAL

**RENT PUBLIC DOMAIN SOFTWARE**
It's not copyrighted, no fees to pay. Copy hundreds of useful business, utility and game programs from our rental libraries onto your own computer at home! CP/M user group library $45. IBM PC-SIG $230. KUG library $25. Send $5 PP for a catalog disk. SASE
NATIONAL PUBLIC DOMAIN LIBRARY
1533 Avohill
Vista, CA 92083
(619) 941-0925 3 minute recording tells all,
(619) 727-1015

### ACCESSORIES/ SUPPLIES

**PROGRAM PACKAGING, DISKS**
Complete program packaging line. D-Ring cloth binders, slipcases, floppy pages, game portfolios. Vinyl binders with clear pockets on covers. Blank disk envelopes. Low prices on BASF, KODAK disks. Many supplies for users, software developers. Call, write for prices. CATALOG. Fast friendly service, low prices.
ANTHROPOMORPHIC SYSTEMS, LTD.
376 E. St. Charles Rd.
Lombard, IL 60148
(312) 629-5160

### TAPE TO DISK CONVERSION

**CONVERSION SERVICES**
Convert any 9 track magnetic tape to or from over 200 formats including 3½", 5¼", 8" disk formats & word processors. Disk to disk conversions also avail. Call for more info.
PIVAR COMPUTING SERVICES, INC.,
47 W. Dundee Rd
Wheeling, IL 60090
(312) 459-6010

### BUSINESS OPPS.

**Personal Computer Owners CAN EARN $1,000 TO $5,000**
monthly selling simple services performed by their computer. Work at home-in spare time. Get free list of 100 best services to offer. Write
C.I.L.B.D.
P.O. Box 60369
San Diego, CA 92106-8369

# INDEX TO ADVERTISERS