Recreational COMPUTING

FOR THE IMAGINATIVE SMALL COMPUTER USER!

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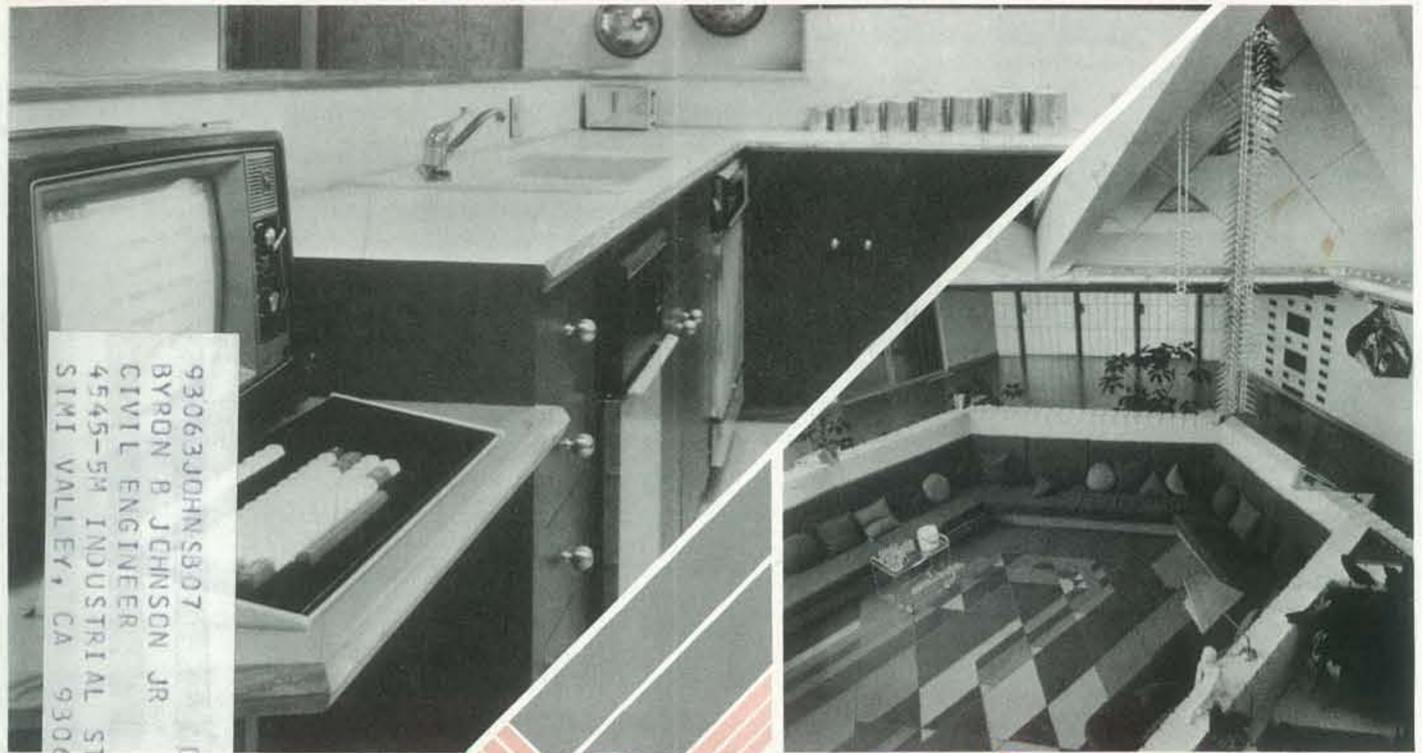
Computerized Voting

Hot Rod Computers and Model T Fords

The Story of Computer-Using Educators

Games !!!



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Editor's Notes

It's the end of the first year of a new decade. "Computer Hobbyist," "personal computers," and "home computers" are becoming more and more passé, or controversial, in terms of how users are defining themselves and their microcomputers. It's no longer a question of when will computers affect our lives, but rather how can we live without them now that they have eased our banking, teaching and business burdens? Through the 1980s, technology will continue to surge forward and, to be sure, Recreational Computing *magazine intends to grow right along with it.*

Many future articles will encompass real-world applications of microcomputers. How microcomputers are used in hospitals, amusement parks, classrooms and even in film are areas of personal interest to all of us because they actually touch our lives. The question is, how do they? Let Recreational Computing *show you.*

In the issues to come, you will begin to see more articles on microcomputers in education. The field is endless. Recreational Computing *will look towards this area and will become the kind of information center you need to stay current. I welcome articles, upcoming events items of interest and especially suggestions to make each issue better than the last.*

There are several things that I want to see happen in this magazine. They include:

1. An open guest column for those who wish to voice their opinions on microcomputers in education. This column would enable you to express yourself on such topics as: Will computers depersonalize the learning process? Will teachers be freer to teach rather than clerk? Will computers replace teachers? ETC. ETC.

2. Let's share programs. If you have a program that you developed for a specific problem, but it might be of some help to others, why not send it to us? High school students, people in business, teachers, professionals, technicians, entry-level computer users and others are all encouraged to submit their programs.

3. Finally, beginning with this issue, there will be an on-going column on ComputerTown, USA! Basically, ComputerTown, USA! is a blend of people and ideas that merged within a community to raise its computer literacy. But enough said. The ComputerTown, USA! column will speak more eloquently for itself.

As most magazine editors will tell you, this publication is really your publication. And this is true, as "old hat" as it may appear to you. What are you mainly reading in this magazine? Do you want more games? More feature articles? More reviews? One way for me to be more responsive to your needs is for you to send me a letter.

I am more than happy to receive letters from readers. I try very hard to respond on a timely basis, although it is not always possible. Your letter may be of particular interest to others, and those are the ones I print in the Letters to the Editor section. In this way, you may receive a much more diverse set of answers than if only one person were to answer you. In a not too distant issue, I also plan to include a reader survey to broaden my scope on who you are and what would be most beneficial to you.

At this time I also welcome software and book reviewers. It would be a herculean task for any one person to review the amount of literature that passes through this office. If you would like to be a reviewer for this magazine, please send me your résumé and area of special interest.

In essence, Recreational Computing *plans to be everything and more that you require in a computer-educating magazine. Your suggestions, contributions and continued readership will ensure these goals.* □

Publisher's Note

As this is the last issue of 1980, we at People's Computer Company want to thank all of our readers for your invaluable support throughout the year.

We'd like to express a special thanks to those Contributing, Retaining, Sustaining and Lifetime Subscribers who have done a little extra to support *Recreational Computing*. You'll see on the preceeding page that we've switched our Donating Subscriber categories to bring them in line with normal publishing protocol.

With warm holiday wishes,
Ann Merchberger

Letters

MICROCOMPUTERS IN EDUCATION

We at the University of South Alabama have recently moved into the area of using microcomputers in the educational process. It is our understanding that you are very active in this area. We are specifically interested in any innovative uses of the microcomputer in the educational process. In addition, we do not wish to re-invent the wheel and are, therefore, interested in any software packages that may be available.

We would like to thank you in advance for your cooperation and attention to this request.

Sincerely,
William F. Gilley, Ed.D.
Chairman
Department of Health, Physical Education and Leisure Services
University of South Alabama

COPYRIGHT INFRINGEMENT

Computer Using Educators (CUE), a nonprofit affiliate of the International Council of Computer Educators, is a group dedicated to helping computer teachers keep in touch with each other and with new developments in the field. We have recently established a means of exchanging educational software among educators and have a question for you about the copyright of materials published in journals.

We are storing contributed programs for the PET, TRS-80 and Apple (Applesoft) on Nestar Cluster/One 8" disks, Integer BASIC Apple programs on a Corvus Winchester disk, and others on their respective media. At our own meetings and at teacher conferences teachers can choose the programs they want and take them away on cassettes or disks. Programs are not available except at these meetings. The service is free, although we add a markup on the media we sell. The Nestar and Corvus systems and necessary computers are loaned by manufacturers or dealers.

We wish to avoid copyright infringement, but as you know, there are large grey areas here. One particular question we have is this: If a program is copied out of a magazine and either (1) not changed, (2) modified to run on another version of BASIC, or (3) changed/improved extensively, can we pass the program on to other educators for classroom use if it has been donated by the secondary source?

Feel free to publish this letter if you think other readers would be interested. Any other comments you have would be appreciated.

William J. Wagner, Ph.D.
Mountain View High School
Mountain View CA 94041

MICROS IN SOUTH AFRICA

Please place us on your mailing list for any news, products, books etc. available.

We also ask that any organizations or firms place us on their mailing lists for products and news or simply to send us floppy's or listings on any software. In our country, micros, CP/M and similiar terms are still relatively new. Help and information, therefore, will be of tremendous value on the educational level as well as to prove that micros indeed can do a lot.

We are also interested in hearing from firms requiring overseas distributors for their products or seeking export marketing support.

In this young and developing country with the richest minerals in the world, there are numerous high-return, low-risk investment opportunities. I, therefore, wish to invite principals to contact me concerning this vast area that has been opening up during the last few years.

Victor Swart
General Manager
Nektar Computer Services
P.O. Box 29146
Sunnyside
0132 Pretoria
Republic of South Africa

"DISCOVERING" PERSONAL COMPUTERS

During the last few months I have "discovered" personal computers, particularly the TRS-80.

I have just started reading "TRS-80 BASIC" by Bob Albrecht, Don Inman and Ramon Zamora, published by John Wiley & Sons, Inc.

My goal is to use a personal computer in my law office for billing clients and other paperwork tasks. I have been using an IBM Office System 6/442 for more than a year for word processing, including administrative files.

Do you think I should first learn how to use a TRS-80 Model I with Level II BASIC before stepping up to a TRS-80 Model II with Level III BASIC? Your recommendation on this perplexing personal problem will be very helpful in my getting started in learning how to use a personal computer.

Thank you for your work in removing some of the mystery of personal computers and writing books that can be understood by a non-engineer.

Kenneth H. Elson
Attorney at Law
104 North Locust Street
P.O. Box 1353
Grand Island, NE 68801

THE ELDERLY AND PERSONAL COMPUTERS

A whole new market is about to become acquainted with personal computers: the elderly. A recent scientific paper (Danowski and Sacks, "Computer Communication and the Elderly," *Experimental Aging Research*, 6(2): 125-135, 1980) reported on an experiment at an old folds home (a well-run urban retirement hotel, middle income, with an extensive program of daily activities for the residents) in which 30 to 40 elderly persons were given instructions in the use of a computer terminal (with an extra large screen and 9/16" characters to accommodate the poorer eyesight typical of this population). The participants had a choice of computer games like DOCTOR, BLACKJACK, HANGMAN, STOCK, SCIFI (this is the order of popularity) and communications with individuals using computer terminals in other parts of the city. These communications were most popular, though the games were a big hit, too. The most interesting part came as a result of a questionnaire of six questions showing attitude change towards computers as a result of their own experiences.

Computers seem like an ideal type of activity for the elderly. They require little physical activity yet interactive programs are absorbing in a way that television cannot be. Elderly have a lot of time on their hands with which they could work on computer activities. There is a real opportunity for moneymaking (including "off-the-tax-books" income) among the elderly, too, since the ability to understand the problems of a particular business are even more important than knowing how to program. Many elderly have gained considerable expertise and understanding of businesses in which they engaged. And, finally, the computer seems to offer the elderly a type of companion that helps fill the gap of social relations often missing for them. Although not many elderly have had the opportunity to become acquainted with computers yet, their coming together in the near future seems inevitable.

Live Long and Prosper,
Sandy Shaw
Research Scientist and Author
Spectrum Technology Services
P.O. Box 942
Palos Verdes Estates, CA 90274

ATTITUDES TOWARD COMPUTERS: DIFFERENCES IN PRE- AND POST-TREATMENT DATA

	Pre n=30	Post n=13	Significance (Chi square)
Do you have confidence in computers?	63%	76%	ns
Do you think using the computer would make you feel more confident in yourself?	43%	62%	$p<0.01$
Do you think using the computer would make you feel less alone?	37%	62%	$p<0.001$
Do you feel frustrated with computers?	37%	30%	ns
Would you like to play with a computer?	63%	85%	$p<0.01$
Do you think computers can help senior citizens?	70%	85%	$p<0.10$

Note: percentages indicate proportion of "yes" responses

CHECK REGISTER PROGRAM

Enclosed is a copy of a short program used to keep a check register for a home or small business. Written in Microsoft BASIC, it is intended to run on a Heath H8 computer with at least one disk drive, and using the Heath H19 terminal. A printer is not required, but with minor modifications could be used. Similarly, with minor modifications to the screen formatting routines, almost any BASIC-speaking computer could be used.

While programs such as these are fairly common in the literature, we feel that they serve a useful and important function. Most computer users admittedly don't use such programs to keep track of their checkbooks, but they do use them for learning the in's and out's of programming, especially those who are just entering the hobby, or who are exploring the possibilities of small computers in small businesses. It is for these users that we write programs like this, and we feel that magazines such as *RC* should make a real effort to print at least one such "entry level" program each issue. Something that is simple, that has a real-world application (possibly to serve as an "icebreaker" with less-than-enthusiastic family members), and that works, can be vital at an early stage of a user's development.

This is the spirit behind the program we submit.

Kathleen & Dudley Shoemaker
2000 A Foxridge
Blacksburg, VA 24060

* * *

LISTING

```
10 REM A transaction recording program for the Heath H8 computer with disk
20 REM and H19 terminal.  Written by Kathleen & Dudley Shoemaker
30 PRINTCHR$(27);"E":REM Erase the crt screen for the H19 terminal.
40 PRINT"        This program keeps track of checking account transactions."
50 PRINT"In this version, entries are made in data statements located at the"
60 PRINT"end of the program.  Any number of transactions may be processed."
70 PRINT"and the results may be printed to a disk file or a printer with"
80 PRINT"minor modifications to the program.":PRINT
90 F$="$$###,###.##"
100 PRINT"Check";TAB(50);"Amount";TAB(60);"Account"
110 PRINT"Number";TAB(10);"Description";TAB(50);"(Dollars)";TAB(60);"Number";
120 PRINTTAB(70);"Date":PRINT
130 LET G=0
140 LET H=0
150 LETI=0
160 LETJ=0
170 LETK=0
180 LETL=0
190 READ A,B$,C,D,E$
200 IF C=0THEN290
210 PRINT A;TAB(10);B$;TAB(45);:PRINTUSING F$;C;:PRINTTAB(60);D;TAB(70);E$
220 G=G+C
230 IFD=1THENH=H+C
240 IFD=2THENI=I+C
250 IFD=3THENJ=J+C
260 IFD=4THENK=K+C
270 IFD=5THENL=L+C
280 GOTO190
290 PRINT:PRINT:LINEINPUT"   (Press RETURN) to obtain cumulative totals.)";Z$
300 PRINTCHR$(27);"E";"       Cumulative Totals:":PRINT
310 PRINTTAB(6);"Fixed";TAB(21);"Variable";TAB(36);"Food";TAB(51);"Miscellaneous
"
320 PRINTTAB(6);"Account #1";TAB(21);"Account #2";TAB(36);"Account #3";TAB(51);
330 PRINT"Account #4"
340 PRINT
350 PRINTUSING F$;H;
360 PRINTTAB(15);
370 PRINTUSING F$;I;
380 PRINTTAB(30);
390 PRINTUSING F$;J;
400 PRINTTAB(45);
410 PRINTUSING F$;K
420 PRINT:PRINT:END
430 REM 1=Fixed payments (house, car, major credit purchase)
440 REM 2=Variable payments (gas, phone, utilities)
450 REM 3=Food
460 REM 4=Miscellaneous
470 REM 5=Cash (To record a deposit, enter as -C)
480 REM To record an automatic bank teller machine transaction
490 REM      JUST ENTER THE AMOUNT
500  REM   FOR EXAMPLE  0,DEPOSIT DC'S CK,12.00,5
510 REM    FOR EXAMPLE  0,CASH MACHINE,25.00,5
520 DATA0,FIRST DEPOSIT,-100.00,5,10JULY79
530 DATA0,CHECK CHARGE,4.12,4,*
540 DATA0,HEATHKIT,85.00,1,*
550 DATA0,DEPOSIT,-45.87,5,17JULY79
560 DATA102,PENNEY'S,16.55,4,19JULY79
570 DATA103,A & P,8.90,3,*
580 DATA104,FLOWERS,11.90,4,20JULY79
590 DATA0,DEPOSIT,-529.60,5,*
600 DATA105,CASH,25.39,5,*
610 DATA106,KROGERS,28.60,3,*
620 DATA107,HOBBY SHOP,10.95,4,*
630 DATA108,WALDEN DEPOSIT,9.57,4,21JULY79
640 DATA109,BERKELEY MED DATA,8,4,*
650 DATA110,KROGERS,35.09,3,22JULY
660 DATA111,UNIVERSITY MOTORS,24.95,4,23JULY
670 DATA112,PIPSISSEWA,5.51,3,*
680 DATA113,KROGERS,31.86,3,*
690 DATA114,WOOLCO,4.3,4,24JULY
700 DATA115,WOOLCO,81.05,4,*
710 DATA0,DEPOSIT,-1.93,0,0
720 DATA116,FROG HOLLOW,3.71,3,*
730 DATA118,MAINSTREET BAZAAR,28.08,4,24JULY
740 DATA0,0,0,0,0
```

END

COMPUTERIZED BULLETIN-BOARD LISTING

First, thanks for your continuing series of programming problems. Since I am still in the process of putting together a personal system based on Marinchip's M9900 CPU board, I haven't tried any yet. Some of them should be very good for learning about and testing the system, besides being just plain fun.

Thanks also for the computerized bulletin-board listing. For many areas, including mine, there are no numbers within the same area code. It would have been a great aid to have done some sorting by geographical area, even if only by general section of the country. Lastly, in the highly unlikely event that no one else has pointed it out, area code 451 is nonexistent.

Sincerely,

Glenn Puro
12 California Ave, Apt. B404
Albany, NY 12205

WHAT IS A PERSONAL COMPUTER?

As a relatively new member of ACM, (Association of Computing Machines), I received my first issue of SIGPC Notes with great expectations. I was surprised by your description of a lack of participation by members. However, this letter is mainly addressed to your call for a definition of a personal computer.

The answer seems to me to be simply "any computer used for personal computing," which is the real focus of this SIG. This, of course, begs the question, which might well be answered in the SIG charter with which I am not familiar. Let me just suggest for the meantime that personal computing is that which is a service aimed at the person doing the computing.

The emphasis of your question was on hardware, which is an approach that can lead personal computing down the same roads non-personal computing travelled. With hardware costs nose-diving and major software problems still unsolved, I think we should concentrate more on logical than physical problems. Rather than backing into BASIC as commercial D.P. has locked itself into COBOL, can't we, as a new and, therefore, more flexible area, demand a better deal? Let's support braoder solutions like a PASCAL micro-engine or implementations of APL or ideas of even greater scope. Let hardware take a back seat for once.

You suggest that a personal computer should run by itself, but to do what? In the very short term (with emphasis on games, etc.) and the very long term (with huge, low-cost storage), perhaps, but the demand for communication and mass storage will prevent mid-term personal computing from being isolated. Its *real* use will be in its connection to networks and large data-base systems. A terminal might well do, especially if communications costs drop significantly. I have visions of the future in which the American family of four not only needs personal computing to keep out of the red but pays through the nose for the information to do so.

About the proposed merger, please, no. It would seem that the foci of the two groups are in opposite directions. SIGSMALL relates to machines beyond the budgets of individuals (i.e., business machines), the concerns being far more practical and economical. An individual who shells out a thousand or so dollars for a personal computer is probably less practical than incurably curious. It is small businesses that will cause systems to proliferate that are locked into one manufacturer, as an economy move. Experimentation is thus stifled. The emphasis for small business would be stand-alone, perhaps dedicated to machines rather than interfacing and networking. This brings me to a final note of two suggestions: a SIGPC network and local forums for information exchange, maybe shared equipment use.

Dana Barish
200 West 82nd Street
New York, NY 10024

Wescon/80

Many people predict that the electronics industry may become the largest industry in the United States. The over 45,000 attendees who descended on the Wescon/80 show held in September in Anaheim, California, along with the approximately 1,200 exhibit booths and 150 presentations, certainly reflect that prediction.

MARKETING CONFERENCE

- Speaking at the one-day Marketing Conference, Jerry Wasserman of Arthur D. Little, Inc., spoke of the U.S.'s enormous growth in electronics sales. In 1979 sales hit $80 billion and resulted in 3-1/2 percent of the gross national product.

  Along with our growth, Wasserman mentioned our foreign competitors. He said that Japan is not our only challenger, but that Europe should be noted as well. He pointed to Siemens in West Germany, Philips in Holland and View Data in England as prime examples. Even countries before not thought of as competitors, such as France, are now emerging.

  Wasserman said that for the U.S. to compete better in the marketplace we must develop a better market focus, acquire government cooperation, place an emphasis on quality, support our products and pay attention to the short product life times built into these kinds of products. He said the government could help by subsidizing research and development, revising anti-trust laws, increasing export financing, instituting investment credits, decreasing foreign taxes and establishing trading companies.

- A panel composed of the press and men in industry discussed components and systems manufacturers, focussing on standards. Whether for software packages or for hardware, the standards would approach the problem of shortages of hardware and software engineers and small market volumes in particular areas so that the industry could produce products and sell them at a reasonable price.

  The panel also seemed to feel that the Japanese are actually better at selling themselves as high quality producers rather than actually selling the best quality item.

- The main thrust of the conference seemed to suggest that the U.S. electronic industry will continue to grow for the next few years, but that to remain a strong, viable contender we should pay close attention to quality control, the lack of hardware and software engineers and the ever-expanding market.

EXHIBITS

- On the exhibit floor, one area of new products and applications was that of industrial robotics. Robots will be used to increase plant efficiency by performing repetitious hazardous tasks. Booth displayed component parts to design intelligent robots equipped with camera-eyes and sensors to perform the most delicate chores.

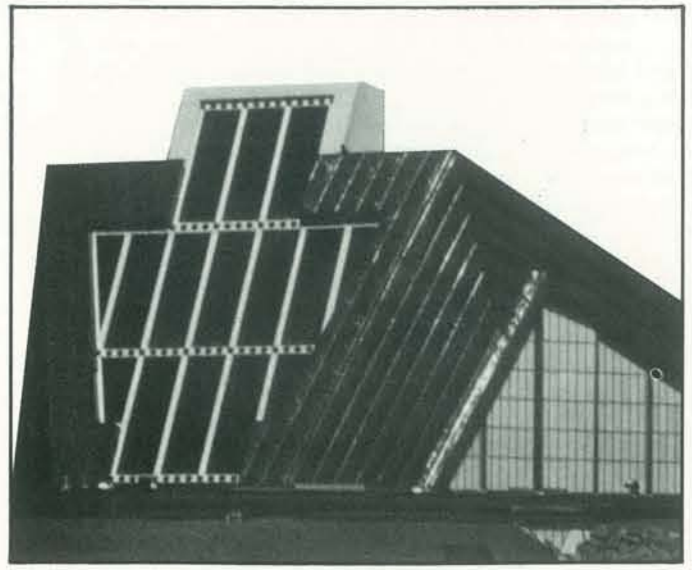
- A special exhibit on personal computers featured the following firms: Atari, CADO Systems, Columbia Data Products, Commodore, Cromemco, E & L Instruments, Exidy, Findex, Fujitsu, GMR, Heath/Zenith, Hewlett-Packard, Ohio Scientific, Personal Micro Computers, Radio Shack, Rockwell International, Smoke Signal Broadcasting, Vector Graphic and Wave Mate.

  This special exhibit was shown because personal computers are becoming a way of life. Engineers are using them in design and laboratory work, businessmen are using them to keep track of their bookkeeping and educators are using them to teach. The aforementioned companies showed the state-of-the-art in a wide range of hardware and applicable software. To be sure, interest was keen as the area was extremely crowded. □

"I just asked it for a list of career possibilities in my field."

HOUSE OF THE FUTURE

AT AHWATUKEE



BY MOTOROLA, INC., SEMICONDUCTOR GROUP

Editor's Note: The Motorola Semiconductor Group was extremely helpful in generating the material for this article. Special thanks to Patrick O'Malley, Systems Engineer, for his project write up.

To the Crow Indians, the word "Ahwatukee" means "shining house of dreams." To many of the people of Arizona, it is a 2,000-acre housing development south of Phoenix. But more specifically, it refers to one particular house in the Ahwatukee development, The House of the Future.

Two years ago, Presley of Arizona, the organization developing Ahwatukee, went to the Frank Lloyd Wright Foundation in search of an idea that would draw large numbers of visitors to Ahwatukee. There Bruce Gillam, President of Presley of Arizona, met Architect Charles Robert Schiffner who saw the opportunity to use the leading edge of sociology, ecology and technology to show the public an alternative to the homes they were used to. Although the home is closely matched to its Arizona environment, many of the concepts displayed in Ahwatukee are applicable everywhere.

"The Ahwatukee project is an exciting demonstration of the many advantages that microcomputer technology will provide for all homeowners in the near future," said Charles E. Thompson, Motorola Inc. Vice President and Director of World Marketing. "Since we were closely involved in the project from its inception, and the electronics requirements were given major consideration when design and construction decisions were made, we believe the Ahwatukee home to be the most electronically sophisticated dwelling ever built."

The design of Ahwatukee is inspired by the desert and mountains where it is located. The solar collectors that heat the home and pool as well as supply hot water were built by Grumman Energy Systems, Inc. Schiffner made them a part of the house, rather than an addition. The sun is also used to light the home through several special skylights supplied by Kalwall Corporation. Windows are kept to a minimum for privacy and to conserve energy.

Because of Arizona's summer temperatures, Ahwatukee consists of large masonry masses designed to absorb and release heat slowly during the wide temperature changes of a day. Earth is used to further insulate the home. Earth berms are piled against the outside walls, and some of the floors in the home are three feet below ground level.

CONSTRUCTION

Extensive and accurate layout was mandatory to accommodate this most unusual structure. The total project is based on a prism concept comprised of standard parallelogram units. The units form a grid system that is repeated through the entire project, including foundation walls, roof systems, floors, lighting system, patio areas, walks and pool.

Bob Glenn, Superintendent for W. M. Grace Construction, Inc., who was the general contractor, states that 660 lineal feet of footing formed in place, were required to support the house proper. The stem walls are five feet high and eight inches thick, bringing the structure up to the floor level. In addition, 300 cubic yards of slurried aggregate base was used for back fill inside the house. This material provided 100% compaction to support finished floors. The exterior and garden walls are cast in place concrete and, in most instances, act as retaining walls for the earth berm. Approximately 60,000 board feet of lumber was used in forming the roof structure, which was composed of 260 cubic yards of poured in place light-weight concrete and 74 tons of reinforcing steel.

The patio and garden walls were all cast in place as well as all of the decorative coping, both interior and exterior. A pre-cast decorative fireplace fascia, custom designed by the architect, was pre-cast and set in place within the masonry fireplace.

The most challenging aspect of the entire structure was the roof system. The vaulted roof over the enclosed atrium is built on a 28° slope. The loft area roof is constructed at a 60° slope. To accomplish this, a specially engineered concrete form support system composed of trusses, scaffolding, structural steel and wood beams was required. The support system was necessary to carry the actual form work, concrete reinforcing and live loads generated during the roof construction.

W. M. Grace Construction, 1900 North Belt Highway, St. Joseph, Missouri 64502, supervised interfaces with all of the trades necessary to complete all structural and decorative concrete work. □

SOLAR ENERGY

Solar energy is used in the House of the Future for heating hot water, the building and the plunge pool. In the main roof, facing directly south at a 60° slope, are 11 Grumman Energy Systems, Inc. Sunstream™ solar collectors having a total area of approximately 200 sq. ft. They provide an estimated 70 percent of the heating and 90 percent of the domestic hot water needs. Energy from the solar collectors is transferred to a 500 gallon main tank by a sealed water loop. From there it is circulated to air duct coils, on demand, for heating the house and to a tank heat exchanger for domestic hot water. During prolonged periods of inclement weather, solar energy is supplemented by heat pumps for heating the house and an electric heater for domestic hot water.

Heating of the plunge pool is provided by 10 identical solar collectors located on the south facing berm adjacent to the pool. These will heat the pool to a comfortable temperature from February through November; thus the swimming season is extended approximately four months without the need for conventional energy.

Both systems use the drain-down approach, that is, whenever the solar collector loop pumps are not operating, water drains back to the main tank or the plunge pool, so the solar collectors will not freeze during very cold nights.

The system is controlled by logic contained in the Motorola central computer by measuring the temperature of the solar collectors, tanks and the heated space. Depending on set point temperatures selected, which can be changed via the computer keyboard, the operation of the solar system's circulating pumps and the conventional energy heat sources are controlled.

This system was especially designed for the House of the Future by Grumman Energy Systems, Inc., 2350 West Northern Avenue, Phoenix, AZ 85021. □

BUILDING MATERIAL

Kalwall Corporation's highly efficient building material was designed to transmit unusually high quality natural daylight, insulate, and control solar heat energy. Kalwall® can be manufactured to vary these three characteristics to suit each project and is used widely in energy conserving and solar heating structures.

The Kalwall® selected for this remarkable project has these characteristics:

Skyroofs and Skylights	
Thickness:	2-3/4"
"U" Value:	.24 BTU/hr.-sq. ft.-deg. F
Light Transmission:	20%
Shading Coefficient:	.27
Solar Transmission:	30%
Glazing Panels	
Thickness:	1-9/16"
"U" Value:	.36 BTU/hr.-sq. ft.-deg.F
Light Transmission:	20%
Shading Coefficient:	.27
Solar Transmission:	30%

Kalwall Corporation is located at 1111 Candia Road, Manchester, New Hampshire 03105. □

Look at the layout of the house in Figure 1. The large central atrium is used to save energy by eliminating hallways. The three bedrooms, sitting room and kitchen are arranged off of the atrium while the conversation pit is located in the middle of it. The atrium also allows lush plants to be brought indoors while the outside is left in its natural desert state.

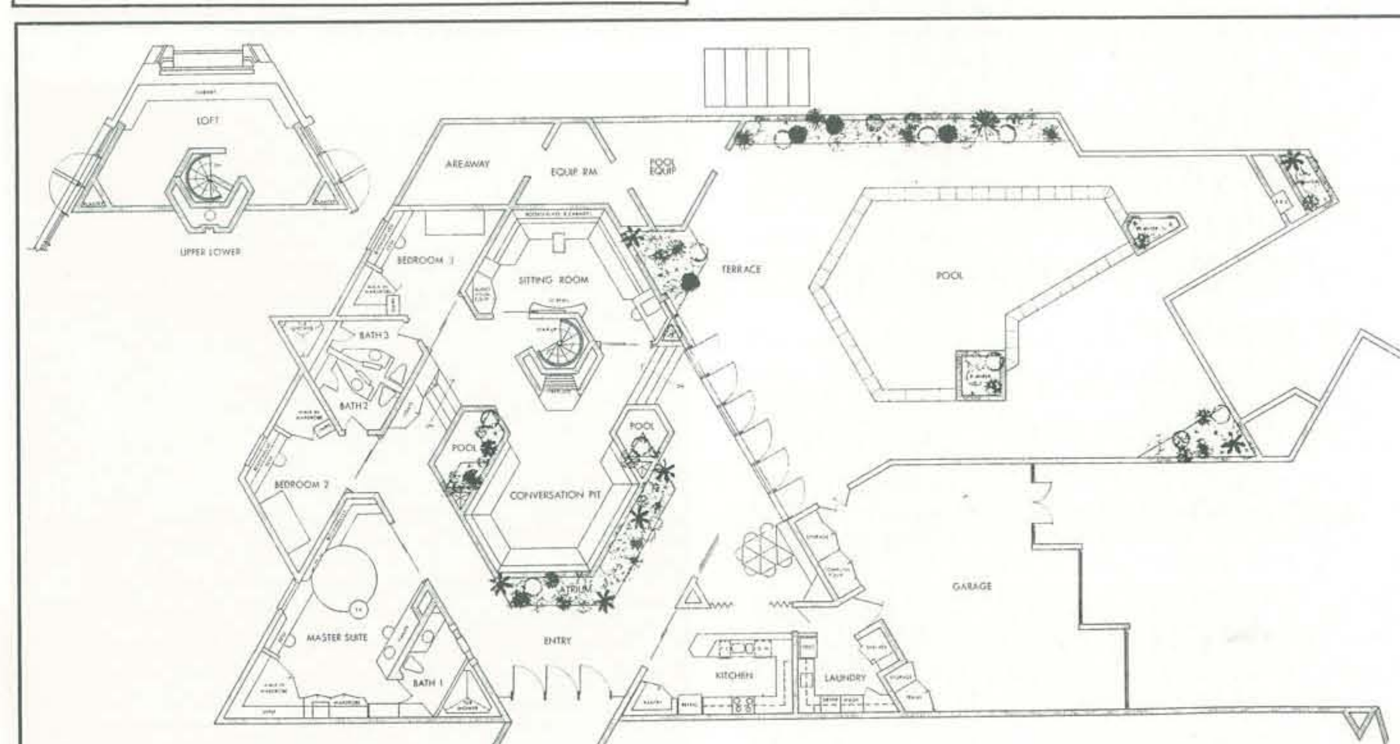


Figure 1. Floor Plan of Ahwatukee.

Sociologically, Ahwatukee provides more privacy from the outside world while promoting family togetherness. The various rooms of the house are separated from the atrium by drapes and glass doors. The intent is to provide a large family room with alcoves in place of isolated rooms of today's homes. The electronic technology being utilized in the house has sociological implications, too. Ahwatukee is able to actively respond to a wide variety of the occupant's needs. It also shows another way the computer is about to become a part of everyone's lives. Figure 2a is a photograph of the kitchen and Figure 2b shows the living room. Notice the terminal in the kitchen.


Figure 2a. A View of the Kitchen.

Ahwatukee is actively responsive to human needs because of its sophisticated microcomputer control system. The system was supplied by Motorola's Consumer Strategic Marketing group, headed by Stan Katz. The result is a very consumer-oriented system. Many of the system's operations are "transparent," meaning there is no way to tell that a computer is involved. A big plus is that the occupant won't have to become a programmer. The system is designed for use by people with no previous experience with computers.

Five major functions are performed by the control system:

1. Environmental Control
2. Security
3. Electrical Load Switching
4. Energy Management
5. Information Storage and Retrieval.

Ahwatukee contains a wider variety of environmental systems than is found in conventional homes. The computers are able to open doors and windows for passive heating or cooling. There are three different ways to actively heat the house—solar, heat pump, and resistive electrical heating. There are also three ways to actively cool it. The first is the evaporative cooler, which has been popular in the southwestern United States for years. The second is by circulating chilled water through a heat exchanger in the home's air ducts. The water is chilled by refrigeration at night when the home's electrical demands are low, and then stored for use during the heat of the day. The third means of cooling the house is by heat pump.

AIR CONDITIONING

The Ahwatukee house is cooled by an experimental air conditioning unit that Salt River Project (SRP) hopes will cut future electric costs. SRP is examining whether ice storage air conditioning will make it possible to shift electric demand from the daytime hours, when electricity is most expensive to produce, to the night, when it is cheapest.

The ice storage unit uses most of its electricity at night to make ice, which is stored in an insulated tank. Water circulating through the ice cools the home during the day. The ice is made by a compressor just like the one in a typical air conditioner, explained Lee Athmer, SRP's manager of customer energy management.

However, the compressor in the ice storage unit, which is monitored by a Motorola computer, runs only at night. Compressors in conventional systems run the most during the hot summer afternoons, and compressors are among the largest energy users in a home.

In the ice storage unit, daytime cooling is provided by a water pump that demands only 1/30th as much electricity as the compressor. The pump circulates the cold water from the storage tank through a coil in the house. The air from the house blows over the coil and is cooled.

The ice storage unit at Ahwatukee is made by Girton Manufacturing Co. of Millville, PA. SRP is testing four other ice storage units, including two made by Girton and two made by the Carrier Corp. Tests during previous

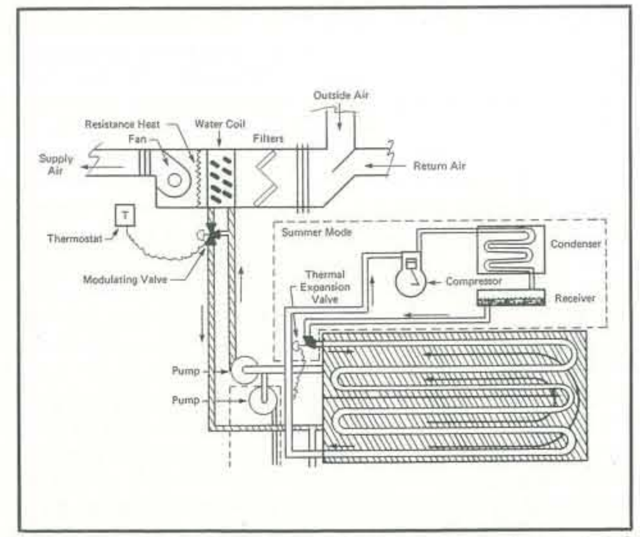


Diagram of the Salt River Project's Experimental Air Conditioning Unit.

summers have shown the units can shift both residential and commercial electric demand, Athmer said, and therefore may offer the consumer both direct and indirect savings.

SRP is trying to determine through its testing whether any additional costs, besides reducing fuel and construction costs, involved in using ice storage air conditioning could be recovered through the use of lower cost, or off-peak, energy. □

The Ahwatukee house is divided into three different environmental zones. Different temperatures can be maintained depending upon the time of day or day of the week. One of the system's primary responsibilities is to always pick the environmental system that can accomplish the task at hand while using the least amount of electrical power.

Figure 2b. The Conversation Pit.

Most of the system's security functions are carried out by sensing the state of smoke and motion detectors located in almost every room of Ahwatukee. If an alarm condition is found, the system can notify the occupants. In the case of a fire alarm, the microcomputers would also turn on the lights

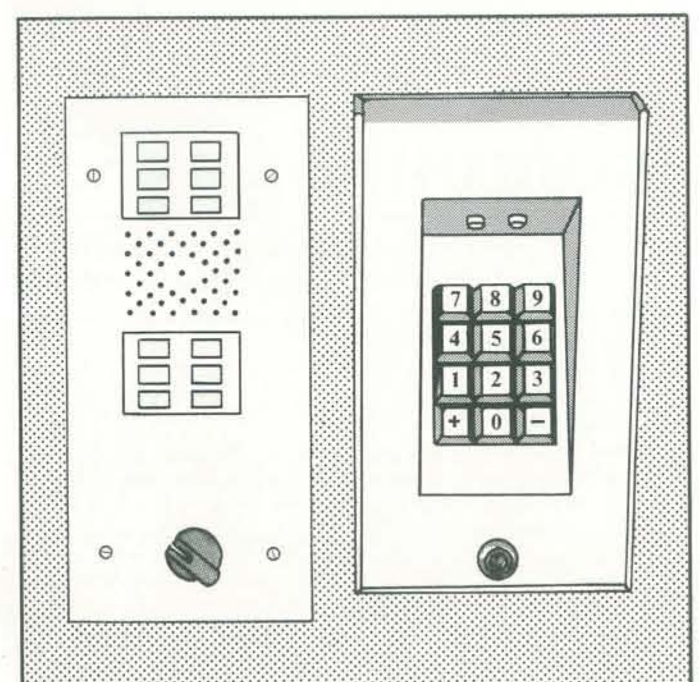


Figure 3. Intercom and Keypad.

and open the doors. One other aspect of the security function becomes obvious when you enter the house. There are no door keys. Instead of a keyhole, there is a calculator-style keypad near each door. When the proper codeword is entered, the microcomputers will open the door and will welcome the visitor in its own voice. Codewords can be given limitations, such as only good on Tuesdays, if desired. See Figure 3, which is a photograph of the keypad. Closed circuit television also plays a part in Ahwatukee's security system. Two cameras are used —one at the front door and the other at the swimming pool. The pictures from these cameras are displayed on unused channels of standard television receivers.

Electrical load switching allows control of lights and wall outlets by the control system. All of the lights and half of all the duplex wall outlets are under control. The most common way to turn on a light is still the wall switch, but even there the microcomputers are involved. Switches serve as computer inputs, but do not switch loads directly. Lights can also be controlled by the time of day or the presence of people. Time of day switching is based on the microcomputer's real-time clock. The motion detectors, normally associated with security, allow lights to be turned on when people are present or off when no one is around. There will be several lights at Ahwatukee that will not have associated wall switches. They will always be controlled by the computer on a time-of-day or other basis.

Any of the means for controlling lights can also be applied to controlling wall outlets. This will allow the computer to control anything from a coffee pot to the stereo.

Conservation of energy is becoming more and more important. One of the microcomputer system's functions will be to conserve electrical power. The computer's efficient control of the electrical devices in the Ahwatukee, especially the environmental systems, performs part of this function. The control system also constantly monitors the Ahwatukee's electric power consumption. Power consumption can be summarized and presented to the homeowner so he can gain insight into how he is using his electric power.

Power consumption is only one type of information available to the homeowner. Information is entered into the system by using a full ASCII keyboard. It is displayed on an unused channel of a standard television receiver. The homeowner can create files of information on any subject for his own use. This information can be in the form of text or graphics (pictures). The system will also serve as a calendar of events. Appointments, birthdays and other items are entered into the system and cataloged by date. When the homeowner requests today's calendar of events, all of the day's events are displayed.

The microcomputer control system is an MC6800 microprocessor-based network. It consists of five microcomputers, referred to as "nodes," located in different parts of the house. The nodes are tied together by an RS-422 communication link. Different nodes do not necessarily perform different functions. Different nodes tend to take care of different sections of the house, but the primary basis for the network configuration is to minimize the effects of a hardware failure.

The hardware used at Ahwatukee is almost all "off the shelf" items made by Motorola's Microsystems Division. These micromodules are used with little or no modifications. The resulting system could not be installed in an already existing house. However, the architects and contractors at Ahwatukee have installed a great deal of special wiring to make the "off the shelf" approach feasible.

Analog values, such as temperature and humidity, are determined by a 32-channel A/D converter. The majority of the inputs at Ahwatukee are digital. Inputs such as wall switches and motion detectors are sensed by looking for contact closure. Contact closure inputs are connected to the microcomputer through opto-isolators.

Outputs are all contact closures. DIP reed relays are located in the microcomputers. Because most of the loads to be switched are 120 Vac loads, the majority of the DIP relays drive commercially available power relays.

Internodal communications are performed by an intelligent communications board. The intelligence is supplied by an onboard MC6800 referred to as the "link" processor. The microcomputer's own processor, called the "host," communicates with the link processor through 2K bytes of shared memory. Both processors are always in operation, but are out of phase with each other. This avoids contention in memory. Communications are carried out by using a modified version of SDLC protocol. This new protocol was developed by Motorola for use with the MC6800. The communication device used is the MC6845 Advanced Data Link Controller.

Display of information is done on standard television receivers. The information may be either text or graphics, and is presented on an unused channel. The key component in the display process is the MC6847 video display generator (VDG). This device was developed for use in video games. It allows the use of eight colors, several graphics modes, and has its own character generator for ASCII text. The different graphics modes allow trade-offs between resolution and memory requirements. The VDG operates out of phase with the "host" processor so that shared memory can always be accessed by either device.

Software development was carried out using MPL. MPL is an MC6800 oriented high-level language similar to PL1 or PASCAL. Different programs, called "processes," concern themselves with different functions. Examples of functions would be security, load switching and display. Processes may reside in more than one node. If a process does reside in more than one node, it would have a different name in each node. A multi-tasking executive resides in each node and orchestrates the resident processes. Inter-process communications are handled by the executive. If the communication is also internodal, an extension of the executive, called PTP, comes into play. Because of the executive, the different processes do not have to remember where other processes reside. A one-byte destination identifier will allow the executive to move data to its correct destination. A good analogy is the telephone system, where all you need to know is a telephone number to speak to someone else.

The disk process serves the other processes. It is only concerned with storing and retrieving files stored on floppy disk. In addition to the homeowner's own information files, many processes store their working tables on floppy disk for nonvolatile storage. At power up these files are requested by the appropriate processes.

The switch manager process keeps track of all the switches resident in its node. A switch resides in a node if its input interface board is in that node. The switch manager keeps a table on each of its switches. When a switch changes state, the switch manager informs all processes that must take action because of the state change. It determines which processes these are from the information in its tables.

The load manager is responsible for switching all electrical loads resident in the node. The load manager keeps a table on each load. Much of the information is for other processes. It includes things like the load's power consumption, whether or not it is being controlled on a time-of-day basis and whether security has temporarily assumed control of the load.

The display process is the interface between human operators and all other processes. It is used to program other processes, such as associating a load with a switch in a switch manager. It can be used to monitor the operation of the system or to store or retrieve information from floppy disk. The display process is the most critical piece of human engineering in the control system. Because the system is designed to be used by operators with no previous contact with computers, the operator's next action must always be obvious. The majority of operator input will be multiple choice. The first screen displayed presents five broad actions that can be performed. Once one of them is selected, another screen is displayed, offering more specific choices. This continues until the exact action to be performed is determined. At this point data may have to be entered.

The philosophy behind the system is that it is a home appliance. In keeping with the nature of computers, it is a general purpose home appliance. It will make life in the home simpler and more comfortable. It also adds new capabilities to the home. The Ahwatukee will be more responsive to the needs of its occupant than any other building ever built. However, the system must always remain subservient to the homeowner. The homeowner makes all decisions about what will be done. The control system merely executes the homeowner's decisions automatically.

"It's very important to note that the Ahwatukee home is not a computer-controlled home," Thompson said. "Rather, the home permits the tenant to be in complete control of his environment, thanks to the assistance of microcomputer technology. The homeowner will continue to make the important decisions, which will then be carried out by the microcomputer system."

In the future, home computers will shrink drastically in physical size without losing any of their capabilities. For that to happen, certain portions of the system must change radically. The I/O portion of the system will be the first to change. I/O interface boards occupy a large volume in the microcomputers. A new I/O system, such as carrier current, would eliminate most of the I/O logic from the control system. It would also eliminate the extra wiring that was needed at Ahwatukee. This would make it possible to install a control system in an existing home with no wiring changes. Special switches and outlets located throughout the house would communicate with the controller over the house's power wiring. Such a system might also have interrupt capability, which would eliminate some of the software polling routines presently in use.

Future systems will also make more extensive use of the telephone. Right now the phone is used to send data to a dumb terminal located outside the house or, if an intelligent terminal is available, to request certain actions or receive status reports. In the future the intelligent terminal may not be required. The same functions could be performed using only the telephone.

The Ahwatukee control system contains 1300 ICs and 750 discrete devices. Within a few years it will be possible to build a system with the same capabilities using less than 200 semiconductor devices. Even sooner, we may find certain isolated functions, such as security or environmental, available for \$100-\$200. The homeowner will be able to install either complete or partial systems himself.

The home control system will not be the only electronic "marvel" at Ahwatukee. The house will be a showcase of new consumer products. Many of these will be electronic. Motorola will use Ahwatukee as a "living laboratory" to demonstrate new consumer electronics to their customers and the public. Ahwatukee will be used to perform experimental projects and test new consumer-oriented devices.

The Ahwatukee home is now complete. The control system has been installed and Ahwatukee is now open to the public. It will remain open to the public for at least two years, after which time it will be put up for sale. □

Computerized Voting

BY J. R. HIRAKI

It's a big Presidential election year. The fanfare and political speeches of the national nominating conventions are over. The economic, domestic and international policies for the next four years will soon be determined by the man we select to be the next President of the United States. It's time to go to the polls and vote.

This year many of us will have our votes counted and handled by mini/microcomputer systems. At Computer Election Systems in Berkeley, California, voting has become a matter of punching a ballot card wih a stylus and inserting it into a vote recorder. The computer is programmed to analyze virtually any primary or general election ballot, giving a composite of the entire election.

HISTORY OF THE CES VOTOMATIC

In colonial America, voting meant a simple voice vote of "aye" or "nay." The written paper ballot appeared in 1634, providing secrecy to each individual. In 1892 the "lever voting machine" was introduced, and would remain an important invention for the next 70 years. By 1962, approximately one half of all voters in the United States used the lever voting machine. Figure 1 (a-f) shows a series of voting methods up to the lever machine.

In 1962, Joseph P. Harris, political scientist and internationally recognized authority on election administration, conceived of the idea of allowing the voter to record his vote on a data processing document and having computers tally the vote. Although then only two decades old, computers had proven to be efficient and accurate means for handling large masses of data.

For the next two years, the vote recorder that would be used by the voter in the precinct was refined and brought into mass production. The computer program, which would count the ballots on election night, was also of vital concern in the project. The first official use of the Harris Votomatic System occurred in a primary election on September 9, 1964, in Fulton and DeKalb Counties, Georgia. Later that year, the system was implemented by Lane County, Oregon, and San Joaquin County, California, for use in the 1964 Presidential election.

Editor's Note: Many thanks for the assistance and information provided by Computer Election Systems, including the tour of their facility.

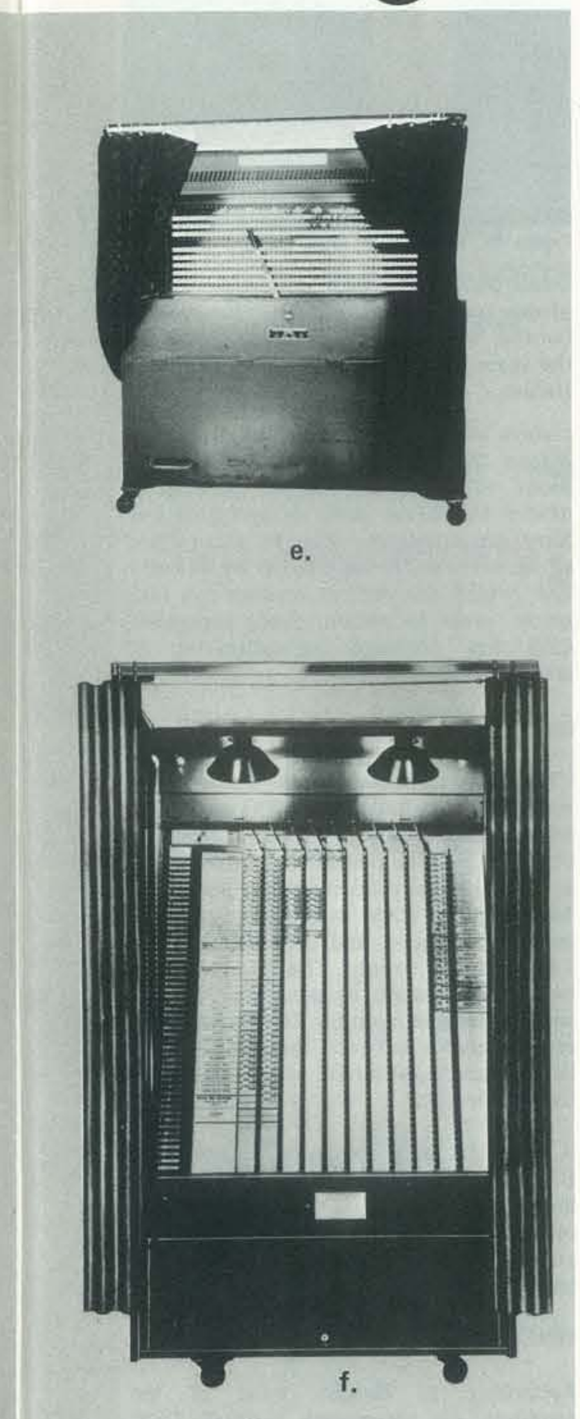


Figure 1. Series of Voting Machines

The Harris Votomatic System was purchased in 1965 by IBM, and later sold to Computer Election Systems in 1972. By the end of 1972, 180 governmental jurisdictions, or 13 million voters, used punch card voting. By the end of 1978, there were 559 governmental jurisdictions using the CES Votomatic System, or 27 million voters.

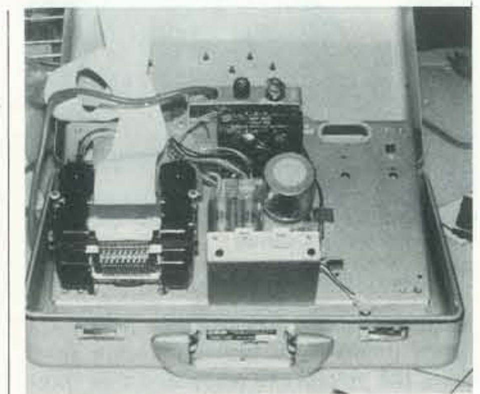


Figure 2a. Printer and Power Supply

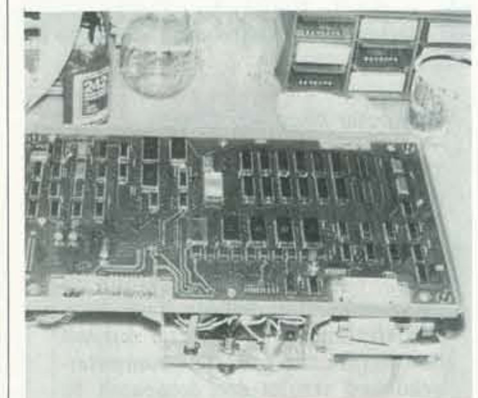


Figure 2b. Board Layout

Figure 3. Casting a Vote

SMALLER THAN A BREAD BOX

The CES Precinct Ballot Counter is a suitcase-size, easily portable unit that contains an 8085 processor, two 2716 EPROMs, the standard 2K bytes of RAM memory and two 8255 peripheral chips to control the printer, buttons, etc. that are built into the unit. All of the software is written in assembly language. Figure 2a shows the printer and power supply. Figure 2b shows the board layout, which sits under the printer. This system is used at the precinct level so, as an example, in a County-wide election the precinct results are known almost immediately after the polls close. Then the cards are transmitted to a central computer center, where CES equipment is also used, for the final consolidated outcome. Figure 3 shows a voter punching her ballot card with a stylus.

Central Counting Center

After the precinct ballots have been delivered to the counting center, the processing team is responsible for the computer operation. They process the ballots through the computer, producing periodic reports throughout the evening. They also have the ability to produce individual precinct results upon completion of the count. After the ballots have been processed, they are sent to storage, where they will remain for the period prescribed by law. □

Because each election is different, the unit must be reprogrammed accordingly. There are two methods that can be used to program the counter. The user can do the programming himself with the aid of a reference manual that is geared for use by non-technical personnel. A minimum of three cards and a maximum of 20 cards tell the machine what the sample of that particular ballot looks like. The minimum set up would have one card telling where the offices are, the second which is the first in each office, and the third which is the number of votes allowed in each office. For those who do not wish to do programming, a PROM module can be purchased directly from CES that plugs into the user's unit, eliminating the need for programming cards.

The ballot and programming cards are unique to CES. They use perforation marks down the center of the card so that positioning of the card is constantly read, ensuring that the voter's punches (votes) are accurately tabulated.

After the voters have cast their votes, the election officials feed the ballots into the card reader, press the print button and wait for the printed results. If the ballot is not read correctly, the microprocessor signals a light to go on and a beeper to go off. The microprocessor reads the corner cut on the card, so there is no chance for error in inserting the card since it reads the card in any position. Figure 4a shows the ballot counter, while Figure 4b gives

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Figure 4a. Ballot Counter

Figure 4b. Close-up of Print-Out

a closer view of the print-out.

Finally, the election officials match the ballot count with the registration sheet from the precinct to make sure that those people who registered to vote and who signed the sheet were issued a ballot that was counted. The microcomputer print-out allows an accurate audit chain to be established.

Computer Accuracy Checks

There are many checks made upon the accuracy of the entire election. Prior to election day, a test is run on the computer with a simulated group of ballots. The results of these simulated ballots have been predetermined and are a known fact before the test. The computer-produced results are compared to the known results. Comparison of the two is assurance that the computer is operating properly. The simulated ballots and the computer program are placed in security following this test.

On election day, the simulated ballots and the computer program are removed from security. They are run again to assure that both the computer and the program are still operating properly. Completing the test, the computer is ready to process the ballots. ☐

UNCLE SAM NEEDS MICROCOMPUTERS TO COUNT YOUR VOTES

With its ease-of-use, portability and speed, it seems almost unthinkable that a city or state would not use a microcomputer in an election. According to J. Greg Haines, CES Manager of Manufacturing Engineering, one factor is money, because it is sometimes hard to justify short-term expenditures despite long-term savings.

"A lot of jurisdictions use lever machines, which are big, bulky mechanical counters about the size of an (floor-to-ceiling) office file cabinet. They have invested a lot of money in them and until they break down completely they may not want to invest any more money. Our voting booths, however, can serve ten voters for the same cost as one lever machine," said Haines.

Haines went on to explain that, "another reason that some states don't use computer voting is the lengthy process required to obtain authorizing legislation. Most states require voting techniques and equipment to be approved by specific law, which for various reasons can take many years to obtain. Since inception, CES has obtained legislation in 37 states."

MINICOMPUTERS

CES also manufactures larger systems, such as their Ballot Tab 200 and ABT, which can be used at a central counting center. The documentation hardware uses a Data General minicomputer, has 4K to 16K bytes of RAM memory, counts 200 cards per minute, and uses the standard 115-V power supply. The information is exactly the same as generated by the smaller precinct counter. In fact, the only real difference between them is based on their actual application rather than their capabilities.

A highlight of these units, according to Bill Hanna, Assistant to the Vice President of Marketing, is that "a computer operator is not required. It is simple enough for someone without a computer background to run it."

WHERE DO WE GO FROM HERE?

According to Haines, most of the products are developed through CES' own internal research and development efforts or as a result of customer suggestions and needs. There are always improvements being made to existing systems.

Voting, like so many other aspects of our society, is being made easier, faster and more efficient through the use of computers. When you vote for your Presidential choice in 1980, don't forget to remember that computers are being used at some point in the process. ☐

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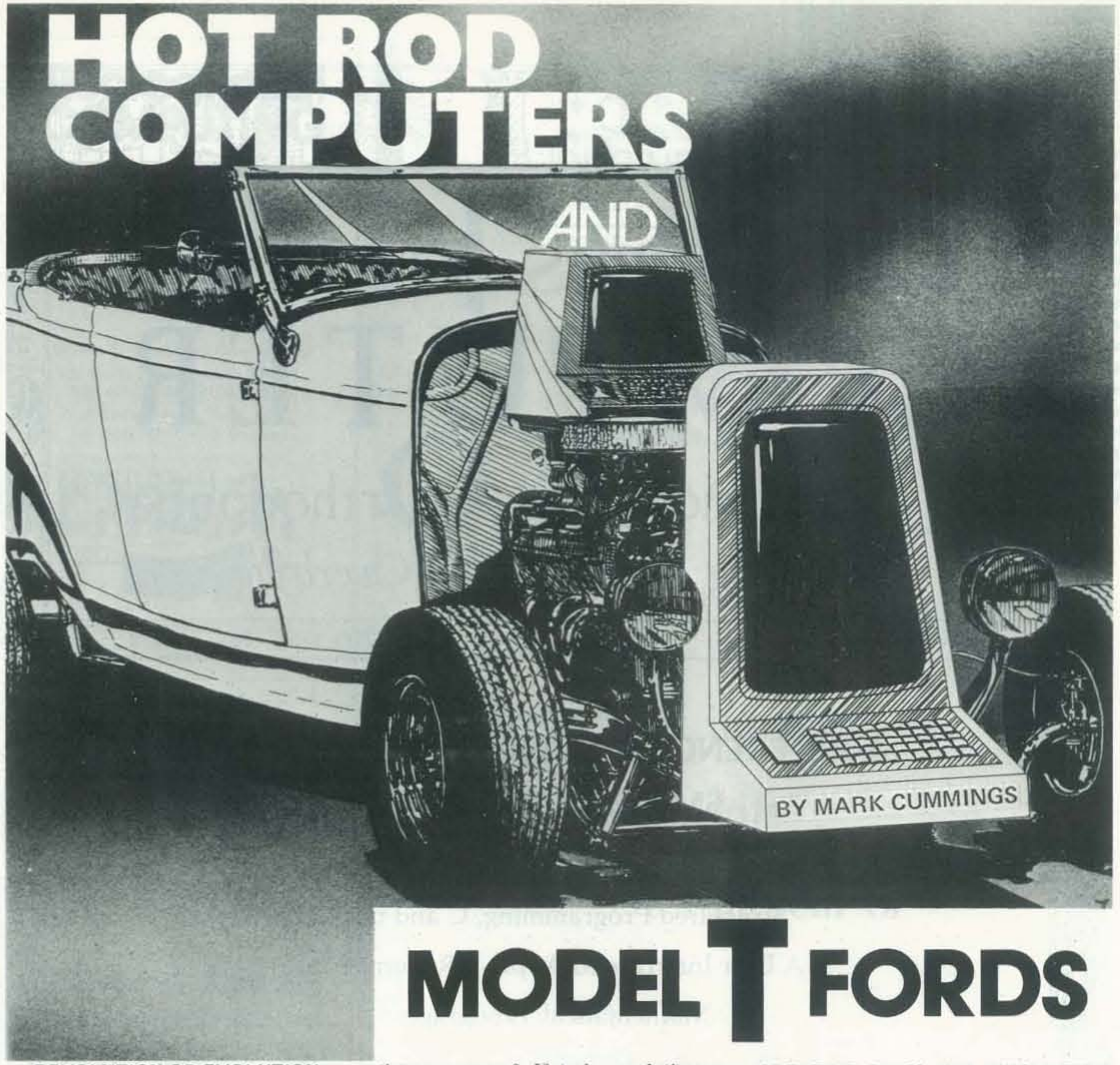


REVOLUTION OR EVOLUTION

Adam Osborne subtitled his new book, *The Next Industrial Revolution*. This title is interesting because at one level it appears to be a contradiction in terms. It seems as though I have been hearing about revolutions for as long as I can remember. There was the civil rights revolution, the "hippie" revolution of the late sixties, and the social/economic revolution of the post industrial theorists (i.e., *The Coming of the Post Industrial Society* by Daniel Bell, 1973). There was also a cybernetic revolution in there some place, and now there is the microelectronics revolution.

Was each of these really a new phenomenon? Or are they more properly seen as successive steps in an on-going evolutionary process? If truly revolutionary, then most of our previous experience or knowledge is invalidated (*The Structure of Scientific Revolutions* by Kuhn, 1962). Here, then, lies the contradiction in Osborne's title. If it is a revolution, it can't be the "next" one.

However, if we conceive of this process as evolutionary rather than revolutionary, the past may be quite instructive. Besides, it can be fun to play with historical analogies. For example, if microprocessors had been developed in 1962 instead of 1972, and in San Francisco instead of Silicon Valley, would Pig Pen and Jerry Garcia have been Jobs and Wozniak? Or would Bill Graham have been Mike Markulla? How about Apple Computer Co. and the Family Dog?

CREATIVE PLAY AND INNOVATION

There are two historical analogies that I find extremely useful and I'm talking about them here because they both involve play. These analogies are the automobile and the ham radio. In both cases, new technologies produced pervasive social, political and economic changes. These technologies followed a direction of evolution set by creative play.

Much of the ground work for the development of broadcasting in this country was the result of the creative play of amateur radio operators. In fact, the first *broadcast* was the result of a ham taking his equipment down to the local concert hall. Soon businesses began underwriting the cost of such activities and commercials were born.

As stations began competing and audiences began depending on their services, the need to control competitive abuses generated regulation. Initially, the Federal Communications Commission acted like a policeman controlling the use of the broadcast spectrum. As the technology matured, the Commission began promulgating standards for the introduction of new forms. Finally, the FCC took on the task of managing the ecology of the mass electronic communications space by protecting organization based on older technologies, encouraging the introduction of new technologies, considering program content, and regulating rates and quality of service.

This long train of development was in large part determined by the creative play of earlier experimenters. These experimenters explored the possibilities of the new technology. Through this experimentation the menu of available choices was defined. The activities of these individuals in the late teens and early twenties set the pattern that controlled developments for the next sixty years.

The expense of early computer sytems limited access to professionals. However, the urge to creative play (albeit illicit in many cases) played in important role. From these professionals came the first computer games, graphics and audio.

This is where we come to the Model T Ford. Before Ford, automobiles were beyond the economic reach of most people. The Model T made it possible for people of modest means who were willing and able to learn to operate and maintain their own vehicles to own them. From simple maintenance the urge to play led to attempts to improve the performance and personalize the design. Hot rodders like hams helped define the menus of available "options."

Microprocessor technology almost inadvertently did the same thing for computers that the Model T did for cars. And here we all are playing with them.

What will become of this play? Well, to start with personal computers will grow into what I call Universal Communication Terminals. By the middle of this cycle of technological development, the majority of economic, social, political, religious, and cultural activity will take place over communications networks linking these terminals. The process of this evolution will have the effect of divesting many of the existing vested interests, creating a plastic period in our social development. One metaphor that evokes this quality of a plastic environment is "the electronic sandbox" (see *The Best of the Computer Faires, Vol V*). The range of possibilities is great but can be defined by hypothetical extremes: highly centralized, alienating, totalitarian versus decentralized, socializing, and democratic. The former approach is best illustrated by IBM of the 1960s and early 1970s with its ranks of men in blue suits, white shirts and brown shoes, selling and servicing huge expensive monsters used by the FBI to catalogue the fingerprints of all U.S. citizens. On the other hand, we have the prospect presented here. To a great extent, it is the result of the creative play of the community of computer hackers.

THE UNIVERSAL COMMUNICATIONS TERMINAL

The Universal Communications Terminal is conceptually the product of merging the telephone, the television and the microcomputer. It would be a low-cost device that would have the following capabilities:

To accept and display alphanumeric data.
To accept and display color graphic data.
To accept and display motion video.
To accept and reproduce audio (digital and analog).
To provide soft copy storage.
To provide hard copy output.
To provide access to computing power.
To provide the ability to translate between all digital and analog forms.
To provide two-way communications (analog and digital).

Figure 1 shows how such a terminal might be configured based on currently available hardware. Figure 2 shows the price breakdown. As those of you who

APPLE II 48K	$1395
FLOPPY DISC	595
DIGISECTOR WITH B/W CAMERA	599.95
D.C. HAYES MICROMODEM	379.95
MT. HARDWARE SUPERTALKER	269.95
DATELPRINTER AND INTERFACE	599.95
TOTAL	$3839.80

TV RECEIVER AND TELEPHONE ARE ASSUMED

FIGURE 2. COST OF OUTLINED SYSTEM

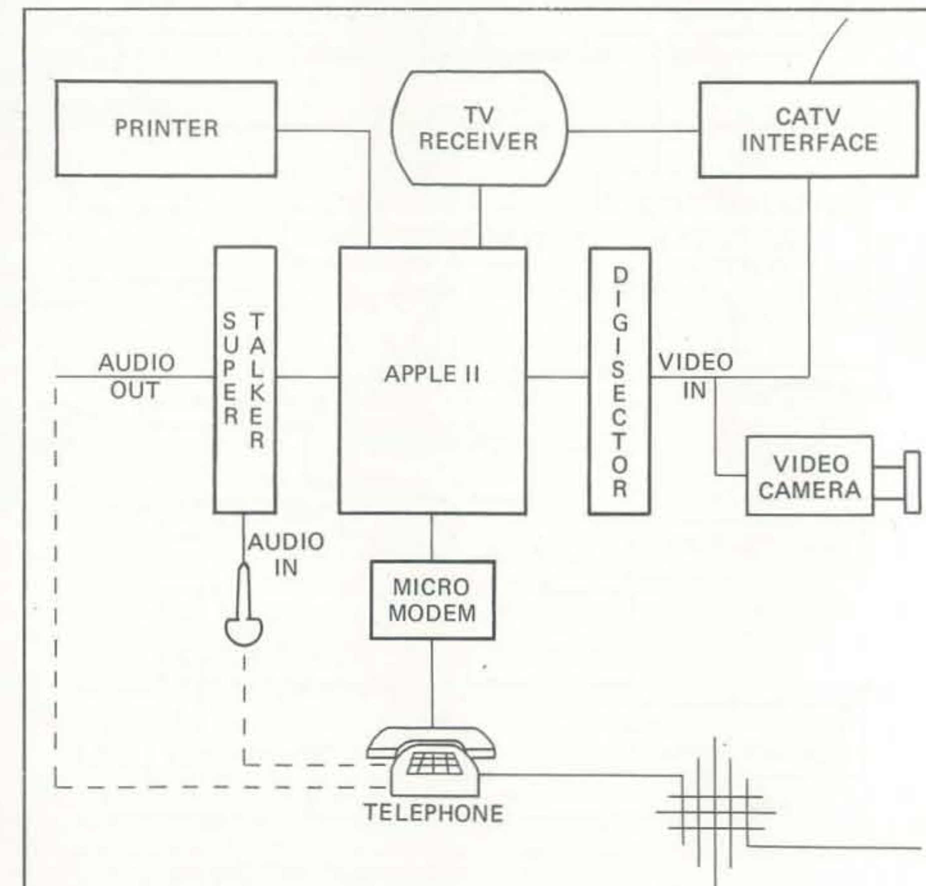


FIGURE 1. UNIVERSAL COMMUNICATIONS TERMINAL PROTOTYPE

are familiar with the Apple II will testify, this configuration will not provide all of the capabilities listed above. The video is not full-color broadcast resolution nor is the audio Hi-Fi. But what is significant is that these rudimentary capabilities are available as consumer items today. The total cost of the system shown may be too high to be accepted by a large number of people. If we increase the cost still more, we can get closer to our list of capabilities. For example, a Whitney CATI interface and a VTR could be added, raising the price to the $6,000 range. Currently, the largest single system price the consumer seems to be willing to support in large numbers is $1,000. Given the dynamics of the economics of digital technology, it seems reasonable to expect a fourfold decrease in price and an approximately equal increase in capability within the foreseeable future.

LINKING TERMINALS

Currently, if I want my computer to talk to yours, we probably would use modems and the switched telephone network. This is costly, slow, and somewhat unreliable. Tymnet and Telenet offer an inexpensive alternative—packet switching. However, to access one of these carriers, we probably have to use the same telephone network. Is there a practical alternative for personal computer users?

Over 25% of the homes in this country are connected to CATV systems. In New York, companies have used cable systems to send data. By the end of this year, there will be over 1,000 satellite-to-earth stations connected to several CATV systems. With the appropriate interface, personal computers could be connected to these systems as shown in Figure 3.

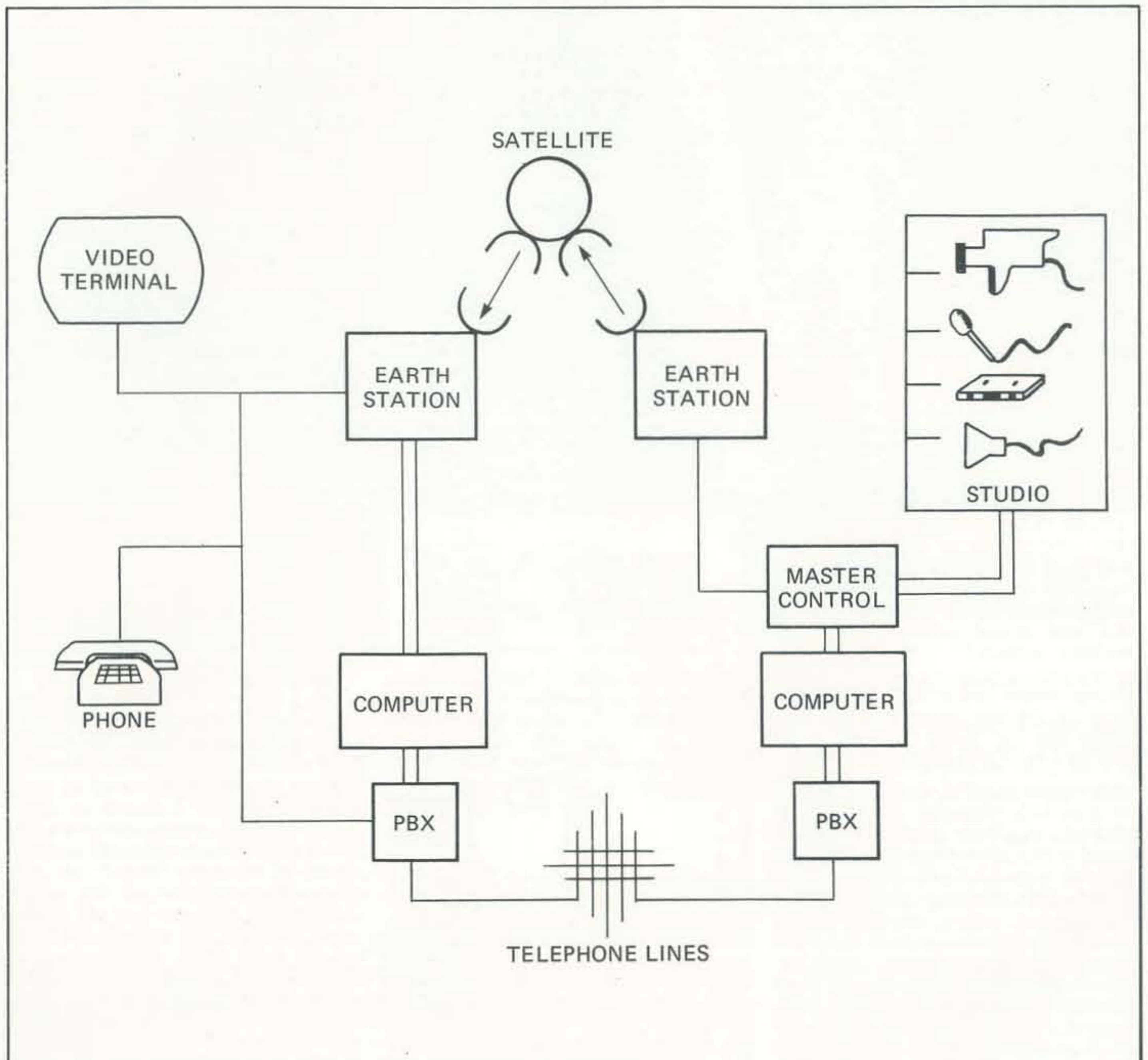


FIGURE 3. BASIC SYSTEM

Presently, there are over a dozen pilot (and one commercial: QUBE) two-way cable systems operating in this country. With proper planning, we could evolve to the type of system shown in Figure 4.

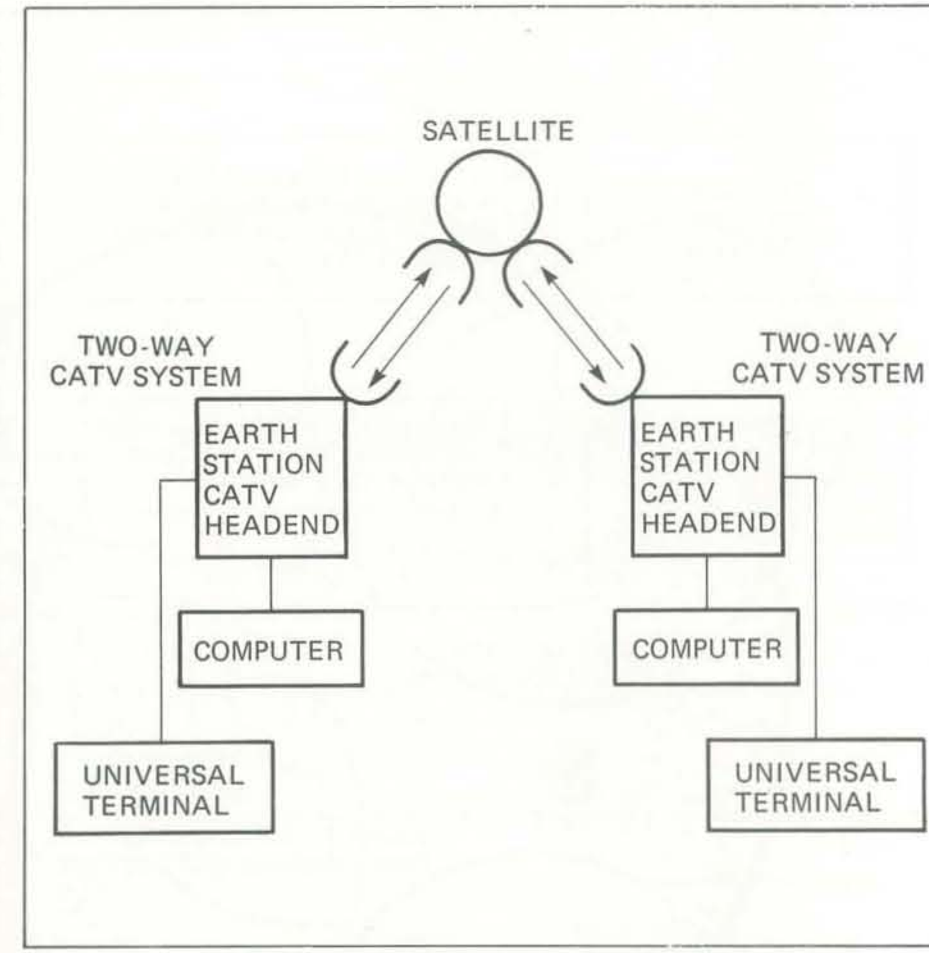


FIGURE 4. FULLY DEVELOPED SYSTEM

POTENTIAL USES

With a system like this, we have the potential capability to completely revolutionize the way we go about manufacturing and distributing symbolic information in our society. For example, a presentation by an instructor at one facility could be delivered to small groups in classrooms or special prupose communications rooms in other locales. What is far more interesting is what happens when large numbers of people are involved in a network. Instead of 20 to 30 people sitting around two conference tables participating in a teleconference, multitudes can participate. They can remain where they are and information can be distributed by this combination of satellite long haul and two-way CATV in such a way that there is interaction similar to that which occurs in smaller groups.

One example of how this might be accomplished is shown in Figure 5. This looks very much like traditional CAI, but the *lecture* segments are full video and can be as elaborate as the author's imagination and production budget will allow.

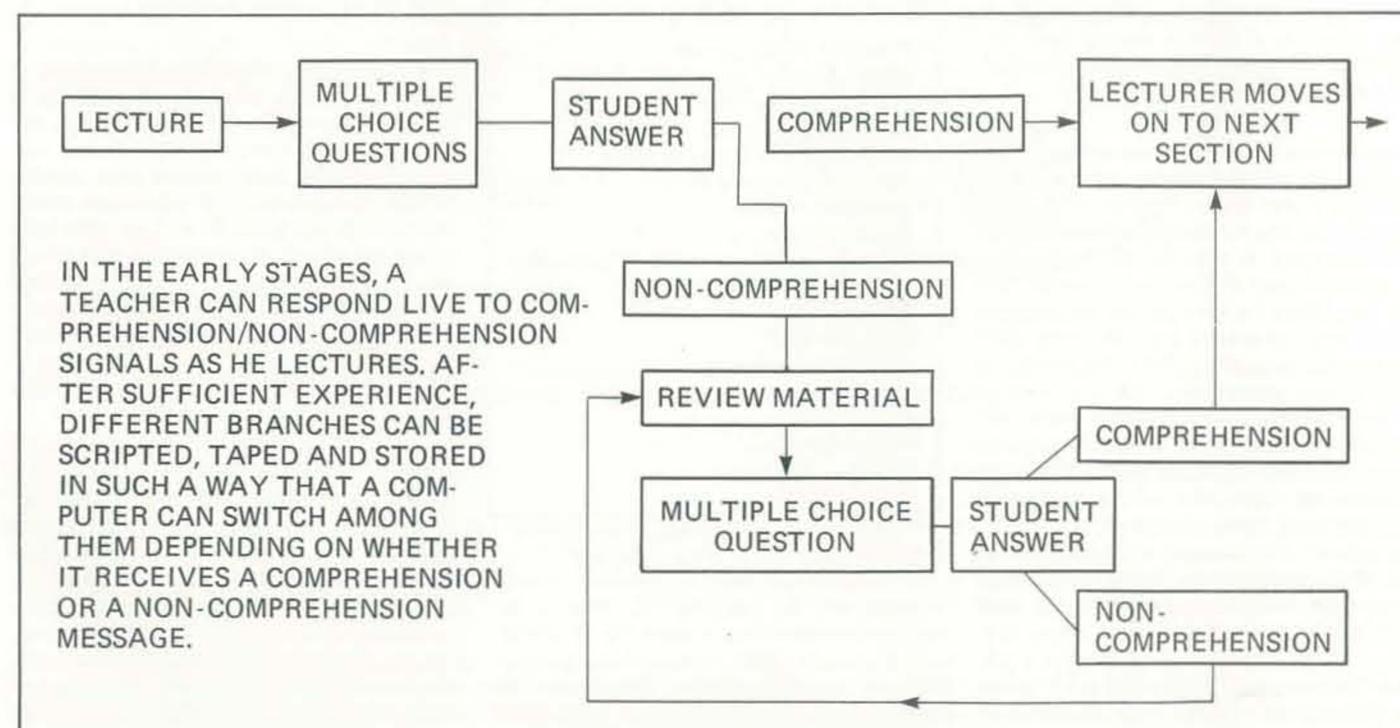


FIGURE 5. INTERACTIVE ELECTRONIC EDUCATIONAL DISTRIBUTION SYSTEM LECTURE

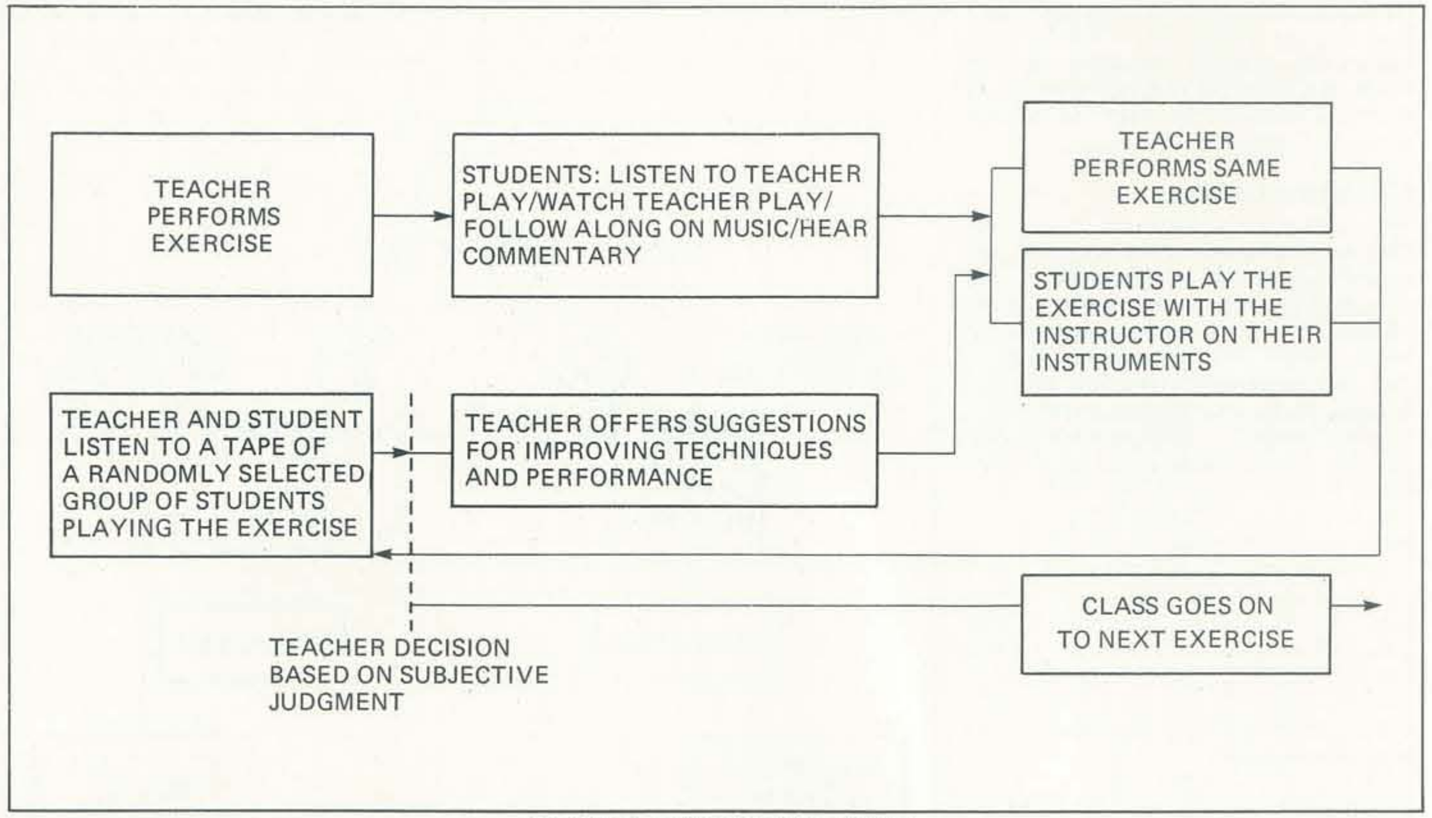


FIGURE 6. INTERACTIVE MUSIC PERFORMANCE INSTRUCTION

Teaching of manual or aesthetic skills is also possible. Figure 6 shows how one might handle a guitar class given controllable audio feedback.

These same kinds of techniques can be applied to entertainment. In fact, this example shows the beginning of the blurring of the line separating education and entertainment. Is a guitar class education or entertainment? Computer games that can be played by two people on personal computers connected by telephone lines are already appearing. With the advent of Source and Micro-Net, we can expect to see N person games. These *information utilities* can provide a wide and growing range of data base services. With the addition of video and audio, the range and depth of these services could be increased by several orders of magnitude. Figure 7 provides an incomplete list of services that might be provided by such a system.

The Commerce Department, in an often quoted study, found that starting in 1967 more than 50% of the Gross National Product occurred in what was dubbed the information economy. The system we have outlined here is capable of handling the majority of functions making up the information economy. This means that it will become possible to reorganize our business lives. The large central office can be eliminated along with the commute and all that that implies. Where will everyone work? The conventional answer is at home.

Electronic Funds Transfer
Electronic Stock Exchange
Electronic Garage Sale
Electronic Newspaper
Electronic Classified Advertising
Community Bulletin Board
Remote Education
Electronic Libraries
Electronic Consumer Information Service
Electronic Town Meeting
Political Polling
Electronic Mail
Telephone Answering
Secretarial Services
Entertainment
Religious Practice
Electronic Publishing

FIGURE 7. INCOMPLETE LIST OF POSSIBLE SERVICES

THE COMMUNITY CENTER

There are many advantages to working at home (I am writing this article on a personal computer in my home), but there are also many objections that can be raised. The most serious may revolve around the question of alienation raised earlier. Are we liable to end up with individual people in their individual cubicles called apartments, with their individual personal computers doing 90% of their business, education, social, cultural and religious activity over this sytem? And if so, what level of alienation will that produce?

As an alternative, there is the kind of Community Computer/Communications Center sketched in Figure 8. Here there would be offices equipped with Universal Communications Terminals leased on a long-term basis, as well as cubicles rented on an hourly basis. Support services would include broadband communications, high-speed printers and high-speed fax services, etc. Here people of all ages and sexes would mingle in the course of their daily activities. Work still needs to be done on determining the optimal size for such a center, but it is estimated

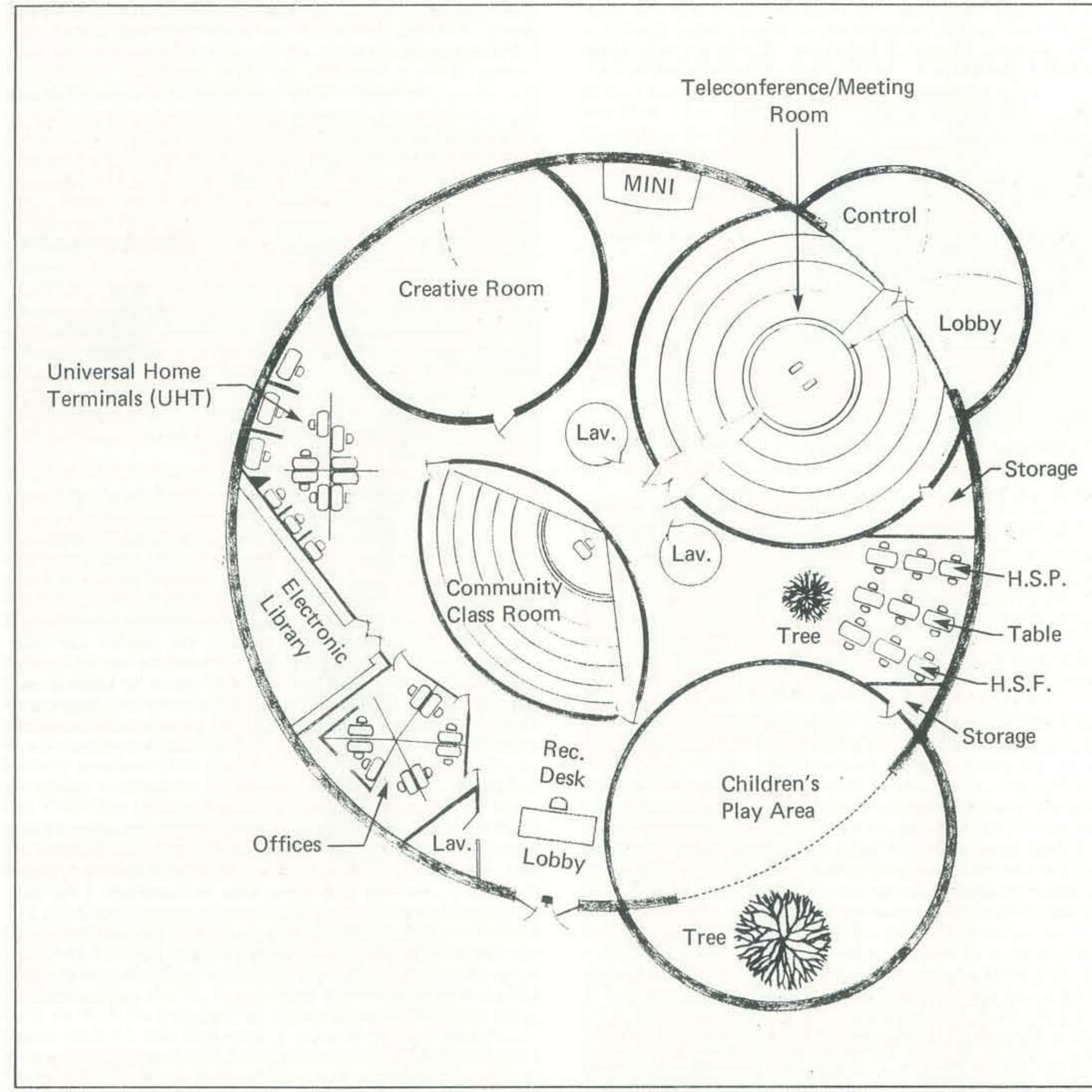


FIGURE 8. COMMUNITY COMMUNICATIONS CENTER

that one center servicing each community of 1,000 would be reasonable. Some prototypical centers already exist. A favorite is the Marin Computer Center.

To make this all happen, some concrete things have to happen. Standards need to be developed and public policy must be focussed on the issues of financing and controlling these systems. Guarantees of personal privacy and freedom must be worked out. But, as concrete as all these issues are, there is one which although ephemeral, may be more important. To a certain extent, our society is technologically determined, but at the same time it is also the product of our expectations. If we want a communication/computing environment that fosters socialization, self actualization, personal freedom and democracy, people in our society will have to come to expect it. They must come to believe that it can happen and must desire that it happen. This belief and desire seems best developed through creative play. □

MARK CUMMINGS has been an assistant professor in the Broadcast Communication Arts Department at San Francisco State University since 1977. Previous to that he was Business Planning and Financial Analysis Manager for Western Union Telegraph Co. and Strategy Planner for RCA Globcom. He is active in community service, including being a board member and co-chair of the Time Sharing and Communications Interest Group of the California Educational Computing Consortium. Mr. Cummings received his MBA from the University of Pennsylvania in 1974.

THE STORY OF
Computer-Using Educators

BY WILLIAM J. WAGNER, PH.D.

THE NEED FOR USER GROUPS IN EDUCATION

All over the country teachers are discovering computers as a possible aid in their instruction. Machines sometimes enter piecemeal, creeping in like the fog, "on little cat feet," one-at-a-time from a little extra money found at the end of the year or from a PTA fundraising project. Other projects are big from the start; even in post-proposition 13, California saw several new school installations that exceeded $50,000 initial investment in the Fall of 1980.

Small and large educational computing efforts generate the same questions: How are we going to use the machines? How do we get more teachers involved? How can we learn more ourselves about computers? How much is enough to know? What are the best logistics to maximize productive use of the computers? Where are the educational programs we need so that these computers will make a difference in our teaching? Do I have to become a programmer? How can I build this installation into an even better one? And from neighboring schools—how can we get into the action?

The new users of computers in education are distinctly different from those of earlier days. They tend to have little technical expertise and a sparse background in programming. And if they have dealt with computers, that experience tends to be with a terminal that required no knowledge of the internal components or capabilities of the host computer. I do not have to remind readers of this magazine that microprocessors have exploded many conceptions about how computers can be used in education. It is important to remember, however, that the average teacher or administrator who is going to implement new curricula with microcomputers probably knew next to nothing about computers ten years or five years or six months ago. Who will provide the required training? How will these individuals avoid duplicating efforts as they develop new curricula and programs?

In past years, educational innovations tended to originate in the schools of education in universities and to be disseminated by publishers or other commercial enterprises. Modular scheduling, new math, individualization, learning labs, novel school architecture, to name a few, swept public education in the 60's like the religious frenzies of the early 19th Century in the northeastern U.S. (the analogy can perhaps be extended to include historians' name for western New York after it experienced the zealous fires of so many new revivalists—"the burned-over area.")

William J. Wagner, Ph.D., Mt. View High School, Mt. View, CA 94041.

But microcomputers have been different. The universities and the publishers are way behind the schools in this revolution and haven't provided the leadership and direction. Manufacturers and distributors, in their struggle to stay in business, were in a poor position to provide direction to educators. State and county educational administrators were more comfortable talking about the big computers they had committed to in the 60's, and couldn't believe that microcomputers would be in the same league with them.

Other microcomputer users have tended to be less helpful than one would expect. My first trip to the Homebrew Computer Club provided a window into the technical world I was joining with the purchase of my SOL in 1977. I was scared by the jargon and the inability of anyone there to understand that I really did not care how it worked, if it would just run a disk BASIC and drive a printer. And I had difficulty even expressing my question to those in the group who may have been interested in helping.

Of course, things have changed since the old days of 1977, and there are counter-examples to each of my generalizations about people and organizations. My point is that the very few educators in the early microcomputer ranks weren't getting support and information from the usual sources, and had to "invent the wheel" alone or in small groups around the country. Furthermore, while institutions and companies have awakened to the needs of the educational market, the market has been growing. An accelerating number of teachers are becoming interested in microcomputers and their need to know is exceeding the capabilities of the existing sources of information. Where would the leadership come from to provide information and assistance to the new users of computers?

A GROUP IS BORN

My own disinterest in electronics and hardware may not have been shared by early educators using microcomputers. However, we all were considering the questions of software, logistics, and curriculum that come with the territory. I for one felt very much alone, being kept from a nervous breakdown by a brilliant and humane software genius named Steve Williams, who worked for the Microdoctors of Palo Alto, then and now my maintenance facility. (In those days printers didn't just get taken out of the package and plugged in, and manuals didn't reveal everything one really needed to know.)

I signed up to give a talk at the Second West Coast Computer Faire in the Spring of 1978 and was rather astounded to find 300 people in attendance to hear a panel of three unknown teachers. During questions and answers I felt that here at last were others like me—all busy working on the same problems in our own little enclaves. Each was confronting the question posed earlier in this article – the questions that continue to be important to teachers using computer. The result was the first meeting of interested educators.

About 25 local people attended our first few meetings. Finally, at the third meeting, in September 1978, we realized that we needed to go beyond introducing ourselves and throwing out random questions and opinions. Once the idea of planning an activity was floated, the group talked right through lunch time and on into the afternoon without a break. We emerged with empty stomachs and the plans for a genuine meeting with speakers and panels, with assignments and responsibilities designated, with officers, and with a name: Computer-Using Educators (CUE).

The remainder of CUE's history up to now is summarized in the chronology of events given at the end of this article. I turn now to consider some of the important requirements, or necessary conditions, in the establishment of such a group, and to a discussion of some current CUE projects.

First, from the beginning CUE had the capability to store names and addresses on computer files, insert new names easily, sort by names or zip codes, and print mailing labels. Although this capability is now becoming available on most microcomputers, in 1978 we were lucky to have the services of the PDP-11 at Independence High School in San Jose and the volunteer time and expertise of Don McKell, who from the beginning has handled all aspects of membership.

Another "sine qua non" for new groups is a way to get communications printed and mailed at no expense. CUE was able to avoid charging dues during its first year because of the generosity of various school districts who took care of these functions free of charge. This allowed us to become well established and to ask for dues only after it was clear that we were here to stay.

From the beginning, CUE has worked with existing teacher groups, particularly the math teacher organizations and recently those for science and business. We co-sponsored meetings with local groups, helped plan the program for the regular meetings of state groups, and held one CUE meeting at the West Coast Computer Faire. In this way our message was brought to wider audiences, and the cause of computers in education was advanced within these groups.

Finally, a most important aspect of the organization has been the existence of a regular newsletter. In addition to helping keep members better informed about new ideas, equipment, curricula, and software, and providing a vehicle for members to ask questions and share their own ideas, a regular newsletter reminds members that they belong to a group that is doing something worthwhile. It is most important to a new group like CUE that members identify with the organization, support its goals, and spread the word. They should be able to feel like participants even though geography prevents their attendance at meetings and conferences.

The actual production of the newsletter deserves further note. At first written and printed on a sophisticated word processing system at Stanford when I was a graduate student, it has been done on my school's old reliable SOL or Horizon for the past year, using the electric pencil word processing program. To keep up with the standard of printing set earlier, I have borrowed time on the high-quality printers at local computer stores. Sometimes, thanks to incompatibilities of software and hardware, this has been almost more trouble than nice copy was worth. So a future agenda item will be the possibility of purchasing a printer for CUE. And, while I am fully aware that some very significant and high-quality writing has been done on regular typewriters, and even pencil and paper over the past few millenia, no volunteer working after hours should be forced to produce a newsletter today without a word processor.

CUE PROJECTS

Three projects of CUE deserve special mention. First, conferences are important and relatively efficient vehicles for providing information to many people. From the beginning CUE has sponsored or participated in conferences in the traditional format—sessions, exhibits, large group presentations. We have come to realize how much work goes into these events and will continue to seek ways to ease the burden on volunteers. I hope that some day there will be more statewide organizations like MECC in Minnesota with personnel whose job descriptions include some of the activities that CUE has undertaken.

A very successful and apparently much appreciated event was the first CUE introductory programming workshop. (See chronology for further description.) The enthusiastic turnout confirmed our predictions that there was a real need for instruction about computers that was not being filled by local colleges and universities. One day is not enough, so a continuing goal will be to promote the establishment of relevant and accessible computer courses for teachers.

As an organization like this expands, it becomes more difficult to think about meetings where individuals can meet with others with similar interest (geography and numbers get in the way). Therefore, in the Spring of 1980 a mechanism for having regional CUE meetings was established. A first regional meeting was scheduled at seven different Northern California locations, with designated local host. Publicity was through a mailing to all members. Future meetings and activities will be the responsibility of local people, but CUE will support them by providing money, publicity, and assistance with activities.

Finally, perhaps our most significant project has been the development of a microcomputer center and software library housed in a permanent location. This idea grew out of the obvious need that teachers have felt for useful software. Through the enormous efforts of Vince Contreras and Bobby Goodson (CUE President-elect and President, respectively, for 1980-81), a software exchange system was set up for the state math teachers meeting in 1979. Using a Nestar Cluster one-disk sharing system, a Corvus hard-disk system, and lots of loaned PETs, Apples, and TRS-80's, they created a three-ring circus in which people could step up to the computer of their choice, try programs from an extensive menu, and place an order for copies.

The software exchange was off to an exciting start, but many questions remained: How to gather and catalog all the programs still out there? How to improve the programs in the library, up to some standard of performance? What to do with the library between conferences? How to handle the mail requests that were coming in? How to minimize the dependence on large amounts of volunteer labor involved in the project?

The answer came sooner than we thought. Within a month Ann Lathrop of the San Mateo County Office of Education began looking at the problem through the eyes of an experienced librarian. We were seeking to provide educators with relevant information and materials, exactly within the task description of the County's Educational Resources Center Library. Always one looking for new and challenging projects (a description which fits most computer educators in these pioneer days), Ann set herself the task of establishing the software library permanently within the county office. With valuable support from throughout the county administration, a plan and then a reality took shape.

The project now has six interdependent components. Manufacturers and local dealers have loaned microcomputers to the center for demonstration purposes, so that anyone who drops in will have the opportunity to see the following complete systems: PET, TRS-80, Atari, Apple, and Texas Instruments. Second, the county has sought contributions and has committed some money for purchase of commercial software, so that visitors may try out what is available. Third, the center maintains an extensive selection of current computer-related periodicals and books.

Fourth, and most time-consuming, has been the effort to gather, organize, evaluate, debug, improve, and catalog the educational programs contributed by individuals. This effort occupied hundreds of person-hours during the Summer of 1980, and is not yet complete. Meanwhile, planning has continued toward the day in the future (early 1981) when the center can begin to process requests for software.

Fifth, the center has also been used extensively for demonstrations of new equipment and software. At a centrally located facility like this, a high-quality demonstration can be arranged and attended by enough people to form a critical mass of informed judgment. Beginners and experienced people alike can benefit from the range of reactions expressed by a larger audience than would be found in a single school, and the manufacturers can be counted upon to put on a good show for such an audience.

Finally, in addition to providing a permanent home for the CUE software library, the potential for the needed supervisory and clerical personnel, and a central location where useful information and demonstrations are continually available, the center has made an unanticipated contribution to the goal of keeping people in touch with each other. Throughout the Summer of 1980 teachers dropped in at the microcomputer center, and one could always find an interesting and informed computer-using educator there to exchange ideas and opinions. And that, after all, was the original and continuing goal of CUE.

Ann Lathrop's hard work and perserverence has paid off with the beginnings of a microcomputer software library located at the San Mateo Office of Education in Redwood City.

Above are CUE instructor Jim Lewis and in the far right photograph is librarian Janice Marshall. Also shown are students Barrie and Kevin.

FOR MORE INFORMATION ABOUT CUE:

Membership: Send $4.00 (no purchase orders, please) to
Don McKell
Independence High School
1776 Education Park Drive
San Jose, CA 95133

Microcomputer Center:
Ann Lathrop
Educational Resources Center Library
San Mateo County Office of Education
333 Main Street
Redwood City, CA 94063

To receive a sample copy of the newsletter:
Walt Ettlin
Alhambra High School
150 E Street
Martinez, CA 94553

Other Users Groups For Computers In Education

In Florida, contact:
Mark Hale
Dept. of Mathematics
University of Florida
Gainesville, FL 32611

Technical Education Research Centers (TERC)
3 Eliot Street
Cambridge, MA 02138

Michigan Association for Computer Users in Learning (MACUL)
Lary Smith
Wayne County Independent School District
33500 Van Born Road
Wayne, MI 48184

Minnesota Educational Computing Consortium
(the model for statewide groups)
2520 Broadway Drive
Lauderdale, MN 55113

International Council for Computers in Education
(Publisher of *The Computing Teacher*– $10 per year)
Computer Center
Eastern Oregon State College
La Grande, OR 97850

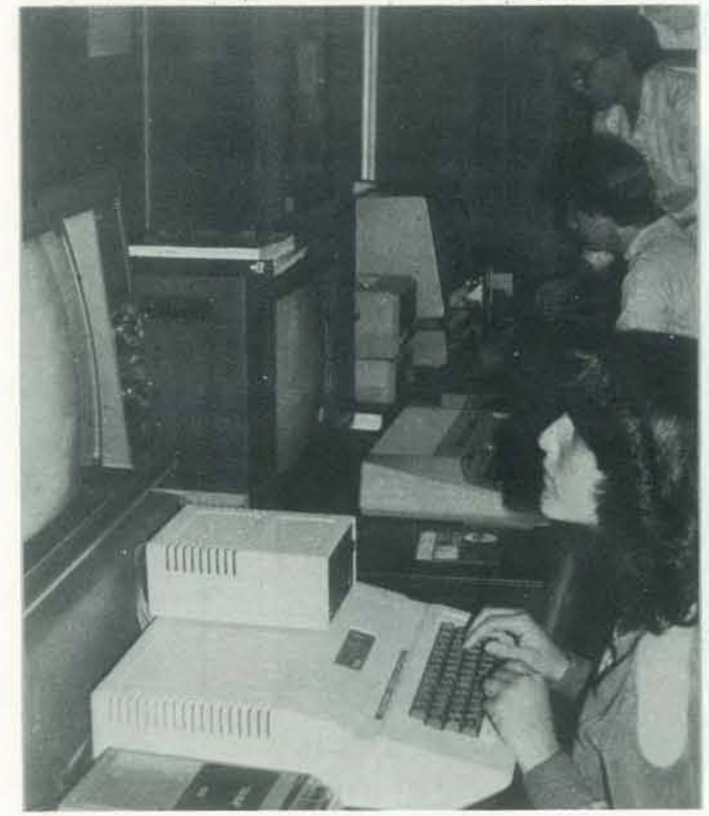
Northwest Council for Computers in Education
Computer Center
Eastern Oregon State College
La Grande, OR 97850

Texas Computer Educators Association
Vicki Smith
7131 Midbury
Dallas, TX 75230

Microcomputer Education Applications Network
($10 for quarterly newsletter)
256 North Washington St.
Falls Church, VA 22046

Ontario Society for Microcomputers in Education
Nick Solntseft
Unit for Computer Science
McMaster University
Hamilton, Ontario, Canada L8S 4K1

Apple for the Teacher (Apple Computers)
Ted Perry
San Juan Unified School District
2331 St. Marks Way
Sacramento, CA 95825



Apple Educators Newsletter
($12 for monthly newsletter)
David Miller
9525 Lucern
Ventura, CA 93003

Association for Educational Data Systems (AEDS)
1201 16th St. NW
Washington, DC 20036

Society for Applied Learning Technology
50 Culpepper St.
Warrentown, VA 22186

Association for the Development of Computer-Based Instructional Systems (ADCIS)
Joan Lauer Hayes
Computer Center
Western Washington State College
Bellingham, WA 98225

CHRONOLOGY OF EVENTS

March 1978. First Meeting. Publicity: Letters to every school district in the immediate area. (Observation: This doesn't really disseminate an idea very well). Topic: Introduce ourselves, share ideas and opinions. What should or could a group of educators accomplish?

June 1978. Similar meeting, with emphasis on sharing educational software.

September 1978. Topic: Sharing curriculum and ideas for teaching with computers. At this meeting we realized the need to plan a more substantial conference.

November 1978. First newsletter sent to about 50 people.

January 1979. Conference featuring panel discussions on selecting equipment, curriculum, teaching programming, and getting funded. Sixty-five people attended and CUE was well launched.

May 1979. Meeting in connection with the Fourth West Coast Computer Faire. Over 200 people attended. Presentations on subjects similar to those of the January meeting. Open-ended discussion afterward on the future of the organization, what should educators demand of manufacturers and programmers, and what are the special needs of "computer-using educators."

May 1979. Newsletter mailed to about 300 people.

September 1979. Begin collecting annual dues of $4.00. Meeting at Lawrence Hall of Science. Fifty people attend.

October 1979. Conference co-sponsored by CUE and Alameda-Contra Costa County Math Educators (ACCCME). Commercial exhibits, 16 conference sessions. Over 200 people attended.

December 1979. CUE helps organize computer stand at California Mathematics Council Annual Meeting at Asilomar conference grounds near Monterey. Twenty-four computer-related sessions; over 80 computers on the grounds, as part of commercial exhibits, informal hands-on opportunities, workshops, and the first attempt at a software exchange.

January 1980. Formation of executive committee of 16 active members.

February 1980. CUE invited to become first affiliated group of International Council of Computer Educators.

Spring 1980. Beginning of microcomputer center and software library at San Mateo County Office of Education.

April 1980. First CUE introductory workshop in programming. Over 100 people attend sessions on beginning BASIC on Apple, PET, and TRS-80 (all hands-on), and lecture sessions on intermediate and advanced BASIC. Afternoon devoted to general discussion of computers in educations, including new products, ideas, rumors, opinions, counter-opinions. Specific presentations: "Why I like my . . . (PET, TRS-80, Apple) . . . ," "How we use computers in our . . . (high school, junior high) . . ." Participants paid $5 each, and instructors received a modest fee.

May 1980. Regional CUE meetings.

July 1980. Five to 15 members and visitors meet at microcomputer center each day to evaluate programs in the library and prepare procedures for collecting, judging, and eventual dissemination of educational programs. Several commercial presentations of new products.

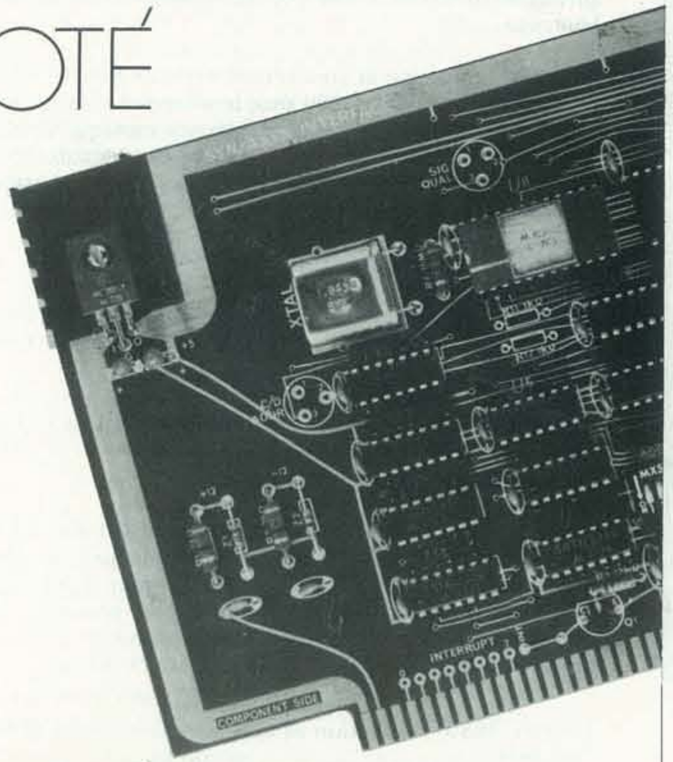
Constitution developed and approved by executive committee.

Newsletter mailed to 500 dues-paying members.

September 1980. Conference sponsored by CUE, California Science Teachers Association, and Santa Clara Valley Mathematics Association. Forty sessions, 30 commercial exhibitors.

December 1980. Enlarged program of computers at the CMC meeting. □

YOTÉ



BY MARK WICKHAM

THE GAME

Yoté is a game similar to checkers. It is played throughout West Africa. Its popularity is probably due to the simplicity of setting up the game: the "board," five rows of six holes, is scooped out of the ground, and the playing pieces are pebbles and bits of sticks ("O" and "X" in the computer version).

The rules allow for a variety of movement, and the game demands strategy and quick thinking because every piece captured allows the capturing player to take another of his opponent's pieces. Thus, a disadvantage can rapidly become a rout. Even for the best of players, changes of fortune are speedy and surprising, which makes Yoté a perfect gambling game. In Senegal, particularly, it is usually played for stakes.

HOW TO PLAY

Two players are equipped with 12 pieces, "X" (sticks) and "O" (pebbles). Each player attempts to capture all of his opponent's pieces. The player with "O" (pebbles) starts the game by putting a pebble in any hole. The other player then places one of his pieces in another hole. Only one piece may be played in each turn. A player does not have to place all of his pieces on the board before he starts to move those he has already put down. Pieces may be moved one space in any direction, but not diagonally, and only to vacant space. A player may capture one of his opponent's pieces by jumping over it. He is then allowed a bonus capture, the choice of removing any of his oppontent's pieces still on the board. Although most Yoté games come to a quick and decisive conclusion, it is possible for a game to end in a tie, when each player has three or less pieces on the board. In the program, the computer will not recognize a tie, and will keep playing until you stop the game.

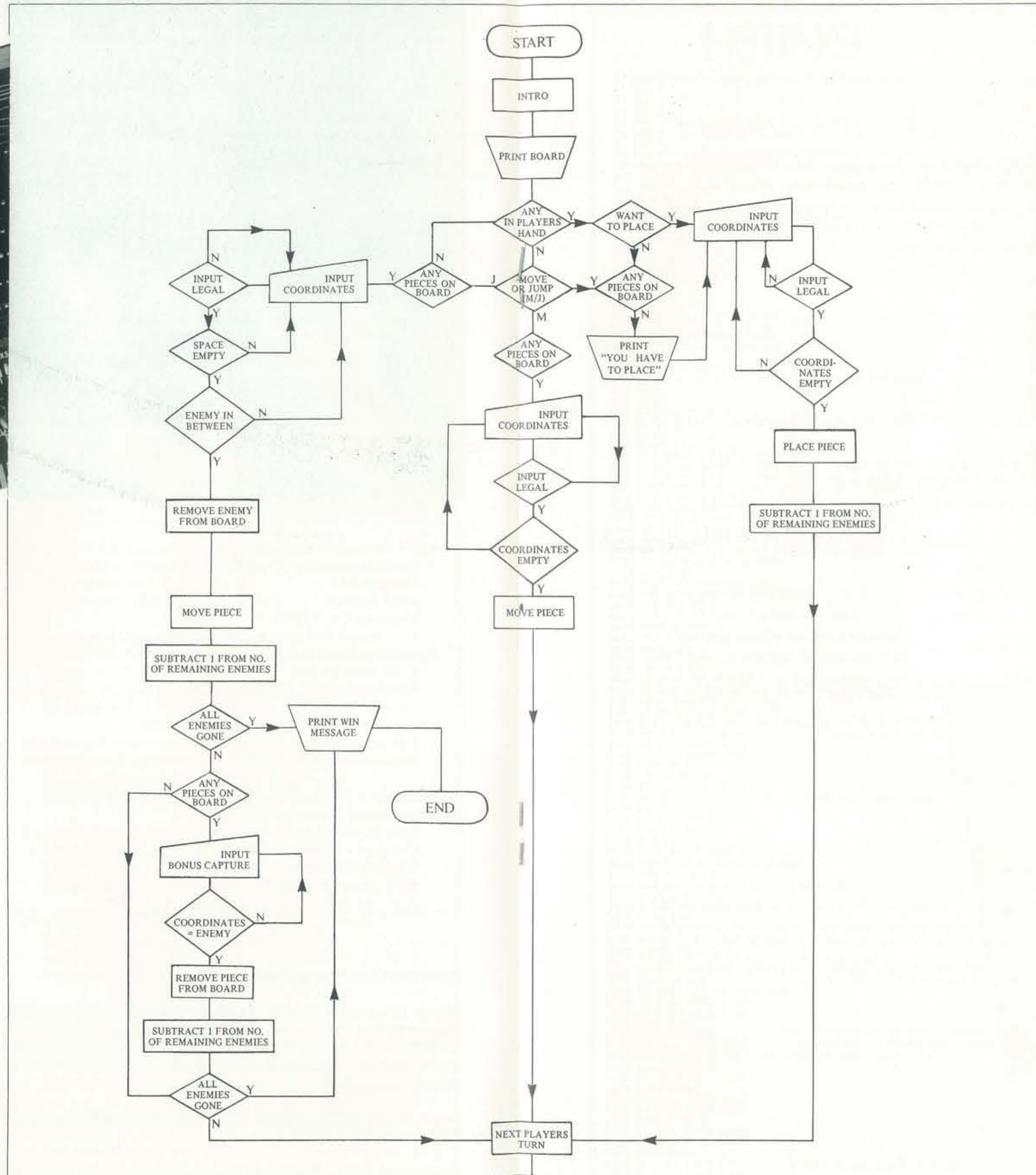
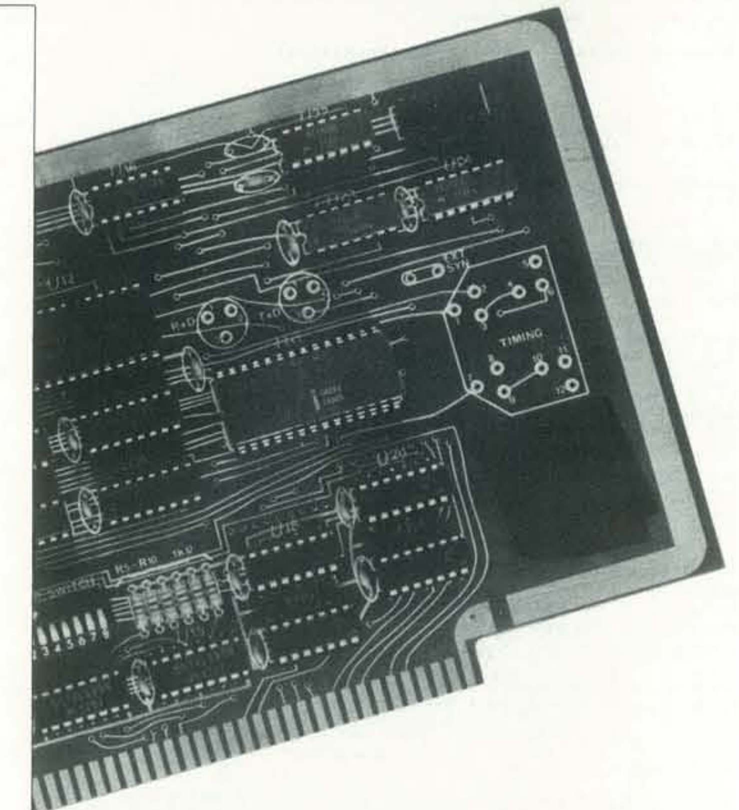


Figure 1. Yoté Flowchart

GAMES • GAMES • GAMES • GAMES • GAMES • GAMES • GAMES • GAMES • GAMES • GAMES



THE PROGRAM

The program is made up of several basic steps. See Figure 1, the Yoté flowchart. It should run in almost any type of Basic with little or no conversion necessary. The only things you may have to change are the use of multiple statements per line and the use of the left$ function. I have left enough space between the line numbers to cure the problem of multiple statements per line, and as far as the left$ command goes, it can be left out without affecting the operation of the program. Otherwise, there should be no difficulty with the program. Figure 2 shows the running of Yoté.

The program is written in Altair 8K Basic Rev. 4.0. (See Figure 3 for program listing.) It will use about 4.5K of memory (not including what you will need for Basic) but by deleting the REM statements and the rules at the end of the program, it can be reduced to 3.5 or 4K of memory.

If you own a CRT, it would be a good idea to use it, because the program has a tendency to consume a lot of paper. Also, if you have a CRT that doesn't have automatic scrolling, you will want to add a statement that will clear your terminal's screen (it would be best inserted at line 403).

For anyone who does not want to type in the program, write to me at 511 Franklin Avenue, Council Bluffs, IA 51501, for information about purchasing a paper tape of the program.

So have the best of fun and good luck with Yoté. □

MARK WICKHAM is a 15-year-old sophomore at St. Alberts High School in Council Bluffs, Iowa. He and his father constructed a homebrew 8080 with 16K of memory. They also have a Model 40 Teletype CRT and a Model 37 printer.

```
RUN
****************************************

                   YOTE

****************************************

DO YOU WANT INSTRUCTIONS? YES

TWO PLAYERS ARE EQUIPPED WITH TWELVE PIECES
PLAYER 1 WILL HAVE 'X' AND PLAYER 2 WILL
HAVE 'O'.  EACH PLAYER THEN ATTEMPTS TO CAP-
TURE ALL OF HIS OPPONENTS PIECES FIRST.

THE PLAYER WITH 'O' STARTS THE GAME BY PUT-
TING A PIECE IN ANY SPOT ON THE 5 X 6 BOARD.
THEN THE OTHER PLAYER PLACES ONE OF HIS PIECES
ON THE BOARD.  ONLY ONE PIECE MAY BE PLAYED
ON EACH TURN. A PLAYER DOES NOT HAVE TO PLACE
ALL HIS PIECES ON THE BOARD BEFORE HE STARTS
TO MOVE THOSE HE HAS ALREADY PUT DOWN; HE MAY
HOLD SOME IN RESERVE UNTIL LATER IN THE GAME.
PIECES MAY BE MOVED ONE SPACE IN A STRAIGHT
LINE, BUT NOT DIAGONALLY, AND ONLY TO A VACANT
SPACE.

A PLAYER MAY CAPTURE ONE OF HIS OPPONENTS
PIECES BY JUMPING OVER IT AND REMOVING IT FROM
THE BOARD.  HE IS THEN ALLOWED A BONUS CAPTURE,
THE CHOICE OF REMOVING ANY OF HIS OPPONENTS
PIECES STILL ON THE BOARD. ---- GOOD LUCK----

TYPE IN NAME OF PLAYER 1 ? MARK
TYPE IN NAME OF PLAYER 2 ? KEVIN

 -  -  -  -  -  -

 -  -  -  -  -  -

 -  -  -  -  -  -

 -  -  -  -  -  -

 -  -  -  -  -  -


MARK HAS 12 PIECES IN HIS HAND
KEVIN HAS 12 PIECES IN HIS HAND

MARK, DO YOU WANT TO PLACE (P), MOVE (M), OR JUMP (J) ? P
WHAT ARE THE CO-ORDINATES OF THE PIECE? 2,5

 -  -  -  -  -  -

 -  -  -  -  O  -

 -  -  -  -  -  -

 -  -  -  -  -  -

 -  -  -  -  -  -


MARK HAS 11 PIECES IN HIS HAND
KEVIN HAS 12 PIECES IN HIS HAND

KEVIN, DO YOU WANT TO PLACE (P), MOVE (M), OR JUMP (J) ? P
WHAT ARE THE CO-ORDINATES OF THE PIECE? 2,4

 -  -  -  -  -  -

 -  -  -  X  O  -

 -  -  -  -  -  -

 -  -  -  -  -  -

 -  -  -  -  -  -


MARK HAS 11 PIECES IN HIS HAND
KEVIN HAS 11 PIECES IN HIS HAND

MARK, DO YOU WANT TO PLACE (P), MOVE (M), OR JUMP (J) ? M
WHERE DO YOU WANT TO MOVE FROM? 2,5
TO? 2,6

 -  -  -  -  -  -

 -  -  -  X  -  O

 -  -  -  -  -  -

 -  -  -  -  -  -

 -  -  -  -  -  -


MARK HAS 11 PIECES IN HIS HAND
KEVIN HAS 11 PIECES IN HIS HAND

KEVIN, DO YOU WANT TO PLACE (P), MOVE (M), OR JUMP (J) ? P

Later in the same game --

 -  -  -  -  -  -

 -  -  -  -  -  -

 -  -  -  X  X  -

 -  -  O  -  O  -

 -  -  -  -  -  -


MARK HAS 0 PIECES IN HIS HAND
KEVIN HAS 2 PIECES IN HIS HAND

BONUS CAPTURE=? 4,3

 -  -  -  -  -  -

 -  -  -  -  -  -

 -  -  -  X  X  -

 -  -  -  -  O  -

 -  -  -  -  -  -


MARK HAS 0 PIECES IN HIS HAND
KEVIN HAS 2 PIECES IN HIS HAND

MARK, DO YOU WANT TO PLACE (P), MOVE (M), OR JUMP (J) ? M
WHERE DO YOU WANT TO MOVE FROM? 4,5
TO? 4,4

 -  -  -  -  -  -

 -  -  -  -  -  -

 -  -  -  X  X  -

 -  -  -  O  -  -

 -  -  -  -  -  -


MARK HAS 0 PIECES IN HIS HAND
KEVIN HAS 2 PIECES IN HIS HAND

KEVIN, DO YOU WANT TO PLACE (P), MOVE (M), OR JUMP (J) ? J
WHERE DO YOU WANT TO JUMP FROM? 3,4
TO? 5,4

THATS THE GAME..  KEVIN IS THE WINNER.
YOU LOSE MARK, YOU SHOULD TRY HARDER.
OK
```

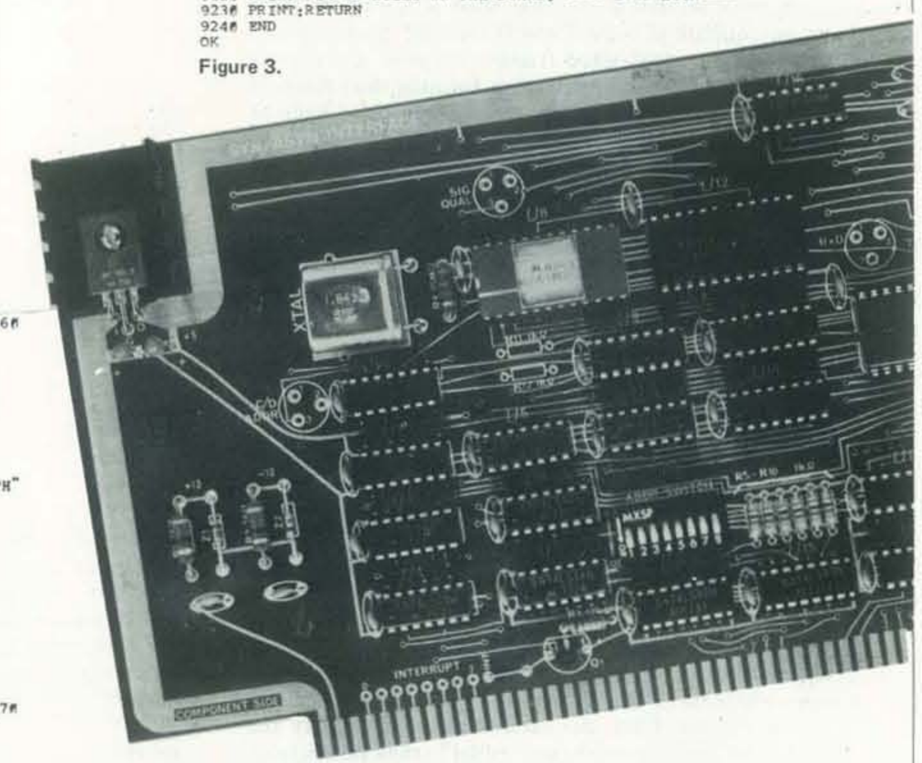
Figure 2. Running of YOTÉ

LISTING

```
LIST

50 REM ****************************************
51 REM *                                      *
52 REM *                YOTE                  *
53 REM *                                      *
54 REM *  Written by Mark Wickham 2-14-1980   *
55 REM *      Altair 8K Basic Rev. 4.0        *
56 REM *                                      *
57 REM ****************************************
100 FOR G=1 TO 40:PRINT"*";:NEXT G:PRINT:PRINT:PRINT TAB(19)"YOTE"
110 PRINT
120 FOR G=1 TO 40:PRINT"*";:NEXT G:PRINT:PRINT
130 DIM A(5,6)
200 INPUT"DO YOU WANT INSTRUCTIONS";A$
210 IF LEFT$(A$,1)="Y" THEN GOSUB 9000
300 FOR I=1 TO 2:PRINT"TYPE IN NAME OF PLAYER";I;:INPUT N$(I)
310 NEXT I
320 I=1
330 T(1)=12:T(2)=12
400 REM PRINT BOARD
405 PRINT:PRINT
410 FOR J=1 TO 5
420 FOR K=1 TO 6
430 IF A(J,K)=0 THEN PRINT" - ";
440 IF A(J,K)=1 THEN PRINT" O ";
450 IF A(J,K)=2 THEN PRINT" X ";
460 NEXT K:PRINT:PRINT:NEXT J
465 PRINT
470 FOR P9=1 TO 2
480 PRINT N$(P9);" HAS";T(P9)"PIECES IN HIS HAND"
490 NEXT P9
495 PRINT
499 IF R9=1 THEN 3570
500 PRINT N$(I)", DO YOU WANT TO PLACE (P), MOVE (M), OR JUMP (J) ";
505 R9=0
510 INPUT A$
520 IF LEFT$(A$,1)="P" THEN 1000
530 IF LEFT$(A$,1)="M" THEN 2000
540 IF LEFT$(A$,1)="J" THEN 3000
550 PRINT"THERE IS NO SUCH COMMAND AS ";A$:GOTO 500
599 IF R=1 THEN 3570
1000 REM PLACE ROUTINE GOES HERE
1010 IF T(I)=0 THEN PRINT"YOU HAVE NO MORE TO PLACE"
1020 IF T(I)=0 THEN 500
1080 INPUT"WHAT ARE THE CO-ORDINATES OF THE PIECE";J,K
1090 IF J<1 OR J>5 OR K<1 OR K>6 THEN 1080
1100 IF A(J,K)<>0 THEN 1080
1110 A(J,K)=I
1120 T(I)=T(I)-1:GOTO 8000
2000 REM MOVE ROUTINE GOES HERE
2010 FOR J=1 TO 5
2020 FOR K=1 TO 6:IF A(J,K)=I THEN 2060
2030 NEXT K:NEXT J
2040 PRINT"YOU HAVE NONE ON THE BOARD TO MOVE"
2050 GOTO 500
2060 INPUT "WHERE DO YOU WANT TO MOVE FROM";J,K
2070 INPUT"TO";J1,K1
2080 IF J1<1 OR J1>5 OR K1<1 OR K1>6 THEN 2180
2090 IF J<1 OR J>5 OR K<1 OR K>6 THEN 2180
2100 IF A(J,K)<>I THEN 2180
2105 IF A(J,K)<>I THEN 3180
2110 R1=J1:R2=K1
2120 IF A(R1,R2)<>0 THEN GOTO 2180
2130 IF J=J1 THEN 2160
2140 IF K=K1 THEN 2190
2150 GOTO 2180
2160 K3=ABS(K1-K)
2170 IF K3=1 THEN 2220
2180 PRINT"MOVE IS NO GOOD, TYPE IT OVER":GOTO 2060
2190 K4=ABS(J1-J)
2200 IF K4=1 THEN 2220
2210 GOTO 2180
2220 A(J,K)=0
2230 A(J1,K1)=I:GOTO 9000
3000 REM JUMP ROUTINE GOES HERE
3010 FOR J=1 TO 5
3020 FOR K=1 TO 6:IF A(J,K)=I THEN 3070
3030 NEXT K:NEXT J
3040 PRINT"YOU HAVE NONE ON THE BOARD TO JUMP WITH"
3050 GOTO 500
3070 INPUT"WHERE DO YOU WANT TO JUMP FROM";J,K
3075 Z1=J:Z2=K:IF J=0 OR K=0 THEN 500
3080 INPUT"TO";J1,K1
3090 IF J<1 OR J>5 OR K<1 OR K>6 THEN 3180
3100 IF J1<1 OR J1>5 OR K1<1 OR K1>6 THEN 3180
3110 R1=J1:R2=K1
3120 IF A(R1,R2)<>0 THEN 3180
3130 IF J=J1 THEN 3160
3140 IF K=K1 THEN 3190
3150 GOTO 3180
3160 K3=ABS(K1-K)
3170 IF K3=2 THEN 3220
3180 PRINT"JUMP IS NO GOOD, TYPE IT OVER":GOTO 3070
3190 K4=ABS(J1-J)
3200 IF K4=2 THEN 3220
3210 GOTO 3180
3220 IF J=J1 THEN 3250
3230 IF K=K1 THEN 3400
3240 GOTO 3180
3250 IF K>K1 THEN K=K-1
3260 IF K1>X THEN K=K+1
3270 GOTO 3500
3400 IF J>J1 THEN J=J-1
3410 IF J1>J THEN J=J+1
3500 IF A(J,K)=0 OR A(J,K)=I THEN 3180
3510 A(J,K)=0
3520 A(J1,K1)=I
3530 A(Z1,Z2)=0
3540 IF I=1 THEN D3=2
3550 IF I=2 THEN D3=1
3560 P(D3)=P(D3)+1:R9=1
3565 IF P(D3)=12 THEN 5000
3567 GOTO 400
3570 FOR J=1 TO 5
3580 FOR K=1 TO 6:IF A(J,K)=D3 THEN 3610
3590 NEXT K:NEXT J
3600 PRINT"OOPS! YOU DONT GET A BONUS CAPTURE- ";N$(D3);" HAS NO ONE ON
3605 PRINT"THE BOARD.  TOO BAD!"
3606 R9=0
3607 GOTO 8000
3610 INPUT"BONUS CAPTURE=";J,K
3615 R9=0
3617 IF J<1 OR K<1 OR J>5 OR K>6 THEN 3610
3620 IF A(J,K)<>D3 THEN 3610
3630 A(J,K)=0
3640 P(D3)=P(D3)+1:IF P(D3)=12 THEN 5000
3650 GOTO 8000
5000 PRINT:PRINT:PRINT"THATS THE GAME..  ";N$(I);" IS THE WINNER. "
5010 PRINT"YOU LOSE ";N$(D3);", YOU SHOULD TRY HARDER."
5020 END
8000 I=I+1:IF I>2 THEN I=1
8010 GOTO 400
9000 PRINT:PRINT:REM RULES
9010 PRINT"TWO PLAYERS ARE EQUIPPED WITH TWELVE PIECES"
9020 PRINT"PLAYER 1 WILL HAVE 'X' AND PLAYER 2 WILL"
9030 PRINT"HAVE 'O'.  EACH PLAYER THEN ATTEMPTS TO CAP-"
9040 PRINT"TURE ALL OF HIS OPPONENTS PIECES FIRST."
9050 PRINT
9060 PRINT"THE PLAYER WITH 'O' STARTS THE GAME BY PUT-"
9070 PRINT"TING A PIECE IN ANY SPOT ON THE 5 X 6 BOARD."
9080 PRINT"THEN THE OTHER PLAYER PLACES ONE OF HIS PIECES"
9090 PRINT"ON THE BOARD.  ONLY ONE PIECE MAY BE PLAYED"
9100 PRINT"ON EACH TURN. A PLAYER DOES NOT HAVE TO PLACE"
9110 PRINT"ALL HIS PIECES ON THE BOARD BEFORE HE STARTS"
9120 PRINT"TO MOVE THOSE HE HAS ALREADY PUT DOWN; HE MAY"
9130 PRINT"HOLD SOME IN RESERVE UNTIL LATER IN THE GAME."
9140 PRINT"PIECES MAY BE MOVED ONE SPACE IN A STRAIGHT"
9150 PRINT"LINE, BUT NOT DIAGONALLY, AND ONLY TO A VACANT"
9160 PRINT"SPACE."
9170 PRINT
9180 PRINT"A PLAYER MAY CAPTURE ONE OF HIS OPPONENTS"
9190 PRINT"PIECES BY JUMPING OVER IT AND REMOVING IT FROM"
9200 PRINT"THE BOARD.  HE IS THEN ALLOWED A BONUS CAPTURE,"
9210 PRINT"THE CHOICE OF REMOVING ANY OF HIS OPPONENTS"
9220 PRINT"PIECES STILL ON THE BOARD. ---- GOOD LUCK----"
9230 PRINT:RETURN
9240 END
OK
```

Figure 3.



END

DOZO IN PASCAL

BY STEPHEN R. BERGGREN

In an article in the April 1980 issue of *Recreational Computing,* Herbert Kohl described a Japanese board game called Dozo. He suggested that it would be an interesting challenge to program the game. He was right; it was a very interesting programming challenge. That's why I chose to program it in PASCAL instead of BASIC. PASCAL is often considered to be a 'serious' programming language. But the power and speed that make it such a good language for business, research and education also make it an ideal language for games.

Dozo is a game played on a triangular board whose sides are seven spaces wide. It looks like a pyramid with a base of seven positions and a height of seven positions. The pieces used on the board are of four colors; blue, green, orange and violet. The players take turns placing a piece of any color on any unoccupied position on the board. The winning player is the one who places a piece so that it and two other pieces of the same color form an equilateral (equal-sided) triangle. So the object is to try to form an equal-sided triangle on your move while trying to prevent your opponent from forming one. Keep in mind that either player can use any color piece. Also keep in mind that the triangle may be right side up, upside down, or tilted at any angle as long as the sides are the same length.

I chose Apple PASCAL as the language for this program because it provides several advantages in applications of this type. First, PASCAL is a structured, block-oriented language. Its use of procedures and its complex array, set and boolean (true or false) variables allow very straightforward programming. Second, PASCAL is very fast. In this version of the language, the program is compiled into a pseudo-machine language called p-code. The p-code is then interpreted. The p-code interpretation goes much faster than BASIC interpretation. Third, the Apple turtlegraphics functions make high-resolution color graphics very simple. Finally, the most important reason for using PASCAL was that I had just received my Apple Language System and wanted to find out just what it could do for me. The best way to learn about a new language is to use it.

The PASCAL program is really just a series of procedures, each designed to solve some part of the overall problem. The use of these procedures in the main program closely follows the logic of the game. First, the variables needed to play the game are set. The procedure labeled "filltri" takes values from the file labeled "dozofile" and puts them into the array labeled "corner." These values correspond to the corner locations of every winning triangle. This file is listed in Table 1. The procedure "setlocs" calculates the locations on the screen of each board position. Once the variables are set, "drawboard" sets up the screen for play and provides instructions for playing the game.

Table 1. Dozofile Values

4	12	5	15	19	17	24	24	20
6	13	6	11	17	18	26	25	21
2	13	7	21	20	22	23	25	25
3	14	8	16	18	23	27	26	26
2	14	9	15	21	24	17	26	27
3	15	10	11	19	25	20	27	28
4	7	1	20	10	4	23	25	6
5	4	2	21	6	7	24	13	9
5	7	3	16	9	8	26	18	10
6	8	4	17	10	11	27	19	13
2	11	5	10	13	12	12	24	14
3	12	6	7	14	13	14	25	15
4	13	7	14	15	16	17	26	18
4	2	8	10	3	17	18	5	19
5	4	9	15	5	18	18	8	20
5	5	10	11	6	19	19	9	21
6	7	11	12	8	22	20	12	24
6	8	12	7	9	23	19	13	25
7	9	13	19	10	24	23	14	26
7	11	14	14	12	25	24	17	27
8	12	15	16	13	26	25	18	28
8	13	1	20	14	2	24	19	3
8	14	2	15	15	4	25	20	5
9	16	3	11	17	5	25	23	6
9	17	4	17	18	7	26	24	8
9	18	5	21	19	8	25	25	9
10	19	6	12	20	9	26	26	10
10	20	7	18	21	11	27	27	12
2	1	8	6	22	12	8	28	13
3	1	9	4	16	13	9	21	14
4	2	10	9	22	14	12	27	15
5	3	11	7	23	16	13	28	17
5	1	12	10	11	17	13	15	18
6	2	13	8	16	18	14	20	19
7	3	14	13	17	19	17	21	20
8	4	15	14	22	20	18	26	21
8	5	16	11	23	22	18	27	23
9	6	17	12	24	23	19	28	24
9	1	18	15	7	24	19	10	25
10	2	19	13	11	25	20	14	26
11	3	20	18	12	26	23	15	27
12	4	21	16	16	27	24	19	28

Now comes the actual play. First, "getmove" takes the player's input from the keyboard and one of the game paddles and puts the move on the screen. Winner then checks to see if that move won the game. If not, "winmove" looks for a winning move for the computer. Obviously if the computer cannot win, it wants to avoid losing. "Fastmove" and "nowin" both look for a move that won't lose the game. "Fastmove" looks first at triangles that have the player's last move at one corner. Because in the middle game these are often the only moves available, "fastmove" will often end an acceptable move very quickly. If "fastmove" can't find a move, "nowin" will search the remaining positions for an acceptable move. If there are no winning moves and no nonwinning moves, the computer must make a losing move. Loser does this but tries to make the losing move as inconspicuous as possible. This sequence of play continues until one of the boolean variables win, won or tied becomes true. "Writeend" then provides the game results.

The program should be very simple to enter and use. If your version of PASCAL does not have the graphics capabilities of the Apple, some of the procedures may have to be modified but the main program should run almost exactly as listed. If your system has the graphics capability but does not have color, the block procedure can be made to print a character instead of a colored block. The file "dozofile.text" is simply a text file typed from the editor. This is PASCAL's answer to the data statement. Enter each number in the table, separated by carriage returns. The procedure "filltri" will convert these characters into numbers for the array labeled "corner." The order of the numbers is very important because it determines which set of positions can win the game.

Almost every programming language devised by man has at some time been used for recreation. This program should prove that PASCAL is not going to be an exception. □

Stephen R. Berggren is a captain in the U.S. Air Force and currently lives in Dayton, Ohio. He holds a B.S. degree in chemical engineering from Rose-Hulman Institute of Technology and is pursuing an M.S. degree in nuclear engineering at the Air Force Institute of Technology. He has been interested in personal computers as a hobby for about two years, primarily in the software end, including programming in Pascal, BASIC and several assembly languages. His favorite pasttime is programming a computer to play games against a human opponent. He owns an Apple II with a language system, Heath H-14 printer and micromodem.

LISTING

```
(*$S+*)
PROGRAM DOZO;

USES TURTLEGRAPHICS, APPLESTUFF;

CONST NUMTRI = 126;(* # OF WINNING TRIANGLES *)
      NUMPOS = 28;(* # OF BOARD POSITIONS *)

TYPE  POSITION = 1..NUMPOS;
      TRIANG   = 1..NUMTRI;
      THREE    = 1..3;
      VALCOLOR = 0..10000;

VAR   WIN, WON, NWIN, TIED, FMOVE : BOOLEAN;(* GAME CONTROL VARIABLES *)
      TRIWIN, TRIWON : TRIANG;(* WIN=COMPUTER, WON=PLAYER *)
      WINCOLOR, WONCOLOR : VALCOLOR;
      WINPOS, GMOVE : POSITION;
      CH : CHAR;
      TRIANGLE :ARRAY[TRIANG, THREE] OF VALCOLOR;
      (* COLOR OF THE CORNERS OF EACH TRIANGLE *)
      CORNER : ARRAY[TRIANG, THREE] OF POSITION;
      (* BOARD POSITION OF CORNERS OF EACH TRIANGLE *)
      BOARDPOS : ARRAY[POSITION] OF VALCOLOR;
      (* COLOR OF EACH BOARD POSITION *)
      XPOS, YPOS : ARRAY[POSITION] OF INTEGER;
      (* X, Y SCREEN POSITION OF EACH BOARD POSITION *)
      DOZOFILE : FILE OF CHAR;
      (* HOLDS THE BOARD POSITIONS OF CORNERS OF EACH WINNING TRIANGLE *)
      I,J,MOVES : INTEGER;

PROCEDURE FILLTRI;
(* FILL CORNER[] FROM DOZOFILE.TEXT *)

VAR I,J : INTEGER;

BEGIN
  RESET(DOZOFILE,'DOZOFILE.TEXT');
  FOR I := 1 TO 3 DO
  FOR J := 1 TO NUMTRI DO
  READLN(DOZOFILE,CORNER[J,I]);
  CLOSE(DOZOFILE);
END;

PROCEDURE SETLOCS;
(* FILLS XPOS, YPOS WITH SCREEN POSITIONS *)

VAR A,I,ROW : INTEG(*$S+*)

PROGRAM DOZO;

USES TURTLEGRAPHICS, APPLESTUFF;

CONST NUMTRI = 126;(* # OF WINNING TRIANGLES *)
      NUMPOS = 28;(* # OF BOARD POSITIONS *)

TYPE  POSITION = 1..NUMPOS;
      TRIANG   = 1..NUMTRI;
      THREE    = 1..3;
      VALCOLOR = 0..10000;

VAR   WIN, WON, NWIN, TIED, FMOVE : BOOLEAN;(* GAME CONTROL VARIABLES *)
      TRIWIN, TRIWON : TRIANG;(* WIN=COMPUTER, WON=PLAYER *)
      WINCOLOR, WONCOLOR : VALCOLOR;
      WINPOS, GMOVE : POSITION;
      CH : CHAR;
      TRIANGLE :ARRAY[TRIANG, THREE] OF VALCOLOR;
(* COLOR OF THE CORNERS OF EACH TRIANGLE *)
CORNER : ARRAY[TRIANG, THREE] OF POSITION;
(* BOARD POSITION OF CORNERS OF EACH TRIANGLE *)
BOARDPOS : ARRAY[POSITION] OF VALCOLOR;
(*$S+*)

PROGRAM DOZO;

USES TURTLEGRAPHICS, APPLESTUFF;

CONST NUMTRI = 126;(* # OF WINNING TRIANGLES *)
      NUMPOS = 28;(* # OF BOARD POSITIONS *)

TYPE  POSITION = 1..NUMPOS;
      TRIANG   = 1..NUMTRI;
      THREE    = 1..3;
      VALCOLOR = 0..10000;

VAR   WIN, WON, NWIN, TIED, FMOVE : BOOLEAN;(* GAME CONTROL
      VARIABLES *)
      TRIWIN, TRIWON : TRIANG;(* WIN=COMPUTER, WON=PLAYER *)
      WINCOLOR, WONCOLOR : VALCOLOR;
      WINPOS, GMOVE : POSITION;
      CH : CHAR;
      TRIANGLE :ARRAY[TRIANG, THREE] OF VALCOLOR;
      (* COLOR OF THE CORNERS OF EACH TRIANGLE *)
      CORNER : ARRAY[TRIANG, THREE] OF POSITION;
      (* BOARD POSITION OF CORNERS OF EACH TRIANGLE *)
      BOARDPOS : ARRAY[POSITION] OF VALCOLOR;
      (* COLOR OF EACH BOARD POSITION *)
      XPOS, YPOS : ARRAY[POSITION] OF INTEGER;
      (* X, Y SCREEN POSITION OF EACH BOARD POSITION *)
```

(continued)

```
   DOZOFILE : FILE OF CHAR;
   (* HOLDS THE BOARD POSITIONS OF CORNERS OF EACH WINNING TRIANGLE *)
   I,J,MOVES : INTEGER;

PROCEDURE FILLTRI;
(* FILL CORNER[] FROM DOZOFILE.TEXT *)

VAR I,J : INTEGER;

BEGIN
   RESET(DOZOFILE,'DOZOFILE.TEXT');
   FOR I := 1 TO 3 DO
  FOR J := 1 TO NUMTRI DO
  READLN(DOZOFILE,CORNER[J,I]);
   CLOSE(DOZOFILE);
END;

PROCEDURE SETLOCS;
(* FILLS XPOS, YPOS WITH SCREEN POSITIONS *)

VAR A,I,ROW : INTEGER;

BEGIN
   A := 1;
   FOR ROW := 1 TO 7 DO
     FOR I := 1 TO ROW DO
       BEGIN
         YPOS[A] := (7-ROW)*23+1;
        XPOS[A] := ((I*2)+6-ROW)*15+45;
         A := A+1;
      END;

      PROCEDURE BLOCK(X,Y:INTEGER;DRAWCOLOR:VALCOLOR);
      (* PUTS A COLORED BLOCK ON THE SCREEN *)

      BEGIN
         VIEWPORT(X,X+10,Y,Y+9);
        IF DRAWCOLOR = 0 THEN FILLSCREEN(WHITE2);
        IF DRAWCOLOR = 1 THEN FILLSCREEN(BLUE);
        IF DRAWCOLOR = 10 THEN FILLSCREEN(GREEN);
        IF DRAWCOLOR = 100 THEN FILLSCREEN(ORANGE);
        IF DRAWCOLOR = 1000 THEN FILLSCREEN(VIOLET);
        IF DRAWCOLOR = 10000 THEN FILLSCREEN(BLACK2);
        VIEWPORT(0,279,0,191);
      END;

      PROCEDURE DRAWSIDES( TRIIN : TRIANG; COLORIN : VALCOLOR);
      (* DRAWS A TRIANGLE *)

      VAR INX,INY : INTEGER;

      BEGIN
         INX := XPOS[CORNER[TRIIN,1]]+5;
        INY := YPOS[CORNER[TRIIN,1]]+4;
        MOVETO(INX,INY);
        IF COLORIN = 1 THEN PENCOLOR(BLUE);
        IF COLORIN = 10 THEN PENCOLOR(GREEN);
        IF COLORIN = 100 THEN PENCOLOR(ORANGE);
        IF COLORIN = 1000 THEN PENCOLOR(VIOLET);
        INX := XPOS[CORNER[TRIIN,2]]+5;
        INY := YPOS[CORNER[TRIIN,2]]+4;
        MOVETO(INX,INY);
         INX := XPOS[CORNER[TRIIN,3]]+5;
        INY := YPOS[CORNER[TRIIN,3]]+4;
        MOVETO(INX,INY);
         INX := XPOS[CORNER[TRIIN,1]]+5;
        INY := YPOS[CORNER[TRIIN,1]]+4;
        MOVETO(INX,INY);
  PENCOLOR(NONE);
END;
PROCEDURE INSTRUCT;
(* GIVES INSTRUCTIONS *)

VAR CH : CHAR;

BEGIN
   TEXTMODE;
  WRITELN;
  WRITELN;
  WRITELN('                  D O Z O');
  WRITELN;
  WRITELN;
  WRITELN('THE OBJECT OF THE GAME IS TO CREATE AN');
  WRITELN;
  WRITELN('EQUILATERAL (EQUAL-SIDED) TRIANGLE BY');
  WRITELN;
  WRITELN('PLACING THREE BLOCKS OF THE SAME COLOR');
  WRITELN;
  WRITELN('AT THE CORNERS.  TO MAKE A MOVE, USE');
  WRITELN;
  WRITELN('PADDLE(0) TO MOVE THE FLASHING BLOCK');
  WRITELN;
  WRITELN('TO THE RIGHT PLACE.  THEN PRESS THE KEY');
  WRITELN;
  WRITELN('FOR THE COLOR YOU WANT.');
  WRITELN;
  WRITELN;
  WRITELN('           (PRESS ANY KEY)');
  WRITELN;
  WRITELN;
  WHILE NOT KEYPRESS DO;
  READ(KEYBOARD,CH);
  GRAFMODE;
END;

PROCEDURE DRAWBOARD;
(* SETS UP BOARD *)

VAR I : POSITION;
    CH : CHAR;

BEGIN
  INITTURTLE;
  FOR I:= 1 TO NUMPOS DO BLOCK(XPOS[I],YPOS[I],0);
  BLOCK(5,170,1);
  MOVETO(20,170);
  WSTRING(' B - BLUE');
  BLOCK(5,150,10);
  MOVETO(20,150);
  WSTRING(' G - GREEN');
  BLOCK(5,130,100);
  MOVETO(20,130);
  WSTRING(' O - ORANGE');
  BLOCK(5,110,1000);
  MOVETO(20,110);
  WSTRING(' V - VIOLET');
  MOVETO(200,170);
  WSTRING('D O Z O');
  MOVETO(185,155);
  WSTRING('INSTRUCTIONS?');
  WHILE NOT KEYPRESS DO;
  READ(KEYBOARD,CH);
  IF CH = 'Y' THEN INSTRUCT;
  MOVETO(185,155);
  WSTRING('             ');
END;
```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```
PROCEDURE MAKEMOVE ( MOVEIN : POSITION ; COLORIN : VALCOLOR );
(* MAKES MOVE OR PROPOSED MOVE *)

VAR M,N : INTEGER;

BEGIN
   FOR N := 1 TO NUMTRI DO FOR M := 1 TO 3 DO
     IF CORNER[N,M] = MOVEIN THEN TRIANGLE[N,M] := COLORIN;
  BOARDPOS[MOVEIN] := COLORIN;
END;

PROCEDURE CLEARMOVE (MOVEIN : POSITION; COLORIN : VALCOLOR);
(* CLEARS MOVE PROPOSED BY MAKEMOVE *)

VAR M,N : INTEGER;

BEGIN
   FOR N := 1 TO NUMTRI DO FOR M := 1 TO 3 DO
     IF CORNER[N,M] = MOVEIN THEN TRIANGLE[N,M] := 0;
  BOARDPOS[MOVEIN] := 0;
END;

PROCEDURE GETMOVE;
(* GETS PLAYER'S MOVE FROM PADDLE(0) AND KEYBOARD *)

VAR MOVE : POSITION;
    INCOLOR : VALCOLOR;
    I : INTEGER;
    CH : CHAR;

BEGIN
   MOVETO(187,155);
   WSTRING(' YOUR MOVE ');
   REPEAT
     REPEAT
       FOR I := 1 TO 200 DO;
        MOVE := ((PADDLE(0) - 4) DIV 9) +1;
       CHARTYPE(6);
       MOVETO(XPOS[MOVE]+2,YPOS[MOVE]+1);
        WCHAR('*');
       FOR I := 1 TO 50 DO;
       MOVETO(XPOS[MOVE]+2,YPOS[MOVE]+1);
        WCHAR('*');
       CHARTYPE(10);
     UNTIL KEYPRESS AND (BOARDPOS[MOVE] = 0);
     READ(KEYBOARD,CH)
  UNTIL CH IN ['B','G','O','V'];
   CASE CH OF
     'B' : INCOLOR := 1;
     'G' : INCOLOR := 10;
     'O' : INCOLOR := 100;
     'V' : INCOLOR := 1000;
     END;
   BLOCK(XPOS[MOVE],YPOS[MOVE],INCOLOR);
   MAKEMOVE(MOVE,INCOLOR);
   MOVETO(187,155);
   WSTRING('  MY MOVE  ');
   GMOVE := MOVE;
END;

PROCEDURE WINNER;
(* CHECKS IF LAST MOVE WON *)

VAR N,TEST : INTEGER;

BEGIN
   N := 0;
   REPEAT
     N := N+1;
     TEST := TRIANGLE[N,1] + TRIANGLE[N,2] + TRIANGLE[N,3];
     IF (TEST=3) OR (TEST=30) OR (TEST=300) OR (TEST=3000) THEN
       BEGIN
         WON := TRUE;
         TRIWON := N;
         WONCOLOR := TEST DIV 3;
       END;
   UNTIL WON OR (N = NUMTRI);
END;

PROCEDURE WINMOVE;
(* LOOKS FOR A WINNING MOVE *)

VAR N,J,TEST : INTEGER;

BEGIN
   N := 0;
   WIN := FALSE;
  REPEAT
     N := N + 1;
     TEST := TRIANGLE[N,1] + TRIANGLE[N,2] + TRIANGLE[N,3];
     IF (TEST=2) OR (TEST=20) OR (TEST=200) OR (TEST=2000) THEN
       BEGIN
         WIN := TRUE;
         TRIWIN := N;
         WINCOLOR := TEST DIV 2;
         FOR J := 1 TO 3 DO
           IF TRIANGLE[N,J] = 0 THEN WINPOS := CORNER[N,J];
       END;
   UNTIL WIN OR (N = NUMTRI);
END;

PROCEDURE FASTMOVE;
(* LOOKS FOR GOOD MOVE AMONG TRIANGLES RELATED TO PLAYER'S LAST
MOVE *)

VAR I,J,K : INTEGER;
    TRYCOLOR : VALCOLOR;

BEGIN
   FMOVE := FALSE;
   I := 0;
   REPEAT
     I := I + 1;
     J := 0;
     REPEAT
       J := J + 1;
       IF CORNER[I,J] = GMOVE THEN
         BEGIN
           K := 0;
           REPEAT
             K := K + 1;
             IF TRIANGLE[I,K] = 0 THEN
               BEGIN
                 TRYCOLOR := 1;
                 REPEAT
                   MAKEMOVE(CORNER[I,K],TRYCOLOR);
                   WINMOVE;
                   CLEARMOVE(CORNER[I,K],TRYCOLOR);
                   TRYCOLOR := TRYCOLOR * 10;
                 UNTIL NOT WIN OR (TRYCOLOR = 10000);
                 IF NOT WIN THEN
                   BEGIN
                     TRYCOLOR := TRYCOLOR DIV 10;
```

(continued)

```
                    BLOCK(XPOS[CORNER[I,K]],YPOS[CORNER[I,K]],TRYCOLOR);
                    MAKEMOVE(CORNER[I,K],TRYCOLOR);
                    FMOVE := TRUE;
                    GMOVE := CORNER[I,K];
                  END;
              END;
          UNTIL FMOVE OR (K = 3);
        END;
    UNTIL FMOVE OR (J = 3);
  UNTIL FMOVE OR (I = NUMTRI);
END;
PROCEDURE NOWIN;
(* LOOKS FOR GOOD MOVE AT POSITIONS NOT TRIED BY FASTMOVE *)
VAR N,CVAL : INTEGER;
BEGIN
   NWIN := FALSE;
   N := 0;
   REPEAT
     N := N+1;
     IF BOARDPOS[N] = 0 THEN
       BEGIN
         CVAL := 1;
         REPEAT
           MAKEMOVE(N,CVAL);
           WINMOVE;
           CLEARMOVE(N,CVAL);
           CVAL := CVAL * 10;
         UNTIL NOT WIN OR (CVAL = 10000);
         IF NOT WIN THEN
           BEGIN
             CVAL := CVAL DIV 10;
             MAKEMOVE(N,CVAL);
             BLOCK(XPOS[N],YPOS[N],CVAL);
             NWIN := TRUE;
             GMOVE := N;
           END;
         WIN := FALSE;
       END;
   UNTIL (N = NUMPOS) OR NWIN;
END;
PROCEDURE LOSER;
(* MAKES LOSING MOVE *)

VAR N : INTEGER;
    MOVE : BOOLEAN;
BEGIN
   N := 0;
   MOVE := FALSE;
   REPEAT
     N := N + 1;
     IF(0=TRIANGLE[N,1])OR(0=TRIANGLE[N,2])OR(0=TRIANGLE[N,3]) THEN
       BEGIN
         IF (TRIANGLE[N,1] = 0) AND (TRIANGLE[N,2] = 0) THEN
           BEGIN
             MAKEMOVE(CORNER[N,2],TRIANGLE[N,3]);
             BLOCK(XPOS[CORNER[N,2]],YPOS[CORNER[N,2]],TRIANGLE[N,3]);
             MOVE := TRUE;
             GMOVE := CORNER[N,2];
           END;
         IF (TRIANGLE[N,2] = 0) AND (TRIANGLE[N,3] = 0) THEN
           BEGIN
             MAKEMOVE(CORNER[N,2],TRIANGLE[N,1]);
             BLOCK(XPOS[CORNER[N,2]],YPOS[CORNER[N,2]],TRIANGLE[N,1]);
             MOVE := TRUE;
             GMOVE := CORNER[N,2];
           END;
         IF (TRIANGLE[N,3] = 0) AND (TRIANGLE[N,1] = 0) THEN
           BEGIN
             MAKEMOVE(CORNER[N,3],TRIANGLE[N,2]);
             BLOCK(XPOS[CORNER[N,3]],YPOS[CORNER[N,3]],TRIANGLE[N,
                                                                2]);
             MOVE := TRUE;
             GMOVE := CORNER[N,3];
           END;
       END;
   UNTIL MOVE OR (N = NUMTRI);
END;

PROCEDURE WRITEEND;
(* GIVES RESULTS *)

BEGIN
   MOVETO(187,155);
   IF WON THEN WSTRING('  YOU WIN  ');
   IF WIN THEN WSTRING('   I WIN   ');
   IF TIED THEN WSTRING(' GAME TIED ');
   MOVETO(180,130);
   WSTRING('ANOTHER GAME?');
END;
BEGIN (*MAIN PROGRAM*)
   FILLTRI;
   SETLOCS;
   REPEAT
     WIN := FALSE;
     WON := FALSE;
     NWIN := FALSE;
     TIED := FALSE;
     FOR I := 1 TO NUMPOS DO BOARDPOS[I] := 0;
     FOR I := 1 TO NUMTRI DO
       BEGIN
         TRIANGLE[I,1] := 0;
         TRIANGLE[I,2] := 0;
         TRIANGLE[I,3] := 0;
       END;
     MOVES := 0;
     DRAWBOARD;
     REPEAT
       GETMOVE;
       WINNER;
       IF WON THEN DRAWSIDES(TRIWON,WONCOLOR)
       ELSE
         BEGIN
           WINMOVE;
           IF WIN THEN
             BEGIN
               BLOCK(XPOS[WINPOS],YPOS[WINPOS],WINCOLOR);
               DRAWSIDES(TRIWIN,WINCOLOR);
             END
           ELSE
             BEGIN
               FASTMOVE;
               IF NOT FMOVE THEN
                 BEGIN
                   NOWIN;
                   IF NOT NWIN THEN LOSER;
                 END;
             END;
         END;
       MOVES := MOVES + 1;
       IF MOVES = 14 THEN TIED := TRUE;
     UNTIL WIN OR WON OR TIED;
     WRITEEND;
     READ(KEYBOARD,CH);
   UNTIL CH = 'N';
   TEXTMODE;
END.
```

END

What is Truth?

BY WINSTON SMOCK

"What is truth?" jested Pilate as he washed his hands of the Nazarene affair. Before dismissing the procurator's remark as an ancient Judaean wisecrack, it is well to consider that philosophers have done little to improve on it in the last 2000 years.

How do we know that a thing is so? The ordinary answer to this question is that while one can never be quite sure, one gathers confidence in a fact with repeated confirmation. And, in the absence of any contrary evidence, this confidence in time amounts to a moral certainty.

The purpose of this little program, which is based on experiments conducted at Stanford University about twenty years ago by Professor John C. Wright, is to demonstrate that moral certainty is not always a reliable guide to reality.

The Wright experiment was used to produce experimental delusions. (A delusion is defined as a false belief that persists in spite of the facts. This definition leaves something to be desired. The Wright experiment does not help us much with this.) The original experiment, which is described in the book "How Real Is Real?" by Paul Watzlawick (Random House, 1976), is admirably suited for computerization. One may well ponder how many of one's own cherished beliefs are based on flimsier evidence than is afforded the hapless subject in this experiment.

Dr. Wright's original apparatus consisted of seventeen push buttons on a sloping panel with a three-digit counter. The subject was told to operate the buttons in such a way as to get the largest possible score on the counter, and that he will hear a buzzer sound when he presses the proper button. What the subject does not know is that there is no connection between the buttons and the buzzer. The buzzer is programmed to operate at random during the first 250 trials, then not at all for a while, then each time that a button is pressed until the end of the experiment. The subject tries one scheme and another in an effort to find the proper pattern, becomes discouraged during the period of no response, then elated when he seems to have hit on the proper sequence. At this point, he becomes convinced that he has solved the problem, and it is difficult to shake him in this belief. He may even become convinced that it is the experimenter who is deluded, and it may then be necessary to dismantle the machine and show him the wiring to convince him of the facts.

The program listing, appropriately entitled "Multiarmed Bandit," follows. □

```
10                    MULTIARMED BANDIT
20                    BY WINSTON SMOCK
30                    MAY 1980
40
50   REM   THIS PROGRAM, BASED ON "NONCONTINGENT REWARD"
60   REM   EXPERIMENTS CONDUCTED BY PROFESSOR JOHN C.
70   REM   WRIGHT OF THE UNIVERSITY OF KANSAS, CREATES
80   REM   DELUSIONS IN THE EXPERIMENTAL SUBJECT.
90   REM
100     R = 250
110     S = 300
120     T = 325
130     A = 0: I = 1
135  REM
140     PRINT "THIS IS AN EXPERIMENT IN PROBLEM SOLVING,"
150     PRINT "YOUR TASK IS TO RESPOND TO THE PROMPTS IN SUCH"
160     PRINT "A WAY AS TO GET THE LARGEST POSSIBLE SCORE,"
170     PRINT "OF COURSE, YOU WILL NOT KNOW HOW TO DO THIS AT"
180     PRINT "FIRST AND YOU WILL HAVE TO START WITH GUESSING"
190     PRINT "BUT YOU SHOULD BE ABLE TO IMPROVE YOUR GUESSES"
200     PRINT "AS YOU GO ALONG. WHENEVER YOU TYPE THE COR-"
210     PRINT "RECT LETTER, YOUR SCORE WILL GO UP ONE POINT,"
220     PRINT "YOU WILL NEVER EARN MORE THAN ONE POINT AT A TIME,"
230     PRINT "AND YOU WILL NEVER LOSE ANY POINTS. BEGIN BY"
240     PRINT "TYPING ANY LETTER OR NUMBER, THEN PRESS"
250     PRINT " 'ENTER.' IF YOU HAVE EARNED A POINT, THE"
260     PRINT "COUNTER WILL INCREMENT BY ONE. THEN TYPE ANO-"
270     PRINT "THER (OR THE SAME) CHARACTER. PLEASE CONTINUE"
280     PRINT "FOR";T;"TRIALS."
290     INPUT "BEGIN";X
300     CLS
310     PRINT "YOUR SCORE IS", A
320     PRINT AT 110, "TRIALS"; I
330     INPUT "TRY AGAIN"; X
340     I = I + 1
350     IF I < R GOSUB 1000
360     IF I > S THEN A = A + 1: GOSUB 1100
370     IF I = T GOTO 390
380     GOTO 300
390     CLS
400     PRINT AT 407, "THANK YOU."
410     PRINT AT 470, "END OF TEST."
999     END
1000 REM     TWO-VALUE RANDOM GENERATOR
1010    X = RND(2)
1020    IF X = 0 THEN A = A
1030    IF X = 1 THEN A = A + 1: GOSUB 1100
1040    RETURN
1100 REM     INSTEAD OF A BUZZER–
1110    FOR N = 1 TO 50
1120    PRINT "CONGRATULATIONS!"
1130    NEXT N
1140    RETURN
```

WINSTON SMOCK studied biochemistry at the University of Washington and UC Berkeley. He worked as an electrical engineer for Ampex Corporation before joining Finnigan Corporation in Sunnyvale as a technical editor.

Programming Problems—Solutions

Computer art by Hiroshi Kawano

COMMENTARY BY JIM CONLAN

Solutions. Solutions! Solutions? Solutions to problems great and small. It is time to check the mail and find out how to do some more of the problems from the Jan.-Feb. issue of *RC*. The solutions readers sent were a delight to read. Well-documented cleverness is a welcome commodity.

In the July-Aug. issue we printed 13 different solutions to problem number 1. We don't have quite that many different solutions this issue, but the solutions do illustrate the maxim that "the human mind is a great labor saving device."

Problem number 2, PALINDROMIC NUMBERS (Jan.-Feb. *RC*) asks for a program to decide whether a given number is a palindrome when written in some base 2 through 10. For example, the number 13231 is a palindrome because it reads the same way backward and forward. The number 16 is not a palindromic number, at least not in the standard base 10 representation. But, 16 = 121 (base 3), thus 16 is palindromic when written in base 3.

There are three things to do in this problem. First, input and check an integer between 1 and 999999. Second, change the number to base B for each B from 2 to 10. Third, check the base B representation to see if it is a palindrome. Here is the top part of the program, which manages these subroutines.

```
1  REM PALINDROMIC NUMBERS
10 DIM D(20)
20 PRINT "INPUT AN INTEGER
   FROM 1 TO 999999"
30 INPUT N
35 PRINT "YOUR NUMBER IS ";N
40 N1=N:REM SAVE A COPY OF N
50 IF N<>INT(N) OR N<1 OR
   N>999999 THEN 20
60 FOR B=2 TO 10
   65 REM FOR EACH B GO
      CHANGE N TO BASE B
   70 GOSUB 100
   75 REM NOW CHECK IF N (BASE
      B) IS A PALINDROME
   80 GOSUB 300
90 NEXT B
95 END
```

The heart of the problem is a subroutine to find the base B representation of a given number N. For example, to change the number 22 (base 10) into its base 3 representation, one must regroup the number into groups of 3.

```
22=(1+1+1)+(1+1+1)+(1+1+1)+(1+1+1)
+(1+1+1)+(1+1+1)+(1+1+1)+1
=3+3+3+3+3+3+3+1
=(3+3+3)+(3+3+3)+3+1
=9+9+3+1
```

When we indicate how many groups of each size are in 22, then we have the digits D(2)=2,D(1)=1, and D(0)=1 of the base 3 representation of 22. The number 22 (base 10) = 211 (base 3).

We can write a routine to do this procedure using only addition and subtraction. Here is a sketch of the process applied to change 22 to its base 3 representation.

STEP J=0. SUBTRACT AS MANY GROUPS OF 3 AS POSSIBLE FROM THE NUMBER N=22. THE NUMBER OF 3'S THAT CAN BE SUBTRACTED IS K=7. THERE IS D(0)=1 LEFT OVER. THIS IS THE 1'S DIGIT OF THE BASE 3 REPRESENTATION.

STEP J=1. REPEAT THE PROCEDURE ON THE N=K=7 GROUPS OF 3. THE NUMBER OF 3'S THAT CAN BE SUBTRACTED IS K=2. THERE IS D(1)=1 LEFT OVER. THIS IS THE 3'S DIGIT OF THE BASE 3 REPRESENTATION.

STEP J=2. REPEAT THE PROCEDURE ON THE NUMBER N=K=2. THE NUMBER OF 3'S THAT CAN BE SUBTRACTED IS K=0. THERE ARE N(2)=2 LEFT OVER. THIS IS THE 9'S DIGIT OF THE BASE 3 REPRESENTATION. BECAUSE K=0 THE ROUTINE IS DONE.

THEREFORE, 22=7*3+1=(2*3+1)*3+1=2*9+1*3+1=D(2)*3*2+D(1)*3↑1+D(0)*3↑0.

```
100 REM FIND BASE B REP FOR N
110 DIM D(20)
120 REM INITIALIZE DIGITS TO 0.
130 FOR I=0 TO 19:D(I)=0:NEXT I
140 INPUT N,B
150 J=0
160 REM IF N<B THEN DONE.
170 IF N<B THEN D(J)=N:RETURN
180 K=0
190 REM CHECK IF DONE
200 IF N<B THEN D(J)=N:
    GOTO 230
210 REM SUBTRACT AND
    COUNT GROUPS OF 3
220 N=N-B:K=K+1:GOTO 190
230 REM REPEAT THE PROCESS ON
    K
240 N=K:J=J+1:GOTO 160
250 RETURN
```

The previous method has some good points and some bad points. A good

point is that it uses the fundamental grouping process. One needs only to understand counting and subtraction to follow the procedure. The main disadvantage is that the routine is painfully slow for large numbers.

One can improve the previous method by using multiplication and powers. To find the representation of 22 in base 3 we proceed as follows. First, find the largest power J of 3 for which 3↑J is less than or equal to 22. This number is found to be 9=3↑2. Hence J=2. Next check how many groups of this size are in 22. The Jth digit is D(J)=INT(22/9)=2. We repeat this procedure on the remainder 22−D(2)*3↑2 to find the next lower order digits.

```
110 DIM D(20)
115 FOR I=0 TO 19:D(I)=0:NEXT I
120 J=0
125 INPUT N,B
130 J=J+1
140 IF B↑J>N THEN 160
150 GOTO 130
160 J=J-1
165 B9=B↑J
170 D(J)=INT(N/B9)
180 IF J=0 THEN 210
190 N=N-D(J)*B9
200 GOTO 160
210 RETURN
```

This method is much faster than the first method and still has the advantage that it corresponds closely to the fundamental grouping procedure and can be explained in simple arithmetic terms. It can be improved. There is (isn't there always?) a quicker way to find the highest power J of 3 that is less than or equal to 22. All one needs to do is solve the equation 3↑P =22. This takes a miracle method. Using the properties of logarithms, we see that P=LOG(22)/LOG(3)=2.81. Hence, the largest integer power of 3 that is less than or equal to 22 is J=INT(P)=2. Replace lines 120, 130, 140, 150, and 160 with the single line

```
140 J=INT(LOG(N)/LOG(B))
```

We have lost the childish simplicity of the first two methods but gained a shorter and faster program.

The next solution is the most elegant of all. Matt Bishop, William Hutchison, and Marv Schwanbeck contributed versions of this approach. Consider what happens when 22 is divided by 3.

```
N=2*3↑2+1*3+1=22
N/3=2*3+1+1/3
INT(N/3)=2*3+1
INT(N/3)*3=2*3*2+1*3
N-INT(N/3)*3=1.
```

We have picked off the first digit D(0)=1. To get the remaining digits we repeat the procedure on INT(N/3)=2*3+1. The following routine uses this method.

```
100 REM CHANGE N TO BASE B
110 DIM D(20)
120 J=0
125 INPUT N,B
130 Q=INT(N/B)
140 D(J)=N-Q*B
150 IF Q=0 THEN 190
160 N=Q
170 J=J+1
180 GOTO 130
190 RETURN
```

The next job to be done is to determine if the base B representation of the number N is a palindrome. To do this we need only compare digits starting at the outside and working inward.

```
300 REM PALINDROME TESTER
310 REM FIND THE FIRST NON-
    ZERO DIGIT
320 J=20
330 J=J-1:IF D(J)=0 THEN 330
340 REM CHECK PALINDROME BY
    COMPARING DIGITS FROM
    EACH END.
350 FOR I=0 TO J
360 IF D(I)<>D(J-I) THEN 420
370 NEXT I
380 FOR I=J TO 0 STEP -1
390 PRINT D(I);
400 NEXT I
410 PRINT "(BASE ";B;") IS A
    PALINDROME."
420 RETURN
```

The numbers 19, 39, 47, 53, 58, 69, and 75 are nonpalindromes for any base 2 through 10.

William Hutchison computed further and found that the numbers 19, 47, 53, 58, 69, 76, 79, 87, 94, and 95 are not palindromes in any base 2 through 16. The numbers 47 and 53 are not palindromes in any base 2 through 36. These latter two numbers are very nonpalindromic. Does anyone know of a base in which they are palindromes?

Matt Bishop and Marv Schwanbeck contributed solutions to problem 3a. This problem asked for the numbers N↑N↑N for N greater than 3. Bishop used the fact that 4↑4↑4=256↑64 and then multiplied 256 by itself 64 times. Schwanbeck sent a printout for 5↑5↑5 that fills one whole page. Its first and last few digits are 19110 . . . 03125. Would anyone care to confirm it?

Matt Bishop, William G. Hutchison, Jr. and Marv Schwanbeck sent solutions to problem 3b. The problem was to compute the number of digits in N↑N↑N. The answer, it turns out, is as easy as falling off a logarithm. (Sorry 'bout that.) The base 10 logarithm of 10 is 1. The log of 100 is 2. The log of 1000 is 3. The log of a number between 100 and 1000 is a number between 2 and 3. The log of a number between 1000 and 10000 is a number between 3 and 4. The logarithm (base 10) of any number is the power to which 10 must be raised to get the number. For example, the log of 150 is 2.176, because 10↑2.176=150. This is all very useful for doing problem 3b. The integer part of the logarithm plus 1 is just the number of digits. A bit of algebra is in order.

LOG(N↑(N↑N))=N↑N*LOG(N).

So much for the algebra. This is useful. The right-hand side is much easier to compute than the left-hand side. The number N↑N is MUCH smaller than N↑(N↑N), and LOG(N) grows very slowly.

```
10 PRINT "INPUT A POSITIVE INTE-
   GER IN THE RANGE 1 TO 9"
20 INPUT N
30 PRINT INT(N↑N*CLOG(N))+1
40 GOTO 10
```

Notice the CLOG(N) in the program. This stands for common (base 10) logarithm. Some computers have this, some don't. There is another log function called the natural logarithm. Either one is sufficient for doing logarithm problems. It is easy to check which LOG function you have. Just print LOG(10). If LOG(10)=1 you have the common or base 10 logarithm. If LOG(10)=2.3, then your LOG function is the natural or base *e* logarithm. They are related by CLOG(N)=LOG(N)/LOG(10).

Problem 4 asked how one might use a computer to find the volume in cubic centimeters for a potato. Toby Perkins sent important experimental information. "I have experimented with one potato . . . It sinks."

In a more practical vein, Fred Piscop had the following suggestion. "Bring the potato and your computer to a nearby university. Locate the head of the Physics Department and say to him: 'If you calculate the volume of this potato for me, I will give you my computer.' "

A great labor saving device is the computer, but the human mind yet prevails. Onward and upward. □

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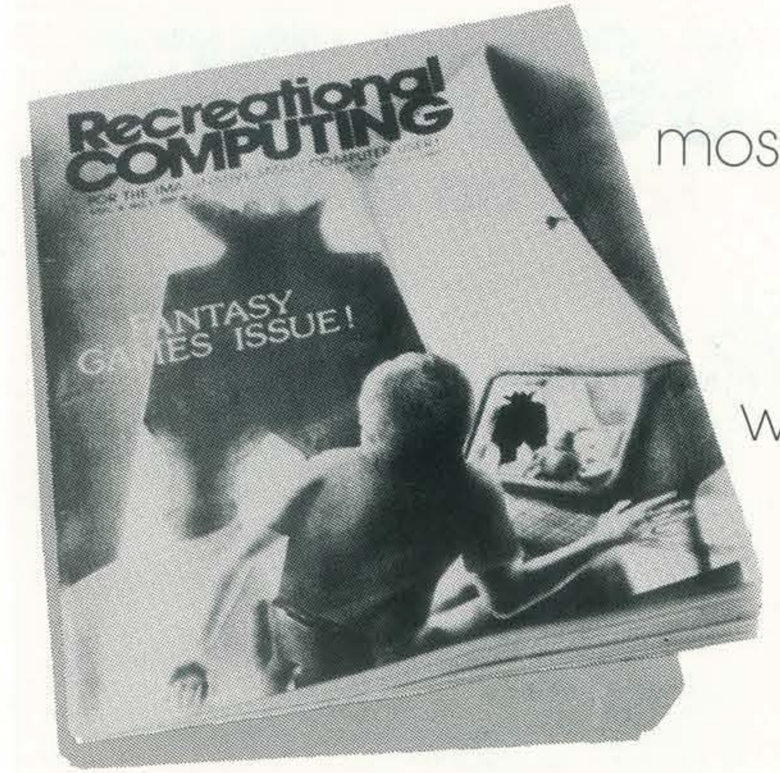

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Sixth Order MAGIC SQUARES on a TRS-80

BY ALLAN WM. JOHNSON JR.

The Model I TRS-80 lacks the number-crunching prowess of a CYBER 205 supercomputer but it is capable of performing very creditable computation if it is programmed intelligently. I recently demonstrated the TRS-80's power when I computed the following magic square with a program developed and run under Radio Shack's $100 FORTRAN product:

131	163	199	271	67	151
61	283	13	181	223	229
277	37	313	73	193	97
233	137	257	17	293	53
101	107	149	317	47	269
179	263	59	131	167	191

This magic square is remarkable for three reasons:

- It is composed of different prime numbers. (A prime number is a number exactly divisible by no numbers except itself and one.)
- It is pandiagonal; i.e., the broken diagonals as well as the main diagonals add up to the magic sum. (A broken diagonal parallels a main diagonal but breaks at the edge of the magic square and resumes on the opposite edge with the numbers determined by extending the broken diagonal past the boundary of the magic square into a copy of the magic square that we imagine to be reproduced along the boundary. The sixth-order magic square has ten broken diagonals; e.g., 163, 13, 73, 293, 269, 179 and 233, 37, 13, 271, 167, 269.)
- It is symmetrical. (A magic square is symmetrical when any two numbers diametrically equidistant from its center add up to the same number. The sixth-order magic square has 18 such number pairs; e.g., 139, 191, and 313, 17.)

When I began the task of computing a sixth-order prime pandiagonal symmetrical magic square, I was faced with the need for some reasonable way to adapt the problem to a computer. Representing the 36 numbers in the magic square with the algebraic symbols X1, X2, X3, . . ., X36, I wrote out the 41 equations that must be satisfied by a sixth-order pandiagonal symmetrical magic square. Looking at the 41 equations in 36 unknowns, I remembered vaguely from high school algebra something about how difficult it is to solve a system of linear equations when the number of equations does not equal the number of unknowns. Browsing through algebra textbooks, I found Professor Hart's comprehensive explanation of the triangular method for solving a system of linear equations. The triangular method is a simple step-by-step procedure that is excruciating to do by hand on 41 equations but easily lends itself to computer implementation. So I wrote a BASIC program that was fed the 41 equations and 30 minutes later the TRS-80 delivered up a solution in the form of 27 equations in nine unknowns. A little hand manipulation massaged these 27 equations into the algebraic result of Figure 1.

Let S=3T=2U be the magic sum and let A, B, C, D, E, F, G, H be eight numbers chosen at will. Then

Q	E	H	G	C	N
F	I	A	L	J	D
R	B	P	M	K	O
T-O	T-K	T-M	T-P	T-B	T-R
T-D	T-J	T-L	T-A	T-I	T-F
T-N	T-C	T-G	T-H	T-E	T-Q

is a pandiagonal symmetrical magic square when the ten numbers I, J, K, L, M, N, O, P, Q, R are computed with the following equations:

$I = U-A-B+C-D$
$J = U-A+B-C-D$
$K = -B+C+E$
$L = A+D-F$
$M = \frac{1}{2}(S-2A-C-D-E+3F-2G)$
$N = A-B+E-F+M$
$O = A+B-E-F+G$
$P = -A+L+G+M-H$
$Q = -G+O+P$
$R = -M+N+H$

FIGURE 1. THE ALGEBRAIC RESULT

Now all I had to do was translate this ponderous algebraic result into a workable computer program. I saw immediately that the "eight numbers chosen at will" would have to be chosen by DO loops when the algebraic result was converted to a computer. I interspersed the equations that compute I, J, K, . . ., R into the DO loops that choose A, B, C,

LISTING
OF THE FORTRAN PROGRAM

```
      WRITE (4,10)
 10   FORMAT (' ENTER THE MAGIC SUM 120 TO COMPUTE' /
  X            ' A MAGIC SQUARE COMPOSED OF ALMOST' /
  X            ' CONSECUTIVE INTEGERS ', 20X )
      READ (5,20) MSIN
 20   FORMAT (I3)
      IF (MSIN.EQ.120) CALL PANSYM(0)
C
      WRITE (4,30)
 30   FORMAT (' ENTER 0990 OR ANY FOUR DIGIT MAGIC' /
  X            ' SUM TO COMPUTE PRIME MAGIC SQUARES',6X)
      READ (5,40) MSIN
 40   FORMAT (I4)
      IF (MSIN.LE.0) MSIN=6
      IF (MSIN.GT.5000) MSIN=5000
C  THE EQUATIONS FOR I AND T-I SHOW
C   THE MAGIC SUM HAS THE FORM 12K+6
      MSIN=(MSIN/12)*12+6
      DO 50 MS=MSIN,5000,12
      CALL PANSYM(MS)
 50   CONTINUE
      STOP
      END
      SUBROUTINE PANSYM(MS)
C  INTEGER*1 VARIABLES SPEED UP NUMBER CRUNCHING
      INTEGER*1 BA(5000)
      INTEGER*1 LA,LB,LC,LD,LE,LF,LG,LH,W,X,Y
      INTEGER   A,B,C,D,E,F,G,H,I
      INTEGER   J,K,L,M,N,O,P,Q,R
      INTEGER   TA,TB,TC,TD,TE,TF,TG,TH,TI
      INTEGER   TJ,TK,TL,TM,TN,TO,TP,TQ,TR
      INTEGER   S,T,U,V
      INTEGER   PT(300),NPT,PP(126),PPA(114)
C
      DATA  NPT/0/
      DATA  PT/3,5,7,11,13,17,19,23,29,31,37,41/
      DATA  S/120/,T/40/,U/60/,V/20/
      DATA  W/18/,X/36/
      DATA  PP/ 1, 2, 3, 4, 5, 6, 7, 8, 9,
  X             11,12,13,14,15,16,17,18,19,
  X             21,22,23,24,25,26,27,28,29,
  X             31,32,33,34,35,36,37,38,39/
C
      IF (MS.EQ.0) GO TO 2000
C
      S=MS
      T=S/3
      U=S/2
      V=S/6
C
      IF (NPT.NE.0) GO TO 30
C  TABULATE THE ODD PRIMES LESS THAN 1666
      NPT=12
      DO 20 I=43,1666,2
      DO 10 W=1,12
      J=I/PT(W)
      J=I-J*PT(W)
      IF (J.EQ.0) GO TO 20
 10   CONTINUE
      NPT=NPT+1
      PT(NPT)=I
 20   CONTINUE
C
 30   DO 40 I=1,5000
      BA(I)=0
 40   CONTINUE
C
      DO 50 I=1,NPT
      A=PT(I)
      BA(A)=1
 50   CONTINUE
C  TABULATE ALL PRIMES (P,Q) FOR WHICH P+Q=T
      W=0
      A=V-1
      DO 80 I=3,A,2
      IF (BA(I).EQ.0) GO TO 80
      TI=T-I
      IF (BA(TI).EQ.0) GO TO 80
      W=W+1
      IF (W.LT.64) GO TO 70
      WRITE (2,60) S
 60   FORMAT ('MAGIC SUM',I5,' HAS OVER 63 PRIME PAIRS'/)
      RETURN
 70   PP(W)=I
      PPA(W)=TI
 80   CONTINUE
C
      IF (W.LT.18) RETURN
C
      WRITE (2,90) S,W
 90   FORMAT (' MAGIC SUM',I5,' HAS',I3,' PRIME PAIRS'/)
C
      X=W
      Y=W
      DO 100 LA=1,W
      X=X+1
      PP(X)=PPA(Y)
      Y=Y-1
100   CONTINUE
C  INITIALIZE THE BOOKKEEPING ARRAY
2000  DO 110 I=1,5000
      BA(I)=0
110   CONTINUE
C
      DO 120 LA=1,X
      A=PP(LA)
      BA(A)=1
120   CONTINUE
C
C  A NEST OF EIGHT DO LOOPS FOLLOWS ...
C
C  THIS ENUMERATION EXCLUDES ROTATIONS AND
C   REFLECTIONS OF THE MAGIC SQUARE BY FORCING:
C          T-I<T-J   I.E.   C>B
C          T-I<I     I.E.   I>V
C          T-J<J     I.E.   J>V
C
      DO 1000 LA=1,W
      A=PP(LA)
      TA=T-A
      BA(A)=0
      BA(TA)=0
C
      DO 995 LB=1,X
      B=PP(LB)
      IF (BA(B).EQ.0) GO TO 995
      TB=T-B
      BA(B)=0
      BA(TB)=0
C
      DO 990 LC=LB,X
      C=PP(LC)
      IF (BA(C).EQ.0) GO TO 990
```

(continued)

. . ., H and obtained most of the program flow of Figure 2. At this point, two questions required answers: How would the program get its primes? How would the program control its primes so the end product was a magic square composed of 36 different primes?

Read a magic sum S and compute T=S/3 and U=S/2.
Build a prime table containing all primes (p,q) for which p+q=T.
Initialize the bookkeeping array from the prime table.
DO loops to choose A, B, C, D from the prime table.
Compute I, J with the equations of Figure 1.
DO loop to choose E.
Compute K.
DO loop to choose F.
Compute L.
DO loop to choose G.
Compute M, N, O.
DO loop to choose H.
Compute P, Q, R.
Substitute T and A, B, C, . . ., R in the magic square of Figure 1 and write the result.

FIGURE 2. THE PROGRAM FLOW

I elected to put a prime table in the program so the program would not have to compute a prime when it wanted one. With pre-listed primes, the DO loops would draw primes from the table to enumerate A, B, C, . . ., H and table look-up would decide whether a computed I, J, K, . . ., R was prime or composite. As for the content of the prime table, three facts dovetailed to persuade me to store just the prime pairs for T:

1. Being symmetrical, the magic square is composed of 18 prime pairs (p,q) each having the property p+q=T.
2. These 18 pairs must be selected from the universe of all prime pairs for T.
3. This universe contains a limited number of pairs by virtue of p and q being positive.

To help the program assemble a magic square composed of different primes, I installed a bookkeeping array that controlled the prime pairs in the prime table. Called BA, the bookkeeping array was initialized to BA(X) = 1 or 0, according to whether X is or is not a prime in the prime table. With this initialization, the FORTRAN statement

IF (BA(Y).EQ.0) GO TO 40

takes the branch if (Y,T-Y) is not a prime pair and it falls through if (Y,T-Y) is a prime pair. If the IF falls through to the statements BA(Y)=0 and BA(T-Y)=0, then the bookkeeping array is changed in a way that makes subsequent IF state-

```
      TC=T-C
      BA( C )=0
      BA( TC )=0
C
      DO 980 LD=1,X
      D=PP( LD )
      I=U-A-B+C-D
      IF (I.LT.V) GO TO 985
      J=U-A+B-C-D
      IF (J.LT.V) GO TO 985
      IF (BA( D ).EQ.0) GO TO 980
      TD=T-D
      BA( D )=0
      BA( TD )=0
      IF (BA( I ).EQ.0) GO TO 975
      TI=T-I
      BA( I )=0
      BA( TI )=0
      IF (BA( J ).EQ.0) GO TO 970
      TJ=T-J
      BA( J )=0
      BA( TJ )=0
C   COMPRESS PRIME PAIR ARRAY PP INTO ARRAY PPA
      Y=0
      DO 130 LE=1,X
      E=PP( LE )
      IF (BA( E ).EQ.0) GO TO 130
      Y=Y+1
      PPA( Y )=E
130   CONTINUE
      Y=X-12
C
      DO 960 LE=1,Y
      E=PPA( LE )
      K=C-B+E
      IF (K.GT.T) GO TO 965
      IF (BA( E ).EQ.0) GO TO 960
      IF (K.LT.PPA( 1 )) GO TO 960
      TE=T-E
      BA( E )=0
      BA( TE )=0
      IF (BA( K ).EQ.0) GO TO 955
      TK=T-K
      BA( K )=0
      BA( TK )=0
C
      DO 945 LF=1,Y
      F=PPA( LF )
      L=A+D-F
      IF (L.LT.PPA( 1 )) GO TO 950
      IF (BA( F ).EQ.0) GO TO 945
      TF=T-F
      BA( F )=0
      BA( TF )=0
      IF (BA( L ).EQ.0) GO TO 940
      TL=T-L
      BA( L )=0
      BA( TL )=0
C   WILL THE EQUATION FOR M COMPUTE AN INTEGER?
      P=C+D+E-F
      Q=P/2
      R=Q+Q-P
      IF (R.NE.0) GO TO 935
      MM=U-Q-A+F
C
      WRITE (4,140) A,B,C,D,E,F,S,X,PP( X )
140   FORMAT (6I6,3X,3I6)
C
      DO 930 LG=1,Y
      G=PPA( LG )
      M=MM-G
      IF (M.LT.PPA( 1 )) GO TO 935
      N=A-B+E-F+M
      IF (N.LT.PPA( 1 )) GO TO 935
```



```
      O=A+B-E-F+G
      IF (O.GT.T) GO TO 935
      IF (BA( G ).EQ.0) GO TO 930
      IF (O.LT.PPA( 1 )) GO TO 930
      TG=T-G
      BA( G )=0
      BA( TG )=0
      IF (BA( M ).EQ.0) GO TO 925
      TM=T-M
      BA( M )=0
      BA( TM )=0
      IF (BA( N ).EQ.0) GO TO 920
      TN=T-N
      BA( N )=0
      BA( TN )=0
      IF (BA( O ).EQ.0) GO TO 915
      TO=T-O
      BA( O )=0
      BA( TO )=0
C
      DO 905 LH=1,Y
      H=PPA( LH )
      P=L-A+G+M-H
      IF (P.LT.PPA( 1 )) GO TO 910
      Q=O-G+P
      IF (Q.LT.PPA( 1 )) GO TO 910
      R=N-M+H
      IF (R.GT.T) GO TO 910
      IF (BA( H ).EQ.0) GO TO 905
      IF (R.LT.PPA( 1 )) GO TO 905
      TH=T-H
      BA( H )=0
      BA( TH )=0
      IF (BA( P ).EQ.0) GO TO 900
      TP=T-P
      BA( P )=0
      BA( TP )=0
      IF (BA( Q ).EQ.0) GO TO 895
      TQ=T-Q
      BA( Q )=0
      BA( TQ )=0
      IF (BA( R ).EQ.0) GO TO 890
      TR=T-R
      BA( R )=0
      BA( TR )=0
C   EUREKA ------ WE HAVE A MAGIC SQUARE
      WRITE (2,150) Q,E,H,G,C,N
      WRITE (2,150) F,I,A,L,J,D
      WRITE (2,150) R,B,P,M,K,O
      WRITE (2,150) TO,TK,TM,TP,TB,TR
      WRITE (2,150) TD,TJ,TL,TA,TI,TF
      WRITE (2,150) TN,TC,TG,TH,TE,TQ
150   FORMAT (' EUREKA ',6I6)
      WRITE (2,160)
160   FORMAT (1X / 1X / 1X /)
C
      RETURN
C
885   BA( R )=1
      BA( TR )=1
890   BA( Q )=1
      BA( TQ )=1
895   BA( P )=1
      BA( TP )=1
900   BA( H )=1
      BA( TH )=1
905   CONTINUE
C
910   BA( O )=1
      BA( TO )=1
915   BA( N )=1
      BA( TN )=1
920   BA( M )=1
      BA( TM )=1
```

(continued)

ments think (Y,T-Y) is not a prime pair. If later on the program executes BA(Y)=1 and BA(T-Y)=1, then (Y,T-Y) is restored as a prime pair. With repetition after repetition of these instruction sequences, the DO loops in the program manage the prime pairs by, in effect, playing peekaboo with them.

With this fast lookup bookkeeping scheme in hand, I went to work writing the program, which turned out to be about 300 FORTRAN statements. It took me a weekend to enter the program into the TRS-80 and fix the bugs in the program. I ran this program for days on end and discovered over 30 different magic sums for which sixth-order prime pandiagonal symmetrical magic squares exist. The example given above has the magic sum 990.

I also modified the program to compute a sixth-order pandiagonal symmetrical magic square that is composed of integers that are almost consecutive. Over 60 years ago, Professor Planck proved 36 consecutive integers (e.g., 1, 2, 3, . . ., 36) cannot be arranged into a magic square that is pandiagonal or symmetrical; but he noted such magic squares do exist for groups of almost consecutive integers like the 36 numbers obtained by dropping the multiples of ten out of 1, 2, 3, . . ., 39. Ball and Coxeter [2] display a pandiagonal magic square and a symmetrical magic square formed from these 36 numbers. The following magic square is both pandiagonal and symmetrical and it is formed from the same 36 numbers:

9	23	29	32	6	21
12	27	1	22	25	33
36	5	38	14	24	3
37	16	26	2	35	4
7	15	18	39	13	28
19	34	8	11	17	31

The FORTRAN program computes this magic square when it is presented the magic sum 120. □

ALLAN WM. JOHNSON, JR. was educated as an engineer and was formerly employed as a systems programmer. The author currently earns his living as a mathematician with the Federal Government. In recreational mathematics, his main interest is number theory, which includes magic squares. His work has appeared in the American Mathematical Monthly *and similar publications. He and his brother jointly own a Model I TRS-80 equipped with Level II BASIC, 48K RAM, two disks, and a printer.*


```
28100   925   BA(G)=1
28200         BA(TG)=1
28300   930   CONTINUE
28400C
28500   935   BA(L)=1
28600         BA(TL)=1
28700   940   BA(F)=1
28800         BA(TF)=1
28900   945   CONTINUE
29000C
29100   950   BA(K)=1
29200         BA(TK)=1
29300   955   BA(E)=1
29400         BA(TE)=1
29500   960   CONTINUE
29600C
29700   965   BA(J)=1
29800         BA(TJ)=1
29900   970   BA(I)=1
30000         BA(TI)=1
30100   975   BA(D)=1
30200         BA(TD)=1
30300   980   CONTINUE
30400C
30500   985   BA(C)=1
30600         BA(TC)=1
30700   990   CONTINUE
30800C
30900         BA(B)=1
31000         BA(TB)=1
31100   995   CONTINUE
31200C
31300         BA(A)=1
31400         BA(TA)=1
31500  1000   CONTINUE
31600C
31700         RETURN
31800         END
```

References. For the triangular method, see [1]. For Professor Planck's work, see [2] which, like [3], contains a wealth of information on magic squares.

[1] William L. Hart, *College Algebra and Trigonometry*, Heath, Boston, 1959, Chapter 20.

[2] W. W. Rouse Ball & H. S. M. Coxeter, *Mathematical Recreations & Essays*, Twelfth Edition, University of Toronto Press, Toronto, 1974, Chapter VII.

[3] W. S. Andrews, *Magic Squares and Cubes*, Dover, New York, 1960.

END

ANNOUNCEMENTS

This section includes current information on Hardware, Software, Education, News and Events. Send any pertinent releases to the editor of this magazine.

Hardware

Radio Shack's new TRS-80 Model III desktop computer is designed to meet the needs of many users for more data storage, greater versatility, and higher computing speed. Available in several configurations, the TRS-80 Model III is priced from $699 for the 4K version, expandable to 32K with 313K of disk storage for $2495. It is highly compatible with Model I and features the more powerful Model III BASIC language.

Considered a breakthrough in computer technology, the TRS-80 Pocket Computer weighs only 6 ounces and is less than 7 inches long. Yet, it is said to be able to do almost any of the smaller jobs the popular TRS-80 Model I computer can do.

Radio Shack's new TRS-80 Color Computer provides color graphics and features instant-load Program-Pak^{tm} software that enables the user to instantly program the computer for a variety of educational and recreational purposes.

In audio equipment, the company is introducing six new stereo receivers, including two with quartz digital tuning, five stereo cassette tape decks featuring Dolby^{tm} noise reduction circuitry and engineered for use with the new metal recording tape, and seven new speaker systems.

A new TV Sound Tuner being offered lets you listen to TV audio through your home music system for high-fidelity sound that is said to be much better than the sound produced by an ordinary TV set's small, built-in speaker.

In the area of home security, Radio Shack will offer the latest in home alarm systems, one microprocessor-controlled system enables homeowners to protect all openings without any wiring required.

Three new general coverage shortwave receivers are being introduced, as well as two new versions of the company's Weatheradio®, a concept they originated for a radio dedicated to receiving 24-hour NOAA weather broadcasts.

Radio Shack's telephone line is being further expanded this year with the addition of 12 new products. Featured is a cordless handset telephone, priced at $99.95, which allows "walk and talk" convenience without tangling cords.

In addition, Radio Shack will offer 13 new electronic calculators, six digital clocks and 17 electronic games. □

For $199.95, you can get a complete, powerful, full-function computer. Sinclair Research Ltd. packed the conventional computer onto fewer, more powerful LSI chips – including the Z80A microprocessor, the faster version of the famous Z80. This makes the ZX80 the world's first truly portable computer (6½ in. x 8½ in. x 1½ in. and a mere 12 oz.). The ZX80 also features a touch sensitive, wipe-clean keyboard and a 32-character by 24-line display.

Sinclair's 4K integer BASIC include:

- Unique "one touch" entry. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry and are stored as a single character to reduce typing and save memory space.
- Automatic error detection. A cursor identifies errors immediately to prevent entering programs with faults.
- Powerful text editing facilities.
- Also programmable in machine code.
- Excellent string handling capability – up to 26 string variables of any length.
- Graphics, with 22 standard symbols.
- Built-in random number generator for games and simulations.

And the computer that can do so much for you now will do even more in the future. Options will include expansion of 1K user memory to 16K, a plug-in 8K floating-point BASIC chip, applications software, and other peripherals.

The ZX80 comes with its own 128-page guide to computing.

Price includes TV and casette connectors, AC adaptor, and 128-page manual.

All you need to use your ZX80 is a standard TV (color or black-and-white). The ZX80 comes complete with connectors that easily hook up to the antenna terminals of your TV. Also included is a connector for a portable cassette recorder, if you choose to store programs. (You use an ordinary blank cassette.)

Phone orders: (203) 265-9171. Mon.-Fri. 8 AM-6 PM EST. (For technical information, call (617) 367-2555, Mon.-Fri 9 AM-5 PM EST.) □

The soft digital musical instrument debuts in New York. Syntauri Ltd. announced an expanded alpha-Syntauri^{tm} musical instrument, a computer-controlled digital synthesizer that is the first modular "soft instrument." Linked to an inexpensive computer – the 48K Apple II – the alphaSyntauri's organ-style keyboard and operating software give musicians sound and control options.

Modular design lets musicians now choose, for instance, between an eight voice waveform controllable alphaSyntauri^{tm} that uses Mountain Computer's MusicSystem hardware and a three-to-fifteen voice polyphonic instrument with multistage envelope control using ALF oscillator hardware. Radical instrument changes are easy with the plug-in sound generating hardware and Syntauri's customized software. Subtle instrument changes – from organ to vibes – can be made quickly with one or two keystrokes on the Apple II keyboard.

The standard system, which interfaces to from one to five ALF Apple Music boards, retails for $1295.00 The optional interface to the Mountain Computer MusicSystem hardware is available for $129.00. Prices do not include either the ALF or Mountain Computer oscillator hardware, which is available from retailers. For more information, contact: Ellen Lapham (415) 494-6267 or Scott Gibbs (415) 494-1017. □

Heath announces new floppy disk system with 2-megabyte storage capacity. Heath Company based in Benton Harbor, MI, introduced its first 8-inch, dual-sided, dual-density floppy disk system at the PC-80 Computer Show, August 21-24 in Philadelphia. The H-47, designed for use with Heath's H-8 and H-89 All-In-One Microcomputers, provides up to 2½ million bytes of on-line data storage – more than 12 times the current maximum capability.

Featuring two 8-inch disk drives as standard equipment, the H-47 Floppy Disk System is fully compatible with current Heath 5¼-inch Disk Systems. Both Heath's HDOS Operating System and CP/M will be supported. Each will permit transfer of data between 5¼-inch and 8-inch disks.

The H-47 offers an average access time of only 176 milliseconds (including settling) – less than half of the 490 milli-second average access time of the disk systems currently available for the H-8 and H-89 computers. □

Modules for Aim-65 microcomputer extend system functionality. Seven Microflex modules provide systems based on the Aim-65 microcomputer with upward expandability.

The Microflex 65 module adapter plugs into the Aim-65's expansion connector, adapting the microcomputer's address, data and control lines to let you drive one Aim-65 bus-compatible module. An extender card offers similar specs and capabilities.

A buffer module extends the module adapter's expansion capability, supporting as many as 15 Microflex modules. It comes with an adapter, two cables and a unit that connects the microcomputer to a 4-, 8-, 12- or 16-slot Microflex 65 motherboard.

A piggyback module stack (PMS) comes with an integral fan and provides four slots in a 4.96 x 3.89 x 8-in. package.

A prototyping module allows you to configure custom circuitry on a board that fits on the system's mother board. This module features a 36 x 36-column wire-wrapping area, four isolated power strips and nine ground strips.

Finally, two memory modules support the addition of either 8K bytes of static RAM or 16K bytes of PROM/ROM. Both boards let you configure the address space with switches.

All Microflex modules are available beginning this month. Module adapter, $100; extender card, $100; buffer module, $150; PMS, $200; prototyping module, $100; static-RAM module, $400; PROM/ROM module, $200 (OEM). (All prices approximate.)

Acoustic coupler. The LEX-11 is a 300 bps acoustically coupled modem with the ability to communicate with other LEX-11's and Bell 103A data sets. It can operate in full or half duplex, and it has both originate and answer capabilities. The unit has a battery power option, allowing up to 2½ hours of operation.The LEX-11 has an RS-232 interface. Pricing starts at $175. Lexicon Corp., Miami, FL. □

Software

ON-LINE SYSTEMS is pleased to announce the release of their new HI-RES graphics package for the Apple II computer. This package is available for use with the game controllers or for use with Apple's GRAPHICS-TABLET.

Many capabilities are brought to the Apple that were not easily available before including:

- Color shape tables constructed simply by pointing the cursor at any portion of the HIRES screen
- 21 HIRES colors! ! !
- UPPER-LOWER case text in any size direction or color
- Fast machine language color fill-in of any outlined figure
- Automated picture generation through easy recall of shape table entries.

Both versions of this product have been released. PADDLE-GRAPHICS costs $39.95 and TABLET-GRAPHICS costs $49.95. Requires 48K DOS and APPLESOFT ROM. ON-LINE SYSTEMS, 772 No. Holbrook, Simi, California 93065. □

DISCO-TECH announces two TRS-80 energy conservation programs. Two TRS-80 microcomputer programs for energy conservation have been introduced by DISCO-TECH, developers of high-quality technical application programs for engineering, architecture, energy conservation, and surveying. The two programs are NRG-1 (residential) and NRG-2 (commercial). They perform calculations for the construction of energy-efficient, cost-effective buildings. NRG-1 printouts may be submitted directly to local building departments.

DISCO-TECH developed NRG-1 and NRG-2 specifically for compliance with California's Title 24 energy conservation legislation, which controls building design, heating and cooling equipment, and lighting. Both programs are useful outside California, however, in the design and construction of energy-efficient residential and commercial buildings.

Cost of NRG-1 is $650. The price of NRG-2 is $450. Package price of both programs is $1,000. TRS-80 Model I hardware required is 48K with two mini-disc drives and a line printer.

Orders or requests for additional information on NRG-1 and NRG-2 and DISCO-TECH's other technical and utility programs may be addressed to DISCO-TECH, Morton Technologies, Inc., P.O. Box 11129, Santa Rosa, CA 95406; telephone (707) 523-1600. □

Channel Data Systems announces the publication of *Explore*. Inspired by the computerized fantasy simulation "Adventure," Explore is a conversational program which operates on the Commodore PET with only 8K bytes of memory. Explore contains four adventures in which you operate a computerized tank, hunt treasure in a magic cave, explore the mall in Washington, DC, and survive in a haunted castle. Explore package includes introduction, five data files, and complete manual. Available from Channel Data Systems on cassette for $15.00 plus shipping in the USA. On foreign orders, inquire for pricing. Indication of old or new ROMs is requested. Channel Data Systems, 5960 Mandarin Avenue, Goleta, CA 93107. (805) 964-6695. □

The A2-FS1 (for the Apple II) and the T80-FS1 (for the TRS-80) are visual flight simulators that offer a real-time 3D out-the-window view of flight. The view will update at an average of 3 times per second. The fast update speed results in easy control during take-offs and landings as well as in normal flight.

The FS1 instrument panel contains all the instruments required under part 91 of the Federal Aviation Regulations for visual flight. Over and above the required instruments, the FS1 includes a stall warning, turn indicator, radar screen, ammo indicator, and control position indicators.

T80-FS1 flight control is accomplished through keyboard input. A2-FS1 flight control is accomplished through either keyboard input or a combination of joystick and keyboard inputs. Other controls (via keyboard) include throttle, brakes, bomb drop, machine guns, high-low downward map selector. The A2-FS1 includes a keyboard/paddle selector.

The FS1 is available from your software dealer or from SubLOGIC direct. The FS1 requires 16K of memory and no extra equipment. The A2-FS1 and T80-FS1 are available on cassette for $25. The A2-FS1 is also available on disk for $33.50. Add $1.50 for shipping. Illinois residents should add 5% sales tax. Contact SubLOGIC Distribution Corp., Box V, Savoy IL 61874 (217) 359-8482. □

FORTH for Apple II (TM). Cap'n Software's FORTH Ver. 1.7 includes the FORTH Interest Group programming language plus extensive development aids and a 130-page tutorial manual. A telephone hot-line to system developers is also available.

The system can generate special turnkey disks that boot directly into the user's own application program. Developers can copy and sell their applications on these special disks with no licensing required or any other legal restrictions.

This system runs on Apple II, Apple II+, or Apple II with language card, with one or two disk drives. 48K memory is required, but over half of that is available for user's programs and data. Complete system price is $140 including all documentation. Multi-use and educational discount licenses are also offered. The system is available now through Apple dealers, or from Cap'n Software, P.O. Box 575, San Francisco, CA 94101. □

Education

SCHOOLMASTER, a record keeping system for teachers, requires a 32K TRS-80 with one drive. SCHOOLMASTER generates cumulative reports for each student, flags students with missing assignments, permits various methods of data entry, allows teachers to examine a variety of grading methods (with allowances for subjective factors) before recording grade data, and provides both individual and class statistical data. Information can be accumulated over grading periods by class. Complete instructions are included. SCHOOLMASTER comes on diskette for only $24.95. Further information is available from THE ALTERNATE SOURCE, 1806 Ada Street, Lansing, MI 48910. Phone (517) 485-0344. □

Compak, Inc., a company composed of professional curriculum designers, educators and programmers, has announced a Mathematics Package (Grades 1-8) for the 32K Apple II and TI 99/4 microcomputers.

The Compak, Inc., Mathematics Package is a unique set of programs with the major objectives of supporting mathematics instruction and improving student achievement. Some instructional materials are designed for review and practice while other materials are designed to introduce and develop mathematical ideas.

The Mathematics Package (1-8) covers ten major concepts and includes over five hundred different self-contained modules. The concept areas include: Addition, Subtraction, Multiplication, Division, Common Fractions, Decimal Fractions, Percents, Measurements, Geometry and Elementary Algebra.

The Mathematics Package (1-8) provides a student record-keeping feature that allows the teacher to keep track of student progress. At the end of a student lesson, the screen displays the number of problems attempted, the number correct on the first try, the number missed, the percent correct and any promotions or demotions. This same information is also automatically recorded on the teacher's "gradebook" disk. A special "gradebook" program enables the teacher to print names, add names, delete names, print scores and change scores. The printing of names and scores may be done individually or by class and on a printer if one is available.

Unique features of the programs include an escape function that allows the student to end the lesson and still retain his score, the capability to erase an answer before completing it, the capability to enter answers in the same direction as they are worked on paper, i.e., right to left for multiplication, and the effective use of attractive color graphics and sound to provide immediate student reinforcement.

Many schools have purchased and been pleased with this comprehensive mathematics package. For example, the Houston Independent School District's regional educational service center has, in its efforts to standardize the region's instructional computing activities, approved the purchase of Compak's Mathematics (1-8) Package.

The complete Mathematics Package contains ten instructional disks and one record-keeping disk in a binder with a teacher's manual. The 1-8 Mathematics programs can be ordered by the complete package for $495, by all concepts for a single grade level (i.e., the disk for Grade 7 with all ten concepts) for $65 or by one concept for all grade levels (i.e., the concept Addition for all eight grades) for $50. A sample disk is available for $35 as is the Teacher's Guide Manual for $20. Dealer inquiries are invited. For further information contact Compak, Inc., P.O. Box 14852, Austin, TX 78761 (512) 452-1680. □

Free educational systems & instruments catalog. A FREE, full-color, 40-page catalog describing educational programs and test instruments for schools, industry, government and self-instruction, has just been published by Heath Company.

This 1980 edition details course information on 17 complete self-instruction and group instruction college-level programs in electronics, microprocessors, automotive, and computer programming. Information on experimental trainers for laboratory sessions is also supplied.

The catalog also features product descriptions and specifications on more than 40 available test instruments, including: oscilloscopes, power supplies, chart recorders, signal generators, and TV service instruments. □

T Y C SOFTWARE^{tm} announces its newest educational release: The EARTH SCIENCE SERIES. The EARTH SCIENCE SERIES contains 12 independent programs. Each is designed to teach a particular topic covered in Junior High or Senior High School earth science curriculum. Topics covered are: Gradient, Heat Energy Lost and Gained, Latitude and Longitude, Basic Chemistry, Steam Erosion, Water Budget, Seismic Waves, Earth History, Seasons, Meterology, and Percent Error. A perfect supplement to a teacher's regular curriculum, or for use in a general resource room.

Also included is a Lab Aid Program. This program makes the computer an intelligent calculator, preprogrammed with 20 of the most common formulas used in lab experiments. While it helps the student with his calculations, it also reinforces the formulas used. In addition, there is a simple data graphing routine in which a student may create graphs of his lab results. All these programs do not require programming knowledge.

Designed by educators to meet specific classroom needs, the programs are illustrated with numerous graphics and students are quizzed throughout to reinforce information learned. The EARTH SCIENCE SERIES comes complete with a teacher/student manual which contains student objectives, worksheets, answer keys, and general student user instructions. 12 programs on 4 cassettes, teacher/student manual, and a vinyl storage binder. 16K TRS-80, $59.95 plus $1.50 postage. MC/VISA accepted. For more information on the EARTH SCIENCE SERIES contact: T Y C SOFTWARE^{tm}, 40 Stuyvesant Manor, Geneseo, NY 14454. □

High Technology, Inc., announces the development and marketing of two unique computer programs for education, CHEMISTRY LAB SIMULATION #1 and #2, both for use on the Apple II computer.
Developed by Dr. John I. Gelder, an Oklahoma State University chemistry professor, the program provides dynamic and colorful simulations of high school and college level chemistry lab experiments, allowing the student to interactively discover the chemistry principles involved.

Chemistry Lab #1 uses high-resolution graphics to simulate introductory level chemistry experiments, including acidbase titration; a monomolecular film experiment used for the determination of Avogadro's number; and finding an unknown weak acid by determining its equilibrium constant. The program provides randomly generated initial values, giving unlimited test results without repetition.

Chemistry Lab #2 visually illustrates the dynamic behavior of gas particles as the user varies the gas environment. This simulation and the user's manual are designed to guide the student to an understanding of the Ideal Gas Law, the Kinetic-Molecular Theory and the principles of Entropy. The program features low-resolution graphics and is written in machine language for fast response time. P.O. Box 14665, Oklahoma City, OK 73113. □

Events

Bell & Howell offers on-site service on Apple-labeled and video products. Bell & Howell has expanded its nationwide service organization to include fast, competitively priced on-site service of Apple Computers and are expanding their existing service on video products.

For more information on Bell & Howell electronic systems support, write: Girard Russell, Manager – Bell & Howell Information Systems Service Operation, 6800 McCormick Road, Chicago, Illinois 60645. Or call him at (312) 539-1077. □

Home and personal electronics to approach 20 percent annual growth through 1982. While some segments of the consumer electronics industry are experiencing their first "no growth" year in history, other segments are booming. According to a newly-published market analysis, the factory value of U.S. consumption of home and personal electronics will increase by almost 20 percent annually.

As described in a report just published by Venture Development Corporation, the Wellesley, Massachusetts market research and consulting firm, the product segments most heavily dependent upon microelectronics will show the strongest sales growth. The factory value of home electronics products will more than double from $336.8 million in 1978 to $764.1 million in 1982. The factory value of personal electronics, $1,261.6 million in 1978, will reach $2,421.0 million in 1982.

The report groups both home security and communications equipment in the home electronics category. Intrusion detection devices will be among the most rapidly growing consumer electronic products. Unit shipments of intrusion detectors will increase by 71.4 percent annually through 1982.

The personal electronics category includes calculators, electronic watches, and personal computers. While total watch and calculator shipments will grow only modestly in the next two years, personal computer shipments will grow by 49.5 percent annually through 1982.

The report notes that the greatest opportunities for electronics manufacturers may well be found outside traditional product categories. Both automotive electronics and major appliances will make increasing use of microelectronics for both control and display purposes. Neither "big ticket" category will show the rate of growth characteristic of the three electronics categories: home, personal, and entertainment electronics. However, the large size of the automotive and major appliance industries means that even a modest increase in the use of electronics will produce significant revenue growth for electronics suppliers.

In addition to forecasting factory shipments for every major product, VDC's study *The U.S. Consumer Electronics Industry 1978-1982: A Strategic Analysis* identifies key marketing and technology trends that will affect specific product groups.

Further information regarding this report can be obtained from Raymond L. Boggs, Consultant, Venture Development Corporation, One Washington Street, Wellesley, Massachusetts 02181, (617) 237-5080. □

Warner Amex's QUBE subscribers to have access to data banks. Subscribers to Warner Amex Cable Communications Inc.'s two-way interactive QUBE service in Columbus, Ohio, will soon be able to retrieve information from data banks permitting a variety of consumer services including computer video games, stock market information, personal financial management and other services.

The service will begin this fall with a two-way interactive project by Warner Amex, Atari, Inc., a leading manufacturer of personal computer systems and a subsidiary of Warner Communications Inc., and CompuServe Incorporated, a leading time sharing computer service company. Atari is a leader in the home video games industry and the coin-operated games business. CompuServe has provided computer services for more than 10 years to some of the nation's largest business and government agencies. Headquartered in Columbus, Ohio, CompuServe is a subsidiary of H & R Block, Inc.

A minimum of 100 Atari personal computers will initially be installed in QUBE subscriber homes giving those subscribers access to data banks which are part of the CompuServe service. The service will be available to subscribers from 6 p.m. to 5 a.m. on business days and all day on weekends and holidays.

QUBE households participating in the project will have access to data that will literally convert their homes into "information centers" containing millions of facts from major information providers.

Through a cross-indexed information "menu," subscribers will have at their fingertips computer video games, current financial and commodity news and diverse business analysis and money management information from some of the best financial sources available. Other data services may include:

– Full coverage of sporting events from around the country.
– Consumer reports.
– Airline and bus information schedules.
– Emergency telephone numbers including health procedures and poison antidoes.
– Employment listings, training opportunities and the teenage job market.

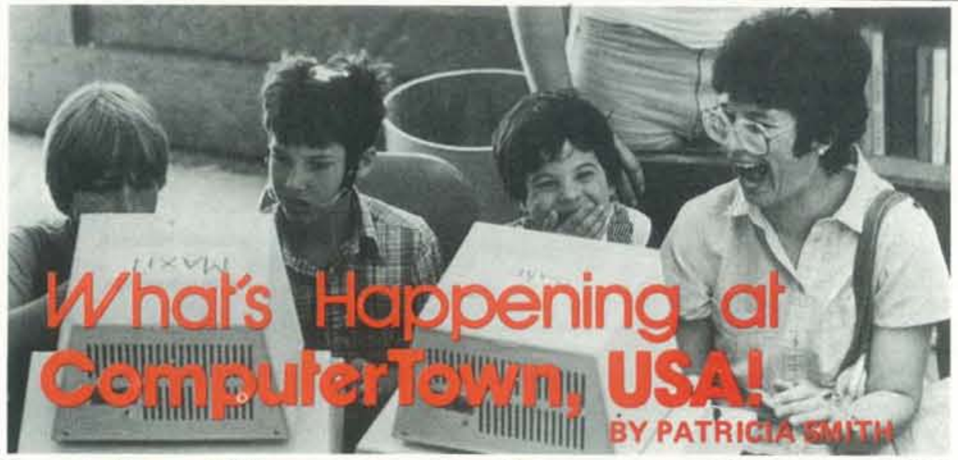
For the past several years, Warner Amex has been providing interactive consumer services at its QUBE system in Columbus, Ohio. These services such as opinion-polling and pay-per-view program offerings are now being extended into the field of information retrieval and will include other transaction services such as shopping and banking.

Warner Amex is currently constructing cable TV systems with QUBE interactive service in Pittsburgh, Houston and the greater Cincinnati area. Warner Amex is a jointly owned company of Warner Communications Inc. and the American Express Company. It operates 148 systems in 29 states serviing 700,000 subscribers. □

Apple computers establish beachhead in Japan. Japan's present 6% share of Apple Computer Inc.'s worldwide sales of personal computers should double in the next 18 months, predicts sales vice president Gene Carter, now that the Cupertino, CA, firm has an official import representative in Toray Industries Inc. Toray will provide full support for the Apple computers, including servicing. Short-range plans call for first-year sales of 10,000 of the new Japanese version of Apple II, which came out in August, 1980. Major differences include a Japanese katakana syllabary pattern generator and key tops and a one-year guarantee to show the quality-conscious Japanese market that the company stands behind its products. Long-range plans include the establishment of Apple Japan Ltd. □

News

RECREATIONAL COMPUTING wants to be your informational bulletin board. If you are sponsoring an event, let us know about it. Send pertinent information to Events, Recreational Computing, 1263 El Camino Real, Box E, Menlo Park, CA 94025. □



What's Happening at ComputerTown, USA!

BY PATRICIA SMITH

ComputerTown, USA!, a grass roots organization formed to bring computer literacy to the general public, recently received a National Science Foundation grant to compile information on how to set up a computer literacy program.

The organization, which has successfully demonstrated the use of microcomputers at the Menlo Park Public Library, a book store and a pizza parlor, will use the grant to develop written materials for other people who want to start computer literacy programs in their communities. "We are finding other people do want to start computer literacy programs. For example, we recently heard from ComputerTown, UK (United Kingdom), a group that wants to start a program there," Pat Cleland, Coordinator of ComputerTown, USA!, said.

Cleland explained that the $224,000, three year grant will allow ComputerTown, USA! to develop course materials, offer workshops and provide information to the public through a monthly newsletter. Although the grant for compiling information will be administered through People's Computer Company, with Ramon Zamora serving as Project Director, ComputerTown, USA! is still a grass roots community enterprise, dependent on the efforts of many volunteers.

Just what goes on at ComputerTown, USA!? What kinds of instructional programs are offered to the public? Who are some of the people who work behind the scenes? These and other questions will be answered in forthcoming columns on ComputerTown, USA! First, though, some background and history.

ComputerTown, USA! began a year and a half ago, when Bob Albrecht and Ramon Zamora, authors and editors of People's Computer Company publications, decided to take their own microcomputers, software, and reference materials to places where people normally gathered.

After an unsuccessful attempt to establish a program in the public schools, Albrecht and Zamora approached the Menlo Park librarian and began offering once-a-week "hands-on" sessions at the library. According to Cleland, during the first few months of operation, approximately 200 kids went through the library and were exposed to the computer.

Several manufacturers took note of the program and soon Commodore donated three PET microcomputers and Atari and Radio Shack each donated a computer to the project. At the same time, some software companies donated cassettes. "The cassettes are mostly games – that is games with a purpose. They show what the computer can do," Cleland said.

Meanwhile, ComputerTown, USA! expanded and began offering computer sessions at Kepler's book store every three weeks and sponsored an informal instruction program every Monday night at a local pizza parlor.

During the past summer, a little over a year after ComputerTown, USA! began, more formal instruction was offered to both children and adults at the library. Children between the ages of 9 and 13 were taught the fundamentals of operating a microcomputer and BASIC. Adults were also instructed in BASIC and weekly classes covered the use of microcomputers, kinds of microcomputers that are available, costs of equipment and sources for programs. Money from tuition was used to pay teenage pages who monitored the use of the microcomputers, now permanently situated in the library.

At a recent special program on Computers for Small Businesses, over 100 people poured into a small room in the back of the library for microcomputer demonstrations. By now, Cleland estimated, "more than a couple of thousand people in the Menlo Park, California, community have been exposed to the microcomputer." □

Recreational Computing MARKETPLACE

Classified ad space available: $60 per vertical inch. Columns are 3¼" wide.

ComputerTown, USA!
A grassroots, economical model of how to offer everyone in a community of 27,000 the opportunity to use a microcomputer. Your interest and help is invited. For more information, please send a large self-addressed, stamped envelope to: ComputerTown, USA!, Box E, Menlo Park, CA 94025.

PCNET PAN
An electronic mail package, PAN allows PET owners to send and receive messages over the telephone network. Entirely written in BASIC, PAN permits immediate message transmission, or unattended transmission at a specified time. PEOPLE'S COMPUTER COMPANY, PCNET Project, P.O. Box E, Menlo Park, CA 94025.

Advertise with Classifieds!
An ideal opportunity to promote your new product or service is our new Classified Section, Marketplace. Priced low at only $60 per vertical inch, here's your chance to test a hungry hardware/software market. Contact Michael Madaj, Advertising Director, *Recreational Computing*, P. O. Box E, Menlo Park, CA 94025, (415) 323-3111.

ADVERTISER INDEX