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Production and Subscriptions: 01-278 9517

Practical Computing is published by ECC as a subsidiary of WHICH COMPUTER? Ltd at its registered office, 2 Duncan Terrace, London, N1, and printed by Bournehall Press Ltd, Welwyn Garden City. Distributed to newsagents by Moore Harness Ltd. 31 Corsica Street, London N5 and to specialist shops by Practical Computing Ltd.

Subscription rates: Single copy: 50p. Subscriptions: U.K., £6 per annum (including postage); overseas, £12 (including airmail postage)

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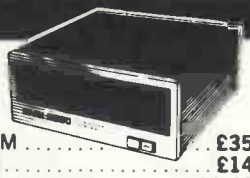

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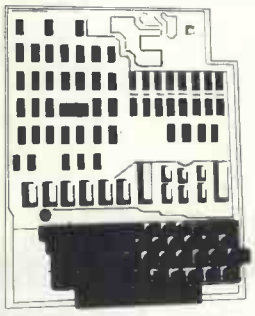

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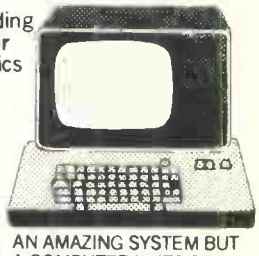

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7474	.30	74194	.95	74L75	.85	74S20	.25
7475	.35	74195	.95	74L93	.55	74S40	.20
7476	.40	74196	.95	74L123	.85	74S50	.20
7480	.55	74197	.95	74LS00	.30	74S51	.25
7481	.75	74198	1.45	74LS01	.30	74S64	.15
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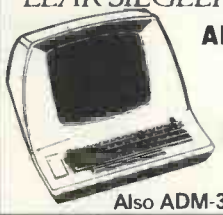

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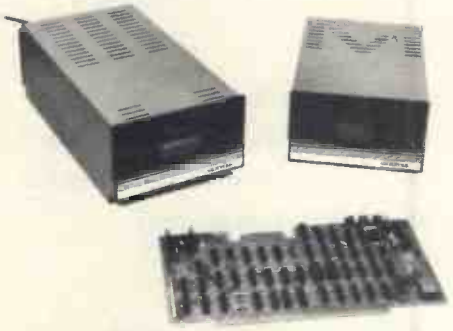

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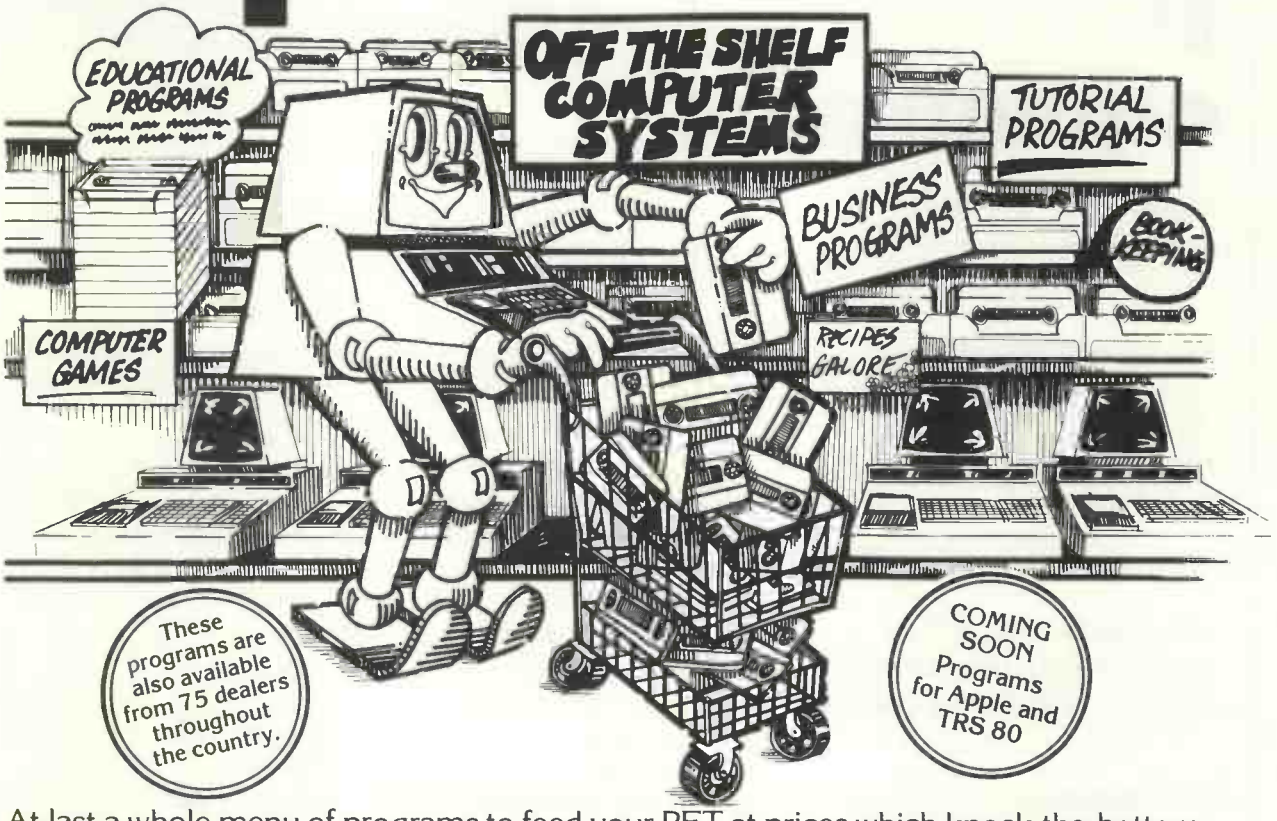

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Publisher's Letter

FROM a survey we completed recently of the number of microcomputers with an initial cost of less than £1,250 which are now in use in business, education and home environments in Britain, we estimate that there are now about 30,000 such computers installed. That number, of course, is growing at a tremendous rate.

They are being used for a wide variety of interesting and useful applications of the type you read about every month in *Practical Computing*. There are plenty more potential applications waiting for the right equipment, as instanced by the tremendous response to our most recent competition (for results see page 78).

As a reader of *Practical Computing* you will appreciate the usefulness of these computers and how they improve the quality of life in areas as diverse as teaching the mentally handicapped, improving financial reporting and planning school meals. Microcomputers are here to stay and the lives of more and more people are beginning to be affected by them.

In the circumstances, it is disquieting that there is still so much public apprehension about computers. There is far more awareness of multi-million pound gas bills caused by data processing errors than there are about paralysed school children being helped by micros to pass their A levels.

All of us involved in this field should do what we can to give computers a better image to the lay public. There is a tremendous role for computer clubs to play here. In the States, local clubs have set-up foundations solely for this purpose, and I was interested to meet Joe Rogers, vice-president of the Personal Computing Foundation of Houston, which "is a non-profit organisation devoted to informing and educating the general public in personal computing".

The Foundation is financed by donations, and its members are happy to help people obtain the best results from their computers. They take every opportunity to spread the word about the benefits small computers are providing. It seems to be one American example which would be well worth following.

The Publisher

Our Feedback columns offer readers the opportunity of bringing their computing experience and problems to the attention of others, as well as to seek our advice or to make suggestions, which we are always happy to receive. Make sure you use Feedback—it is your chance to keep in touch.

Pet behaviour

I AM a final-year psychology student and am an interested observer of the new behavioural patterns emerging within the family, as a consequence of my husband having bought a Pet computer for our home.

It seems to me that a basic fact concerning the human-computer relationship is that it is one-way. I do not doubt that the flow of information is two-way but I maintain that it does not constitute a true relationship. The computer provides information; in no way does it take into account the effect that it may have on the receiver. This new kind of relationship may be detrimental to the learning of normal behavioural patterns.

To give a specific example relevant to the Pet situation, man has always played games, partly because the process of problem-solving is stimulation, and partly because of the challenge it provides when competing with other people.

Pet, however, now acts as the opponent and as such all the subtleties of the relationship are missing. I have noticed how my children have learned very quickly to play various games which hitherto were of no interest to them—apparently because the learning situation is enhanced, feedback is immediate, and the frustration of waiting for the opponent to make a decision is absent.

For the young child, 'self' is a dominant factor, and as attention is focused on his own game-playing, the situation is inherently rewarding. But one of the benefits of game-playing is that the child learns how to behave with and towards others, how to cope with success and failure, and what effect it has on others. In the human-computer relationship, the child does not learn these valuable social skills.

It may be that as microprocessors encroach on human relationships even further, they may have a beneficial effect; people will certainly have access to more information and of a greater variety than before. I hope that the variety will encourage man to become less narrow-minded and more aware of others.

On the other hand, future generations may become less interested in others; and they certainly will have less opportunity to learn how to behave in social relationships. This may make for a more insular society, where challenges come from within self rather than from others.

Personality is not only a product of inherent traits but also develops through experience and interactions with others. I fear that unless man is aware of himself, not only as an individual but also as a social animal, society will suffer as a consequence.

Jennifer Adams,
Streetly,
Sutton Coldfield

Records accounting

I HAVE been looking for some time for a software program suitable for incomplete records accounting but have so far failed to find any suitable for microcomputers. Do you have any information on the subject?

P. Finlay,
Stratford,
London E15

● **There are many packages for incomplete records accounting, ranging from cassette systems for Pet or TRS-80 at one end to turnkey microcomputer systems costing between £5,000–£12,000. This is an area which we intend to look at, though not in the immediate future.**

Beginner

I AM an O & M officer in a large computer-using company. In my job I am in increasing contact with computers, so I decided the best way to understand their basic principles was to build and use my own microcomputer and I could have fun doing it. Not knowing which way to turn, I bought your magazine, which gave me an insight into the obviously massive world of microcomputers and a few 'leads'.

I would be very grateful if you could recommend a good kit I could build. My knowledge is minimal and my needs are as follows:

- a computer able to handle both simple and more sophisticated games, with me being able to handle the programming.
- a VDU.
- tape input.
- ability to handle domestic accounts.
- potential for expansion without having to replace expensive units, as my enthusiasm is bound to become even more unrestrained.

Could you also recommend any books I could read on building, using and programming for the beginner, with a comprehensive dictionary of the baffling terminology.

W. Athinger,
Manchester, 20

● **We suggested a few titles including Rodnay Zaks'** *Introduction to Personal and Business Computing* **and James White's** *Your Home Computer*.

Harrow group

YOUR READERS may be interested to know about the ACC Harrow group, which has been meeting regularly for several months. The meetings take place on alternate Wednesdays at 7pm in room 135 of Harrow Technical College and give both professional and amateur users the chance to get together and discuss their problems, and to advise those thinking of buying a system.

A software project is under way and a hardware group is being formed to build, initially, an EPROM programmer. We welcome anyone interested in microcomputers to visit us or to contact me on 01-950 4771.

Bazyle Butcher,
Watford

Satisfied

IN THE March issue Glossary, 'Foreground' is defined, but just as there are some people who insist that '0' means letter 'O' (when everyone knows it is a zero), so there are some who use 'foreground' and 'background' in exactly the opposite sense to you.

Not only that but there is a completely unrelated third definition to each word (see *Penguin Dictionary of Computers*).

Having had to learn Basic from a Hewlett-Packard manual, and having read several Basic handbooks since, I feel that your

(*continued on page 31*)

TERMINALS FOR YOUR MICRO

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H1400 VDU
Low Cost Video Terminal
£550

● Circle No. 149

New low cost VDU featuring full cursor controls and 24x80 screen displaying high resolution upper case characters using a 5x7 dot matrix. Keyboard generates all 128 ASCII codes and unit interfaces through an RS232 interface at transmission rates up to 9600 baud.
H1500 series features upper and lower case characters using 7x9 dot matrix integral numeric keypad, buffered editing, and printer port.

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● Circle No. 150

Industry standard dot matrix keyboard printers featuring 132 column upper and lower case printing on standard listing paper at printing speeds of continuous 30cps or 180cps. KSR and RO versions available with a wide range of optional features.

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● Circle No. 151

File oriented mass data storage minidisc terminal featuring random access by file name to 200,000 characters stored per diskette, interfacing through terminal and modem/CPU RS232 interfaces at up to 9600 baud. Powerful string search and editing options.

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● Circle No. 152

Range of microprocessor controlled 'daisy-wheel' terminals for text processing applications, printing at 45cps over 158 columns with a wide range of interchangeable type fonts. Many advanced features including IBM2741 compatibility, graphics capability, 'absolute' tabbing, and variable character/line spacing.

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● Circle No. 153

Magnetic tape cassette unit storing 150,000 characters per cassette, communicating at up to 2400 baud through terminal and modem/CPU RS232 interfaces with full local and remote device control. ECMA, TI and NCR format compatibility options available.

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● Circle No. 154

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RAIR 30-32 Neal Street, London WC2H 9PS Telephone 01-836 4663

continued from page 29)
serialisation of *Illustrating Basic* is one of the clearest descriptions of the language I have seen. Once one is accustomed to Donald Alcock's personal style—which could take all of five minutes—his explanations are clear, his examples relevant, and his notes and warnings on the restrictions imposed by different dialects of Basic more useful than any others I've met.

Sgt. M. Bruce,
BFPO 21

Noughts and crosses

I WAS very impressed by the noughts and crosses game published in February and immediately ran the program on my TRS-80 (Level II 16K). After a time I discovered a bug in the program. If you play square 7 and 3, the computer takes 5 and 8; but if you then take square 1, instead of taking 2 to win, the computer will take 4 to block you. You can take 2 and win. The following modification takes care of the minor problem:

```
Add to line 80          K=0 PA:—1:
and to line 870         K=3:
and to line 960         K=1:
and continue
1130 IF F=2 THEN M(PA)=—1:F:1
1135 RETURN

1150 IF PO=P THEN IF M(P+K)=—1:F=1
     M(PO)=—1:F=1:RETURN
1160 IF PO=P THEN IF M(P+K)=0 THEN
     PA=PO: F=2: RETURN
1170 IF M(P)=—1 THEN M(PO)=—1:F=1:RETURN
1180 IF M(P)=0 THEN PA=PO:F=2: RETURN
1190 M(PO)=—1:F=1:RETURN
```

Thank you for a most informative and interesting magazine.

David Sellwood,
Leigh, Lancs.

Nascom fan

AS a newcomer to computing I have been buying your magazine since issue 2. I find that I am beginning to understand more as time passes but would appreciate more beginner-type articles—particularly on the software side.

I have a Nascom-1 and hope to expand this as my increasing knowledge permits. I am writing to support your idea of a page for Nascom owners. Although I would not be able to contribute much at present, I certainly would like to see such a development for the following reasons:

- there is now a large number of Nascom owners.
- we are supporting home-produced equipment (to some degree, anyway).
- it will provide more programs relating to Z-80.
- The Nascom system is now becoming increasingly versatile.

C. Bowden,
Truro, Cornwall

Petsoft payroll

I ENJOYED the February issue of *Practical Computing* and felt that your comments on our payroll program were both fair and accurate.

Nowhere in the article, however, did it mention the names of the publishers, authors or distributors. For the record, they were all us. I would be grateful if you could include a note of this fact, as we have received a number of enquiries from readers asking whether we could supply this program.

Julian Allason,
Petsoft,
Newbury

Tape standards – 1

I WAS interested to read the article on the proposed new Tape Cassette Standard by Bert Martin in the February issue. Since purchasing a Nascom-1 late last year, and being the owner of a Philips N2229 audio-visual tape cassette machine, I have been thinking about ways and means of improving the speed and convenience of data transfer between the computer and the N2229. I had come to similar conclusions to Bert Martin.

The Philips machine has, I believe, some advantages over the more expensive stereo machines listed by Martin—it is cheaper; its track width is double that of a stereo machine, thus improving the signal-to-noise ratio and reducing the probability of drop-out; its input for recording slide-changing pulses also provides for the remote control of the tape drive motor; it is claimed by the makers to have a very rapid response to the sensor start/stop control.

One possible drawback to the N2229 is that it records only two tracks (sound and control) and thus can be used only on one side if the control track is to be retained. Personally I don't think this is a serious problem.

The frequency response of the normal channel is better than 10KHz, thus allowing a high data rate to be recorded—say of the order of 2,400 baud, or 10 times the Nascom rate. The re-wind and fast-forward speeds are approximately 25 times the normal tape speeds.

I have had some experience with Hewlett-Packard desk-top computers, in particular the 9821A which has a built-in cassette unit. The ability to label and record files from the keyboard, and later to call up files by number at the fast tape speed, is a great advantage; I think such a feature should be allowed for in any proposed new specification.

When long programs or large amounts of data are being transferred, though, it is surprising how tedious the waiting before proceeding with the job becomes. This emphasises the need for any specification to provide for the highest rate of reliable data transfer, and for the rapid location of the start of any particular file.

One further aspect of microcomputer use is the need to make hard-copy. The high capital cost of printers is likely to deter many enthusiasts. To postpone such an investment, I have considered the use of a Polariod camera with a suitable mounting frame to ensure reliable pictures of the video display.

The Polaroid Instant 30 (£20 approx) or the R100 (£40 approx) using the black and white film-pack type 107 (34p per exposure size 85mm × 73mm) would allow some 1,000 photos to be taken before the cost of a printer is approached.

The characters would be about 4mm × 2mm (the capital letters on your page are approx 2mm × 2mm). A close-up lens would be required to focus down to about 400mm for a 12in. screen. Some arrangement to assure optimum exposure from the auto exposure system may also be required.

The copying rate would be about 20 characters per second from the Nascom display.

It is my intention to develop both these systems after my Nascom-1 is working properly and I have gained some experience in its use.

I would be willing to co-operate in the development of the proposed cassette system by passing on the results of my work with the N2229.

K. Russell,
Sunbury-on-Thames,
Middlesex

Tape standards – 2

RE Bert Martin's article on the proposed cassette standard, my company has spent some time and money working on a cost-effective system with a reasonable degree of success.

We recorded a 'clock' on the top track and data pulses—not tone bursts—on the bottom. Each word is recorded twice with the usual parity checks. The amps (our own) drove a CPU input port direct; the amps cost less than most people spend on tone filters.

De-coding is done by a simple software program which also allowed the tape to be read in reverse. Bit 8 was used as the tape direction indicator; bit 7 was clock and bit 6 the data. Bits 5, 4 and 3 can provide not only multi-machine inputs but also allow multiplexing of simultaneous transmissions.

Being independent of frequency, the tape speed has an enormous tolerance. Our Z-80 system was able to receive data at 1·5K bits per second with infrequent errors. Each program or file had a leader consisting of a number of tone pulses recorded at the search speed—the data was beyond the amp cut-off during search.

It is a very simple matter to strip-down a cheap mono cassette recorder, abandon the capstan drive, fit an end-of-tape direction reversing mechanism, and induce the whole thing to run at the two required speeds. It is also easy to purchase and fit a stereo head and replace the electronics with some which will handle logic signals; this includes 'record', which we managed to do satisfactorily using only half of a 4011 and a few resistors—DC bias, of course.

In fact, once you have had the courage to abandon the text books and all that's dear to the hi-fi man, you will find the whole thing really easy.

Our systems are rather specialised, and don't use ASCII, Basic or the S100. As such, our software would be of little use to most but if anyone is really interested in trying one, I would be pleased to furnish details—all of them. You see, we have rather lost interest since we developed our eight-track car-type cassette system.

If this system, including a ROM for the software, costs you more than £50 in all, you have robbed yourself.

John Allen,
Portsmouth,
Hants.

Looking to Ohio

I AM 16 years old and I want to buy a Challenger IP computer made by Ohio Scientific. My father is a bit uneasy about sending $349 to the States for it, so could you please tell me if you know of any company in England selling the same computer?

Can you also recommend to me any other personal computers, which run on Basic, are reasonably cheap, and are ready-built? I am very inexperienced when it comes to the hardware side.

R. Goli,
Wolverhampton

● **Ohio has a main U.K. distributor, Abacus Computers Ltd, (01-637 0777). Abacus has arranged several local distributors around the country and will be able to put you in touch with your nearest one. Be warned, though—the price won't be anything like $349.**

Award winner

THANK YOU for your kind response to my letter about word processing. It has since occurred to me that your readers might be interested in the award-winning SCRIB from Bobst Graphic of Switzerland.

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(continued on page 33)

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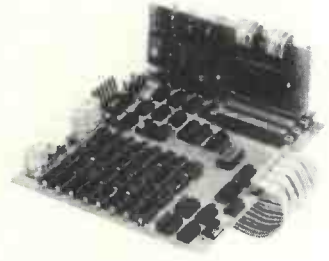

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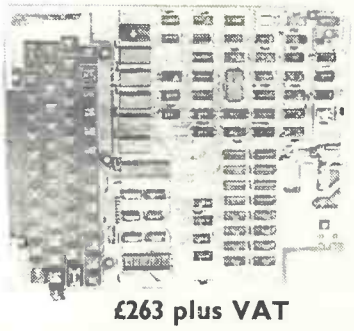

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(*continued from page* 31)
Angeles. I'm not sure if it is available in England.

More power to your Printout. By the way, I don't have shares in Bobst Graphic.

G. Peter Winnington,
Orzens,
Switzerland

For MK14 users

AS a Science of Cambridge Mk 14 owner, I would be obliged if any of your readers could put me in touch with a users' club. If no such club exists, I should be interested to exchange Mk 14 experiences with other Mk 14 owners.

How about an article on the most economical cassette recorders to use as a storage medium—can inexpensive models be used, or are there certain basic requirements which these machines do not fulfill? And how much care needs to be taken when using recorders How often does the head need demagnetising?

J. G. Walton,
Newton,
Derbyshire

Numeral input

I AM in the process of establishing the use of an Apple II for a small business application. As you know, this machine has a Qwerty keyboard with the numerals along the top.

I should like to know whether you are aware of anyone selling a separate numeral keyboard which could be wired to the Apple to improve the hand motion when the input is mainly digits.

A. C. Maule,
Harrogate

● **We do not know of any specific supplier but suggested two potential sources.**

Mix'n-match

AS a Nascom owner, I was delighted by the recent mention in Printout of the possibility of a Nascom page and I am sure that this will prove to be very popular.

Although I have recently taken a subscription to *Practical Computing*, I am a little disappointed in the contents. My criticism centres on the hardware side of your magazine most of which seems to be aimed at the enthusiast building-up a system by buying add-on units from one particular firm.

There are, however, people who like to mix'n-match their own systems, either for personal preference or for cheapness and versatility. I even hear that there exists a strange breed of masochists who like to design and build things from scratch or is this just a rumour?

What such individuals require is hard technical information, particularly in relation to interfacing. To give a concrete example, I must have seen RS232, 20mA Loop and S100 in print thousands of times, but not once have I ever encountered a detailed exposition of any of these formats.

K. B. Cusson,
Doncaster

● **We are planning more 'hobbyist' articles, including a discussion of these standard interfaces.**

Manchester plea

I WOULD like to compliment you on its general content and layout. Doubtless it can be improved, but as far as a newcomer to the computing world is concerned, it seems to do what is required of it.

I read that various parts of the country have Pet users' groups and the like. Is there such a group serving the northern half of the Greater Manchester area? After all, the sales of these machines in the area must be large by now; and from discussions with some owners I find that there are many mutually-experienced problems which refer either to lack of experience of the operative, or machine errors, or machine instruction manual errors, or commercially-available programmes being unsuitable or inadequate for the tasks in hand.

In many cases, the inadequacies and difficulties will be sufficient to deter people from buying the machines once the news gets round and the novelty value fades. This would be a pity from everyone's point of view, whether as manufacturer, dealer, journalist or user of the contraptions.

The only real solution to the general problem is the proliferation and exchange of knowledge in the field. This is obviously where your magazine has its best and growing market, but while magazines are excellent in their way, they cannot replace entirely personal contact between experienced people who share the same problems. They can, of course, supplement the contact and reduce the need without eliminating it, and for this reason I wish you continued success.

R. F. Doran,
Bacup,
Lancs.

Tandy problem

I WAS glad to see the Tandy Forum. A reading of your first effort has raised a question and a problem, though.

Who is publishing the *Guide to TRS-80 Information*? Your article gives the address but not the author or publisher. I don't know to whom to send my cheque in Oak Park.

I can't get Freddie Nicholls' 'square' program to run with my Level I 16K configuration. When I hit RUN I get two horizontal lines of the correct length, separated by the correct vertical distance, but no vertical lines appear to complete a square.

Timothy Meno,
Eastcote,
Middlesex

● **The *Guide* is published by F. Huebner, Box 37206, Oak Park, MI 48237.**

Addictive

I WAS very interested in the two articles on epic games in your February issue, both of which referred to Willie Crowther's game *Adventure*. Unfortunately, the appeal of it is limited severely by the coding being in non-standard Digital Fortran and the core requirement is very large.

Recently I have removed the first of these restrictions from a new version of *Adventure*—with more caves, features and fun—by writing it in standard Fortran.

Although I reduced the core requirements wherever possible when programming, a more substantial reduction could probably be made by using Nick Hampshire's suggestion of 'text packing'. Does anyone have a working scheme to do this, or is anyone interested in developing such a scheme?

With the proliferation of microcomputers with limited RAM, there could be a wide application for a good text packing scheme.

If anyone is interested in running my *Adventure II* they could get in touch with me. I am particularly interested at the moment in getting it to run on a smaller machine to see if fine-tuning of the program output is necessary to accommodate any delay in program response.

I must issue a word of warning, though, to anyone who has not played *Adventure*. It can be very addictive, so unless you are very strong-willed or have plenty of spare time, think twice before getting involved.

In Feedback in your March issue you give the address of a computer club in Sussex; have you the address of one near Bedford?

Jack Pike,
Chawston,
Beds.

● **No, we haven't, but both the Independent Pet Users' Group and the Amateur Computer Club have groups around the country. It would be worth contacting Mike Lake of IPUG, (19 Littleover Lane, Derby) or Mike Lord of ACC (7 Dordells, Basildon. Essex). We are trying to put together a new, improved directory of user groups and computer clubs, so anyone with a contribution to make could contact us.**

Jargon program

I OFFER for publication the attached program and sample runs. As a regular reader of your magazine. I have become disappointed at the lack of impenetrable jargon, especially in your correspondence column.

To help readers in their search for "the original cliche", the meaningless profundity, I have devised this program, which automates the process fully. The ABG will be an invaluable aid to all those with nothing to say, and an urge to say it.

The program was written in a Hewlett-Packard Basic, which has a few quirks worth pointing out:

Line 150—DIM A$(17)—gives a string variable 17 characters long, not 17 subscripted strings.
Line 310—this Basic does not allow RND(X) when X does not have a value assigned. Also, RANDOMIZE statement may be necessary in other Basics to prevent the program always starting in the same place.

Apart from these features, the program is fairly simple—and could be simplified even further, for example by placing the subroutine in the main program body.

```
10 REM  ****AUTOMATIC BUZZPHRASE
        GENERATOR****
20 REM  **A P SHELBOURNE, FEB 79***
30 REM
100 REM **** CONTROL AND PRINT
        SECTION****
110 PRINT
120 PRINT "AS OF NOW, AT THIS MOMENT IN
    TIME, THE CURRENT"
130 PRINT "AND CONTEMPORANEOUSLY
    FUNCTIONAL BUZZPHRASE IS"
140 PRINT
150 DIM A$C[17]
160 Z=1
170 FOR I=1 TO 3
180 GOSUB 300
190 REM ****RANDOMISES AND READS
        LIST*****
200 PRINT A$;
210 NEXT I
220 PRINT
230 PRINT
240 PRINT "HAVE A NICE DAY!"
250 GOTO 600
260 REM
300 REM ***RANDOMISING SUBROUTINE***
310 X=1
320 A=Z+INT(10*RND(X))
330 REM ***THE FOLLOWING DATA CONSISTS
340 REM ***OF 3 LISTS OF 10 WORDS*****
350 DATA "ONGOING ","OVERALL ",
    "SYNCHRONISED "
360 DATA "COMPATIBLE ","MEANINGFUL ",
    "OPTIMAL "
370 DATA "SYSTEMATISED ","VIABLE ",
    "INTEGRATED "
380 DATA "RESPONSIVE ",STRUCTURAL ",
    "ORGANISATIONAL "
390 DATA "THIRD-GENERATION ",
    "TRANSITIONAL ","REAL-TIME "
400 DATA "RECIPROCAL ","OPERATIONAL ",
    "DIGITAL"
410 DATA "LOGISTICAL ","INCREMENTAL ",
    "SCENARIO "
420 DATA "CONCEPT.","PROGRAMMING.",
    "HARDWARE."
430 DATA "SITUATION.","CONTINGENCY.",
    "SOFTWARE."
440 DATA "FLEXIBILITY.","OPTIONS.",
    "CAPABILITY."
450 FOR J=1 TO A
460 READ A$
470 NEXT J
480 Z=Z+10
490 RESTORE
500 RETURN
510 REM
600 END
```

A. P. Shelbourne,
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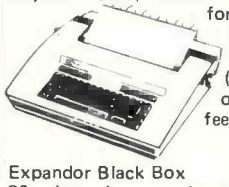
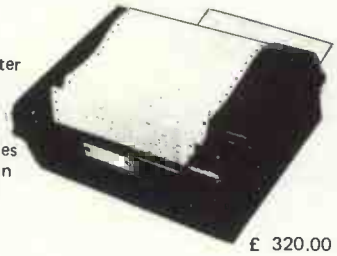
Automatic volume control (AVC) for CLOAD	£ 25.00
'Electric Pencil' text/word processing package C/W lower case mod. (Supplied & fitted)	£ 93.00
'Electric Pencil' text/word processing package (on cassette) inc documentation	£ 65.00
S100 Interface for TRS 80	POA
'Library 100' — 100 programs for TRS 80 on cassette	£ 39.00

Printers

TELETYPE 43KSR £875.00
Keyboard send/receive Serial printer for PET or TRS 80



(Interfaces or friction feed extra)



Expandor Black Box	£ 320.00
80 column impact printer	
Centronics 779 parallel printer	£ 790.00
Centronics 701 parallel printer, Bi-directional+tractor fed	£1375.00
Centronics micro printer (40 columns)	£ 330.00
QUME 'Sprint 5' daisy wheel serial printer — as new, (pinch+tractor feed+other options included)	£2095.00

In/Out

Altair 6801/2 Analog/Digital convertor board S100	£ 382.00
Altair 6804 Process control interface 8 output relays/12 Input channels. S100 board	£ 275.00
Phone Modem	£ 115.00
(For Pet/TRS 80/Sorceror/Apple see headings)	

Terminals

Soroc IQ120 VDU/Keyboard -80 char/24 lines	£ 660.00
Cypher CUB VDU+separate keyboard	£ 380.00

Etc.

Diskettes 5¼ (blank) Boxed (Min order 10) each	£ 3.00
C60 Cassettes (Min order 10) each	£ 0.40
Computalker — Speech synthesis S100 Board	£ 350.00

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Compucolor II available now in the U.K.

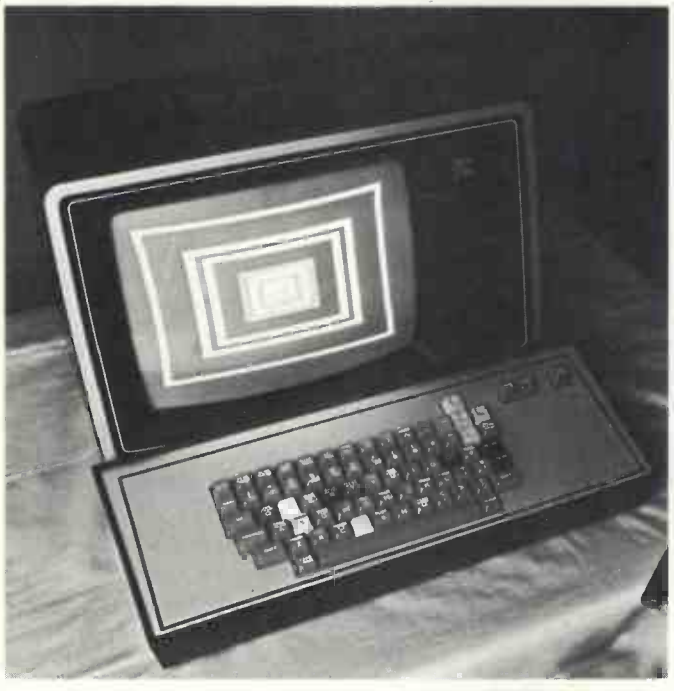
THE COMPUCOLOR II personal computer is now available in quantity in the U.K. Launched by Compucolor Corporation of Georgia about a year ago, the model has been seen rarely in this country because of distributorship problems.

Abacus is the official importer and a contract has been signed whereby Abacus will receive an agreed percentage of all manufacture for sale here.

Compucolor II has jumped rapidly to fourth in the hobbyist popularity stakes in the U.S. and ranks after Tandy, Apple and Pet. No doubt it will soon become a firm favourite in the U.K.

The basic model is the Compucolor II Model 3 which costs £1,390, and standard features include a 13-in. eight-colour display, a 72-key detached keyboard, a built-in minifloppy disc drive and 8K RAM for user programs, with Basic as its language.

Other features on Model 3 include 16K extended disc Basic in ROM, a VDU giving 64 characters per line by 32 lines per page, and graphics with 128 × 128 point plotting, I/O ports including one RS-232 serial asynchronous channel for printer or modem, and discs with a 51·2K bytes/side capacity. Operating instructions and a sampler floppy disc containing a variety of programs complete the system.



The 8K version is expandable but you can go straight for the 16K and 32K versions. Options on the keyboard comprise expansion up to 101 and 117 keys. Ready-made software will also be available, including games and business packages.

The microcomputers are on sale now and can be seen at several retail outlets, including the Byte Shop in Gants Hill and Trans-Am of Chapel Street, London.

Hopefully, someone will soon be starting a users' group in the U.K. for this much-heralded machine. In the meantime, you may be interested in writing to Compucolor in the U.S. for a copy of its monthly newsletter. Contact Susan Sheridan, manager, Technical Publications, Compucolor Corp., PO Box 569, Norcross, Georgia, 30071.

Studying impact of micros

A SPECIAL one-day conference and micro exhibition to explore how microcomputers will impact data processing management is to be held on May 23.

Organised by *Practical Computing* and the Institute of Data Processing Management, topics to be covered are: Microcomputers—introduction and review of the present microcomputing scene, by Richard Hease, managing director, *Practical Computing*; how the microcomputer has already effected data processing management in the U.S., by Joe Rogers, vice-president of the Personal Computing Foundation, Houston; the office of the future, by Alan Patterson, Logica; the impact of microcomputers in traditional data processing areas, by Commodore, manufacturers of the Pet; and an application of microcomputers in a large organisation, by Robert Bittlestone, Roneo Vickers.

Cost of one-day event is £7 for members of IDPM and £10 for non-members; it includes a buffet lunch.

Venue is the Bloomsbury Centre Hotel, London, and tickets are available from The Institute of Data Processing Management.

Attache shows its parentage

ONE OF the neatest desk-top microcomputers we have seen, the Pertec Attache, is new to the U.K. this month.

It is in an elegantly-styled white case with a full 64-character ASCII keyboard, the well-liked configuration of the very successful Apple II. The processor is a 2MHz Intel 8080 and the standard features include 10 S-100 slots in the compact cabinet.

In a sense the Attache is Pertec's first microcomputer. The systems sold here with some success by Compelec derive directly from the Altair designs acquired when Pertec took over MITS.

The Attache shows that parentage, notably by using the S-100 bus and Intel processor, but in other respects it appears to be a different design.

The system includes 16KB memory, a video interface, and the usual cooling and power supply. At 25lb, it probably qualifies as portable, too. The price is £1,737.

You will probably want to add your own video screen and some external storage. There is a Kansas City cassette interface but much more attractive is the Attache floppy disc subsystem—it costs another £1,700 and gives you twin 8in. floppies storing 310KB apiece, though not in IBM-compatible format.

A double-density disc subsystem costs £2,200. You will also need an easy programming language and there is a disc Basic for £41. A printer can be plugged into the serial interface provided; alternatively, you might pay £208 for a parallel printer interface, which will probably be a better bet.

So by our calculations you could put together a neat and reasonably powerful Attache system with, say, 32KB memory and dual single-density floppies for about £3,850. For another £1,500 or so you could have a screen and a decent printer.

The sole U.K. agent, Moncoland, has also made some attractive business packages available at low prices. All modules cost £30 apiece and that means you can have a complete order processing system—order entry, stock control, customer records, and invoicing—for £120.

The same price would buy an accounts-payable suite with purchase ledger, cheque payments, VAT, and buying records. There are also groups of applications covering sales and nominal ledger and payroll—with personal records too; that is unusual.

Moncoland is arranging distributors. We know of four—Keen Computers in Nottingham, Alba in Renfrew, Lion House in London, and GBH in Cardiff. We understand there are a few distributorships still available.

Looking for faster management aids

SIPHER DESIGNS has a microprocessor consultancy package (MCP) which has been tailored to provide clients with an "objective assessment of how microprocessor technology could help solve specific problems or improve their individual business or manufacturing operations".

Each study will help the understanding of new technology and Sipher hopes that once this knowledge has been grasped, you will be able to think of ideas on how to make the best use of computers. It also hopes to identify areas where the technology could be applied most successfully.

A consultancy approved under the Department of Trade and Industry MAPCON scheme, Sipher will look for benefits such as savings in raw materials and energy through more efficient manufacturing processes, quality and reliability, reductions in stock levels, shorter operator learning times and machine setting times.

Better and faster information for management and control, the ability to undertake operations or processes previously considered too difficult, hazardous or costly, and better health and safety conditions will also be examined.

The consultancy says that a typical four-to-six-weeks' study, producing a formal presentation of the final report, identifications of microprocessor solutions and an estimate of probable costs and time-scales, will cost around £2,500 plus VAT and expenses. A proportion will be covered by the DoI.

So far, Sipher has only one customer, although others have been approached, and it is now awaiting replies.

Nasco's £1 million order for chips

NASCO, Nascom Microcomputers parent company, has reorganised its semiconductor distribution business, following the runaway success of the Nascom-1.

Nasco buys all the components which make the popular computer kit and placed an order recently worth almost £1 million with Mostek for chips. It was reputedly the biggest order placed by a British firm for this type of component.

This is reflected by the competitive price structure of its semiconductor range and has helped the Nascom-1 fall again in price to £165, excluding VAT.

Nasco will offer a wide range of semiconductors and TTL, especially low-power Shottky. Apart from standard CMOS devices, many of the more specialised MOS devices used within the digital industry are available, together with memory products, microprocessors and peripheral products from most of the big names in the business.

Staff increases in the sales and marketing divisions are on the way to promote a more direct selling drive. More information from Nasco on (02405) 75151.

Drive for members

THE MEMBERSHIP drive by the Intel MDS Users' Group has attracted some 50 new members.

Membership is free, the group being an informal organisation of Intel MDS users, including representatives of many large companies such as EMI, GEC, Hawker Siddeley, ITT, Plessey, the Post Office, Pye, and STC, plus several smaller companies and educational establishments; a few European organisations are also represented.

The group is keen to expand its membership further. Any organisation or individual wishing to join should contact Lewis Hard on 0234 41685.

The group intends to launch a small newsletter in the near future to provide a "common information platform", as well as information about members' products and services. It will also keep members up-to-date with new Intel products and developments.

Lincoln society prospers

A FASCINATING letter reached us from Lincoln from Michael Lyne, chairman of Lincoln Microprocessor Society.

Two issues ago we mentioned the forthcoming inaugural meeting, and it seems to have gone well.

"It was a foggy and unpleasant night yet our most optimistic hopes for attendance were easily surpassed; between 300 and 400 people crowded into the hall and extra chairs had to be sent for", writes Lyne.

The public was most interested in an exhibition of microcomputer and of microelectronic devices contributed by local firms. The College of Technology mounted "a comprehensive display to show the possibilities and emphasise the complication of applying microelectronic control in a number of applications".

Dr John Todd of the City Hospital, Nottingham, demonstrated a 'lung function calculator' which he and two colleagues built in six months at a hardware cost of £300.

Membership of the society is now more than 70 and increasing. Requests apparently include a session for women on the future of microelectronics in the home, the trade union point of view, an evening in depth on a single computer and a series of evenings specially for the under-18s.

Membership secretary is Elizabeth Nurser, The Chancery, Minster Yard, Lincoln.

Micro keyboard

STAR DEVICES of Newbury, has a low-cost ASCII-coded keyboard designed specially for microprocessors.

This data input terminal features seven-bit parallel ASCII-encoded output with positive and negative strobe edges, full ASCII character set, auto repeat, audio feedback, low-profile plastic case and requires 5V at 200mA.

Optional extras include serial RS232 output, 20mA current loop, parity check bit, on-board 5V regulator, and open collector outputs, active high or low.

The all-in price for the unit is £37·50, including VAT and post and packing, a handbook and edge connector. Further details from Star Services, PO Box 21, Newbury, Bucks.

Ready for change

THERE ARE plans for Sumlock Bondain to replace the North Star Horizon 32K processor being used in its Book-Keeper installation in the near future.

The present configuration, which has the unit built into a neat desk-type unit, will not be changed substantially in appearance as a result.

Sumlock Bondain can be contacted on 01-253 2447/8.

British debut following extensive testing

THE IES Datacorder data capture unit and data processing terminal is now available in the U.K.

The machine is to be marketed by Office Services Swindon (OSS), part of the Computer Services Centre group.

It has already been successful in the U.S. for three or four years and OSS received its first model more than nine months ago, but extensive testing delayed its debut into the British market.

The Datacorder is a programmable microprocessor, equipped with the Z-80, and is described by OSS as a "complete desk-top computer system". It can be used as a stand-alone unit, a data processing terminal or a data capture unit.

It incorporates an 80-character printer which can be used as a communications terminal, allowing direct output from the central computer. Other standard features are an ECMA/ANSI cassette recorder, a 40-character display screen, typewriter and calculator keyboards and full telecommunications facilities.

Its 16K RAM is expandable to 64K and the unit, compatible with virtually all mainframe and minicomputers, has full standard RS-232 interface.

The machine is programmed in a special language called Quick. This, we are assured, is fast, interactive and very simple. It is designed for the compilation of conventional input programs including normal validation, verification, editing and formatting. It is also possible to use the Datacorder for invoices, orders and shipping documents.

Datacorder also supports Extended Basic for stand-alone processing, which means that you can run complex engineering and business applications, such as compound interest and regression analysis.

The programs are stored on an ordinary cassette and loaded into memory. A blank cassette is then inserted for data capture and the machine takes the operator step by step through the program, using a question-and-answer routine which ensures that data is entered in the correct sequence. Floppy disc storage facilities are in the pipeline.

The unit is very compact and weighs 26lb. One of its main advantages is that you can add any make of peripheral to it, or hook it to any type of mainframe. The price for a one-off unit will be around £2,700.

IES Datacorder

Conversion chance

AN OLD Teletype plus £188·50 equals an 8K Basic computer. Well, that is the latest news from Ohio Scientific dealer U-Microcomputers.

Its 500 board has all the ingredients—MOS 6502 processor, 4 or 8K RAM, 8K Basic in ROM, 48-line OSI bus, machine code monitor and serial interface—to turn Teletypes or other serial terminals into computers in their own right.

All you will need initially for the conversion is a backplane to couple-in the OSI bus. To get the system operational you must also have a +5V/—9V power supply.

Third-generation TTL from Texas

TEXAS INSTRUMENTS has introduced the third generation transistor transistor logic (TTL) integrated circuit series, which it expects eventually to replace all existing standard TTL series, low-power Schottky and CMOS support circuits.

The two models are the advanced Schottky TTL series which comprises high-speed circuits and the advanced low-power Schottky TTL series, with circuits which consume significantly less power than similar ones on the market.

The advanced Schottky is twice as fast as the last generation and the ICs feature switching speeds of 1·5 nanoseconds. That is the time it takes for each of the basic digital electronic building blocks (a gate) within the integrated circuit to process computer binary data from gate input to gate output. Each gate data conversion consumes an average of 22 milliwatts or 22-thousandths of a watt power.

The advanced low-power Schottky TTL circuit features one milliwatt power consumption per gate and switching speeds of four nanoseconds. They are intended for use with minicomputers, terminals and electronic office equipment in which low-power consumption, rather than high speeds, increases efficiency.

Initial introduction will include 65 circuit functions in the two series. SN74ALS samples are already available and SN74AS samples will be available soon. Volume production is scheduled for the second half of 1979 and this will take place in the U.S., West Germany and at Plymouth.

The new logic integrated circuit series is expected to be from 20 percent to 50 percent more expensive than the present ones, depending on the function. By the middle 1980s, though, they will be very cheap.

Excuse to visit Paris in the spring

A GOOD EXCUSE for visiting Paris in the spring is the microcomputer show which Sybex, the French-American publishing house, is organising from May 15–17.

Micro/Expo '79 promises to be one of the biggest shows in Europe for the micro world and is proof that personal computing is booming in Europe.

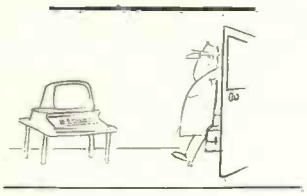
It will be the fourth show to be run. It has apparently doubled in size and attendance every year, so, as 5,000 people attended last year, the organisers must be expecting 10,000 this year.

In addition to the exhibition, a series of conferences will be held at the same time. The programme is organised around three themes—personal computing, new products, and industrial applications. The conference was so successful last year that the hundreds of people wanting to gain entry caused considerable headaches to security staff. According to one report, police had to be called to deal with "several hundred people trying to force their way in to the already-crowded hall".

One of the forces behind the show is man-about-micro Rodnay Zaks, well-known to micro buffs for his *Introduction to Personal and Business Computing*.

The exhibition will feature a comprehensive range of all products and services related to the microprocessor and microcomputer field.

Micro/Expo '79 will be held at the Centre International de Paris, at the Porte Maillot (handy for the airport).



Horizon dealers

OUR REVIEW of the North Star Horizon computer in last month's issue listed all the dealers for Equinox selling the system.

Another major distributor is Comart Ltd, PO Box 2, St Neots, Cambridgeshire PE19 4NY. Tel: (0480) 215005.

The company has also set up a wide range of dealers. They include:

Microcomputermart Ltd, Manchester. (061-832 2269); The Byte Shop, Ilford, Essex (01-554 2177); Cambridge Computer Store, Cambridge (0223 68155); Xitan Systems Ltd, Southampton (0703 38740); New Bear Computing Store, Newbury, Berkshire (0635 49223); Holdene Ltd, Leeds (0532 459459); Isherwoods (Personal Computer Systems) Ltd, Luton (0582 424851).

Leasing

MAZUMA, of Ingatestone, Essex is leasing small systems to small businesses and personal applicants for a minimum of one year. At the end of the agreed period, you may continue to rent equipment indefinitely for a nominal charge, or you can buy it outright at a residual value.

Mazuma stresses that the offer is a financial arrangement not to be confused with short-term hiring, and it is therefore unsuitable for someone who wants to hire a personal computer for a short time.

Home games centre

PHILIPS is launching a home computer games centre which will retail at less than £150, plus £10 per program package.

The unit, called the G7000, has a full alphanumeric keyboard, which is most unusual for a computer with only 1K byte of ROM and each cassette has 2K bytes of plug-in ROM.

The Intel 8048 microprocessor-based machine is a video games unit.

There will be eight cartridges available immediately and some will contain more than one game. They will include such pastimes as baseball, American football, lunar landing, racing cars, air-sea warfare, and word and logic games like Mastermind.

On a more serious note, a mathematics cartridge and a teach-yourself-Basic cartridge, in very simplistic terms, will also be available.

With colour graphics, it will reach the consumer via a network of retail outlets.

Philips G7000

New group in London

A USERS' GROUP has been set up in South-East London. The group, called Selmic—South-East London Microcomputer Club—aims to provide a platform for the exchange of ideas and give expertise, advice and assistance to novices.

Meetings will be held at the South-East London College where laboratory facilities have been loaned. Special interest groups will be set up, for people in education and small businesses, people with the same machine types and people with a limited knowledge of computers.

The meetings will be held at the college in Breakspeares Road, Lewisham Way, London SE4. For more information contact John Williamson, chairman, on 01-850 4195 or Hugh Gilhentie (treasurer) on 01-303 4968.

Portables only

PORTABLE MICROSYSTEMS is a recently-formed company which intends to deal exclusively with portable computer equipment.

A range of services and products will be offered to "large and small industrial groups", including many hardware and software configurations, and if there is nothing suitable, the company will design and build a product especially for you.

The founder of the company is Mike Ayres, who claims "more than 20 years' experience" with ICL, Plessey, Olivetti and Ampex.

The Attaché Business System

The only system designed and supported exclusively for business applications

Who but Attaché can offer full supporting software at prices you can afford?

For example—Order Entry, Stock Control £160 the lot.

Basic system: Case + CPU + Turnkey monitor board + 16K RAM (capable of expansion to 64K)	£1,466·00
Video Board	£ 271·00
16KB Static RAM	£ 347·00
Printer Interface Card	£ 208·00
Floppy disc system 2 × 310Kb diskettes + controller + box	£1,701·00
Basic Interpreter	£ 41·00

Attaché business systems can be obtained at the following:–

Alba Computer Supplies & Services Ltd., 8 High Street, Renfrew (see John Coleman)
Computer Hardware Ltd., 113 Clonskeagh Road, Dublin 6 (see Liam McAlasdair)
GBH Data Services Ltd., Dumfries Chambers, St. Mary's Street, Cardiff (see Geoff Higgins)
Keen Computers, 5 The Poultry, Nottingham (see Tim Keen)
Lion House Ltd., 227 Tottenham Court Road, London (see Lawrence Sarkin)

There are still a few more distributorships left
Interested? Contact Moncoland 11/12 Pall Mall, London SW1

Attaché—*More than a hobby with us.*

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TO MANY prospective owners of a microcomputer, the thought of acquiring their own computer for less than £50 must be appealing. The problem, though, is that at this price level the only way to obtain a microcomputer is to buy a kit; and the problem with a kit, of course, is building it.

If you possess a fine-tipped soldering iron, you are halfway there. If you also have a leaning toward registers, hexadecimal arithmetic and chips—rather than floppy discs and high-level languages—then one possibility is the MK14 kit from Science of Cambridge.

MK14 is one route you can choose to computing for less than £50

THE MK14 is based on the National Semiconductor SC/MP processor, an established 8-bit micro. It includes a PROM monitor, 256 bytes of RAM, a hexadecimal keyboard and a LED display, for £43·55.

To that must be added a power supply for about £5 and an edge connector. To allow easy replacement of the PROM monitor you will also need two sockets. Many prefer to socket all their chips, and if your experience is limited, this would be an advisable outlay of £2·50 or so.

The MK14 is complete with an 88-page instruction manual, divided into two parts. Part one gives general details of the system, together with step-by-step instructions on assembling it and some generally useful hints on soldering techniques.

It also outlines the internal operation of the processor and the various opcodes available.

Part two contains listings of a variety of programs, including the monitor, and notes on how to use them. Some of the programs, however, require extra hardware to make them work.

Apparently a larger programming manual is in preparation. We hope this will give more detail on programming for the inexperienced owner.

The manual also contains two removable pages, one illustrating the layout of the components on the circuit board, the other a schematic of the system. The component layout, unfortunately, has the component list on the reverse side, which means turning the paper each time a component has to be identified; that is an unnecessarily clumsy piece of organisation.

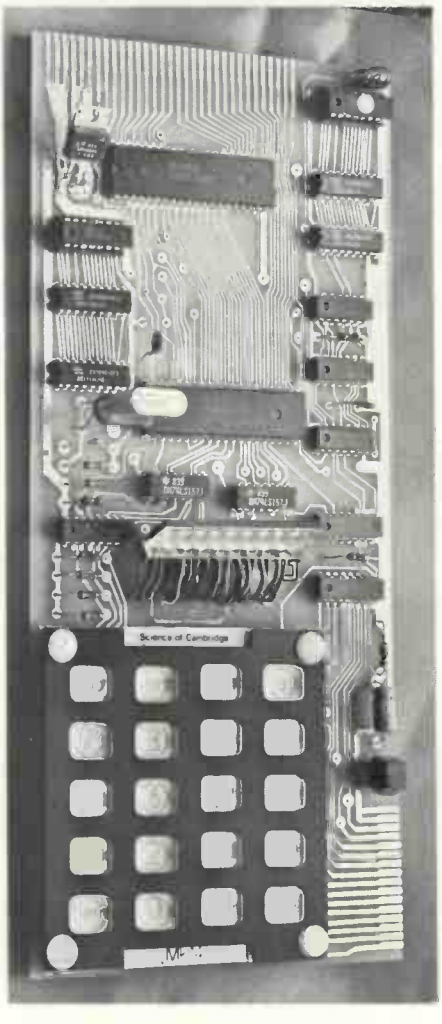
'If you follow the assembly procedure detailed in the manual, construction is straightforward, apart from problems with the keyboard.'

If you follow the assembly procedure detailed in the manual, construction is straightforward, apart from problems with the keyboard. It shouldn't take more than two or three hours.

Assembling the keyboard, though, requires some patience. The test MK14 had a keyboard with plastic keys which fit into a metal lattice, and metal contacts are held on to the board by a self-adhesive separator. Some juggling was necessary to prevent keys and/or contacts falling out.

We gather ours was a pre-production model; current versions should have an indented separator to hold the contacts in place. We understand that all kits will now have ready-assembled keyboards.

Fixing our keyboard to the component board called for additional patience. The



Cost

Basic MK14 system	£43·55
Power supply	4·95
Two sockets (minimum)	0·30
Edge connector	0·95
Rubber feet	0·20
	£49·95

A complete set of sockets would cost approximately £3·30, making a total of £54·05.

Extras

Cassette interface	£9·99
RAM (256 bytes)	£3·88
RAM I/O	£8·42
Revised monitor	£9·99
PROM programmer	£9·99
Blank PROMs	£9·99
TV interface (available end of 1979)	£99·99

buttons provided were too large for the holes. Careful pruning with a sharp knife, plus some enlargement of the holes with a small drill, gave a perfect fit.

At that point we also added some rubber feet so that the MK14 did not rest on the component pins.

After a final check on component orientation, the power supply was connected. The LEDs should have lit up like a Christmas tree but they remained blank. Touching the LED strip, however, brought a LED alight, so it was obvious that the display was not properly connected.

Several attempts later, all the LEDs still would not light. Having decided that the standard connector between display and component board was causing the problems, it was removed and put to one side. Display and board were then joined, using single wires between each pair of connection points—a more cumbersome method, but it worked. On applying power, all the LEDs lit, displaying dashes as expected.

Six LEDs are used. Four give the current memory address, the other two the contents of that address. Data is entered

"It will probably appeal more to those with a hardware background than to the keen programmer."

via the keyboard; it has 16 hex keys— 0 to 9, A to F—and four special keys labelled GO, MEM, TERM and ABORT.

Those four allow different memory locations to be read or written to, so that a short program may be entered quickly and run. Keying-in longer programs becomes tiresome, though, especially if the power supply is disconnected accidentally, as was ours on two occasions. The need for permanent storage then becomes apparent.

So you might think about cassette. Science of Cambridge also manufactures a cassette interface kit which allows a domestic cassette recorder to be used for storing programs and data. It is simple to build and uses several of the lines on the edge connector, together with input and output to and from the cassette recorder.

The interface uses LEDs to signify when data is being read from or written to the tape and so gives visual indication that data is being transferred. Up to 256 bytes may be transferred at a time, using the software provided; this must be entered via the keyboard unless you buy a revised monitor.

This replacement obviates the necessity to enter the interface software. It also provides some other useful routines, such as single-stepping through a program for editing.

The monitor is in two colour-coded PROMs which replace those containing the old monitor, hence the need for at least two sockets. Unfortunately we received no documentation with the monitor and have not been able to test it.

"Apparently a larger programming manual is in preparation. We hope this will give more detail on programming for the inexperienced owner."

Two other items may also be added to the main component board—an extra 256 bytes of RAM and a 16-line Input/Output device which contains a further 128 bytes of RAM.

The RAM I/O is a flexible device which allows any of the 16 lines to be input or output or grouped together for eight-bit parallel data transfer under program control. Hand-shaking for devices is also available by configuring the lines in the relevant manner.

The RAM I/O, therefore, greatly expands the capabilities of the MK14, as a wide number of circuits may be constructed to use it. The manual gives one example, a function generator, which will generate different waveforms, depending on the data supplied.

Conclusions

- **The MK14 proved easy enough to build in its basic form apart from the irritating keyboard, the deficiencies of which are apparently being alleviated somewhat in current models.**
- **It will probably appeal more to those with a hardware background than to the keen programmer. As it stands you don't get a lot of system—what do you expect at that price?—and you will certainly be tempted to add more PCBs. Connecting additional boards requires some hardware knowledge, particularly for the RAM I/O. The new programming manual suggests, however, that Science of Cambridge expects more programming in due course.**
- **The cassette and TV interfaces which the manufacturer promises should add greatly to the usability of the MK14. At the moment you should expect pleasure from building it rather than using it.**
- **It takes some imagination to find applications for the basic MK14 which would not be cheaper and more appropriate on one of the low-cost programmable calculators. Of course, the manufacturer disagrees strongly with this.**
- **Still, the basic MK14 is capable of reasonable expansion, bearing in mind its low price and, on the face of it, represents good value for money at the present time.**

Other views

PREPARING this review, we collected opinions from about a dozen readers who are less than enthusiastic about MK14 or, more accurately, about Science of Cambridge Ltd.

We do not know how widespread the criticisms are, though we suspect that they represent a small proportion of what is by now a very large number of users. The most detailed and most aggressive comments we heard have since been resolved and, to a large extent, were demonstrably frivolous. Still, it is important to summarise the principal criticisms:

- *delivery*: most of the complainants said they had to wait some time before their kit arrived (it is sold on mail order).
- *non-performance*: some kits arrived with faulty components—and our display was less than perfect.
- *poor response*: kits about which there are complaints can be returned to Science of Cambridge, but in some cases that resulted in very long delays before a replacement was sent.
- *poor documentation*: the instructions do not apparently give enough information on detecting and recovering blunders, and the programming information was inadequate for some.

We invited Science of Cambridge to comment, and received the following response:

"We do not deny that we have been beset by component supply problems and we apologise to those people who have been kept waiting.

"We have had very few component failures and any repairs which exhibit symptoms of original component failure are repaired free of charge.

"A recent batch of 100 which we had to supply ready-built contained only two which did not work first time, and they were due to IC pins being bent over on insertion.

"It is extremely difficult to provide a fault-finding guide, as almost any component failure or solder bridge gives rise to the same fault indication on the display. We provide a considerable amount of fault-finding guidance over the telephone which can be very time-consuming, hence the difficulty in reaching us."

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Ready-to-go Sorcerer is source of attraction

A solidly-built, low-cost personal computer from a specialist in the 'arcade' games business attracted a good deal of attention when it appeared last Summer. The Exidy Sorcerer is a ready-to-go micro-computer in the same vein as the Apple II, TRS-80 and Pet but it has one very unusual feature—a plug-in chunk of pre-programmed ROM.

EXIDY is the third largest U.S. manufacturer of coin-operated or domestic video games. Bally and Atari, the top two, have produced home computers recently which start from the 'entertainment centre' angle of micro-based games running on a TV set.

Exidy opted for a much more computer-like computer, eschewing the game paddle in favour of a solid professional keyboard and making its initial software a Microsoft Basic rather than a selection of games.

The Sorcerer appeared a year after the TRS-80 and Pet and the designers were probably able to detect some of the shortcomings of those systems. The obvious examples are the much-maligned keyboard of the Pet and its use of the IEEE instrumentation bus for connecting extra peripherals; the TRS-80 has a real keyboard but lacks a numeric pad and is built with a plastic case.

The Sorcerer is in a neat, suitcase-styled cardboard box, complete with straps and buckles printed on. The basic Sorcerer unit looks like an enlarged keyboard assembly, with a QWERTY layout and a numeric keypad.

Solid feel

Inside is a Zilog Z-80 with up to 32K bytes of RAM and a non-board monitor. Interfaces are provided for video output, dual audio cassettes, and an eight-bit parallel I/O port—a standard 25-pin connector at the back of the unit, which is where all the sockets are located; the parallel port allows quick and easy attachment of a printer. The cassettes are also attached by a 25-pin connector in the back.

There is also an RS232 serial interface and a 50-pin edge connector for the Exidy expansion unit. At the side is the slot for the ROM-PAC.

The unit is very well-designed and particularly well laid-out. It has a much more solid feel to it than most of the systems we have reviewed to date. All the rear connectors are clearly labelled; the keyboard is easy to use and is the same substantial unit used on Hazeltine VDUs.

Our system was loaned by one of the principal U.K. importers of the Exidy Sorcerer, Factor One. It had 32KB RAM.

There are two unusual features to the Sorcerer. One is the multi-way keyboard. It was not explained particularly well in the user documentation but there are as many as five key modes.

For a start, there is lower- and upper-case, using the SHIFT key for capitals. Using a GRAPHIC key gives access to the 64 Pet-style graphics characters. Then it becomes clever, because with SHIFT LOCK and GRAPHIC engaged at the same time you can create your own graphics characters. Those you have to set up in memory as specific bit patterns but once that has been done you can reference them by using the SHIFT/GRAPHIC keys with an alphanumeric character.

In addition, when you are in Basic or the Sorcerer's command mode, you can set up complete Basic statements or commands to be referenced by a single keystroke with GRAPHIC engaged. That can certainly speed program entry.

The ROM cartridge is trade-marked as ROM-PAC. It is about the size of an eight-track tape cartridge but instead of tape it contains pre-programmed system software in ROM. The ROM-PAC has a bare edge-connector which slides into a mate.

Slide-in connector

The ROM-PAC supplied with our system contained an 8K Microsoft Basic. Others available are an EPROM pack—create your own microcoded software, £35; and a word processor—£70 but we have not yet tried it. Colour graphics and games are said to be in the pipeline.

The availability of system software in this form makes the Sorcerer very flexible. All other computers we have tested with software in ROM have it as an integral part of the system, making it difficult or impossible to change. The alternative is to supply software on cassettes, which

(continued on next page)

Prices

These prices were quoted by Factor One, which supplied the test system. Prices at the other principal U.K. source for Sorcerer, Comp Computer Components, are about the same.

Sorcerer with 8KB	£650
Sorcerer with 32KB	£859
12in. display monitor	£240
EPROM pack	£35
Word processor	£70
S100 expansion unit	£210
Micropolis minifloppy drive (315KB)	£680
Dual drives	£1,200

Sorcerer keys with graphics symbols

(continued from previous page)

means it has to be loaded each time the system is used. That wastes time and, with the current state of low-cost tape cassettes, is, to say the least, error-prone.

We had no trouble in setting-up the system. With the ROM cartridge plugged-in, powering-on took us straight into Basic.

As the display allows 30 lines of 64 characters, a good-quality monitor is essential for serious use, though as an alternative you could use a standard television with an RF modulator for regular use.

Documentation

There were two manuals supplied with the system. One was titled *A Guided Tour of Personal Computing* and included how to get the system up, an introduction to programming—yet another flowchart of how to go to sleep—descriptions of Basic and the monitor, and a number of technical appendices. The second manual was an introduction to the ROM-PAC Basic.

Both manuals were useful when we were setting-up the system; they are clearly written and well-produced. Because they were written for the beginner, though, they would not be very effective as reference manuals. They contained some unusual tips—"During a thunderstorm it is advisable to unplug your Sorcerer from the main electrical power . . . do not use alcohol to clean the case".

One of the annoying features is that both have to be read to find out how to use the standard Basic; for example, the *Guided Tour* contains a full description of number formats which is not included in the Basic manual.

As the manuals are short and cover a wide range of information—from the definition of software to a description of the cassette interface—the user surely will find that there are gaps in the information supplied. There are other manuals available, we understand, but we have not seen them.

Standard Basic

The Basic supplied on the ROM cartridge is described as standard (Altair) 8K Basic. Points which we liked about it were:

- Variable names are not restricted to one letter.
- String arrays are supported.
- Multiple statement lines and multi-line statements are allowed.
- Instructions can be entered with a single key-stroke using the special characters.

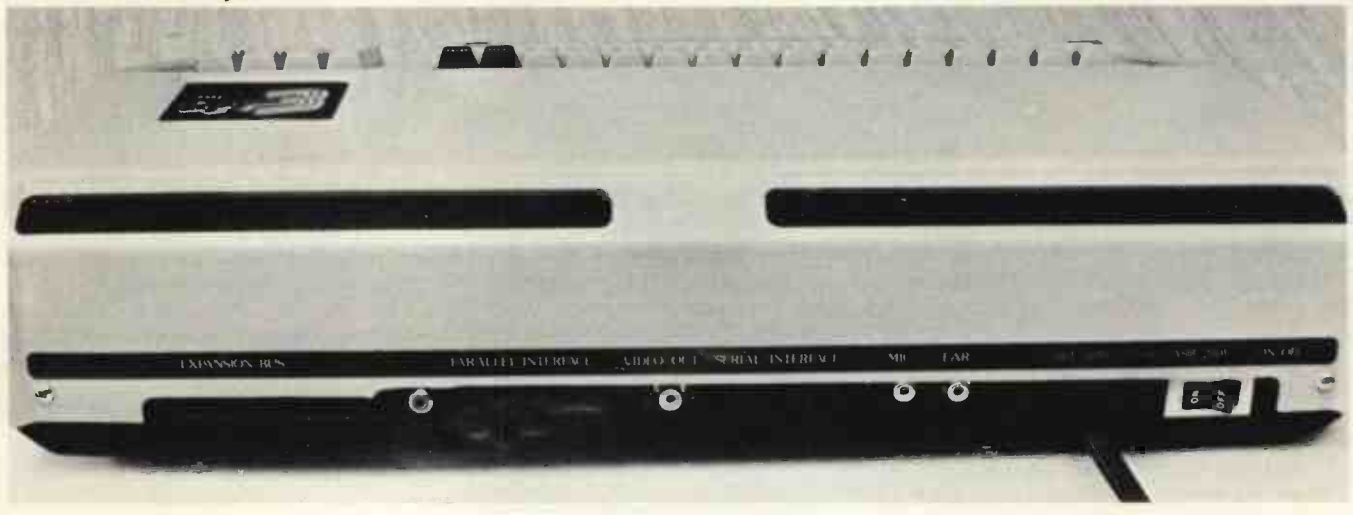
On the other hand this is not the easiest Basic to use:

- There is no line editor—make a change and you re-type the whole line.
- If you press CLEAR to erase the screen, the next time you type RUN you will get a syntax error message.
- No syntax checking is done until a program is run.
- The LIST command does not allow single lines or line groups to be displayed.
- A FOR without a NEXT does not give an error message.
- There is no easy way of outputting to a printer on the serial or parallel port.

If you start the system—or press RESET—without the ROM cartridge in the system you enter the monitor. This allows memory to be examined and changed, tapes to be loaded and dumped, and includes a memory test. One use of the monitor is to change the graphics characters; they are defined by an 8 × 8 matrix and the use of them gives a resolution of 512 × 240 points.

As with many personal computer sys-

Neat and clean layout at the back of the box



tems, much emphasis is placed on the graphics capability of the Sorcerer. Although the system has an extensive character set, and though it allows the user to define his own graphics characters, there is no software which simplifies the use of them—for example, to generate lines or curves. Much hard work has to go into the use of graphics.

Cassette system

The cassette interface uses a standard audio tape recorder. The MIC and EAR sockets are connected to a pair of sockets on the back of the Sorcerer by cables supplied with the system.

The manuals contained straightforward instructions on saving and loading programs; we had few problems doing this—we were using a portable Sony recorder. As with the Pet, the Sorcerer always tells you what is going on. If you ask the system to load a particular file it will search the tape for it, tell you what other files it finds, and tell you when it is loading it. As part of the monitor there is a FILES command which lists the files and heading information on a tape.

According to the *Guided Tour* manual, the cassette can be run at 300 or 1,200 baud. We think ours was running at 300 baud—it certainly seemed to be fairly slow. The manuals did not give sufficient information on how to change the speed.

Apart from the parallel and serial interfaces with the system, there is an expansion interface which can be plugged into a six-slot Exidy expansion unit. It utilises the S100 bus, so the system can use all those S100-compatible devices.

Exidy also sells the Micropolis disc unit, which can be used with the Micropolis operating system or CP/M; we intend to check these later.

Remember that the Basic in the ROM cartridge is called 'standard Basic' and allows multiple-character variable names? Well, the Micropolis Basic allows only single-character names. If you write lots of programs for the cassette system using ROM-PAC Basic, the business of upgrading to a floppy disc system may mean re-writing all your programs, so beware of so-called standards.

Conclusions

- **Exidy Sorcerer is well-made, has an excellent keyboard, and a good expansion capability.**
- **The ROM cartridge concept is an impressive and effective means of supplying system software.**
- **The cassette system is one of the best we have used with a standard audio recorder.**
- **The basic system has serial, parallel and expansion interfaces.**
- **The standard Basic was disappointing. With the exception of difficulty of addressing a printer and lack of a PRINT USING statement there were no major omissions, but it was different to use—no line editor, no system checking on entry, inadequate LIST command.**
- **The two manuals supplied with the system would be satisfactory for a beginner but not particularly useful as reference manuals.**
- **Expansion capability is good but be wary of 'standard' Basics.**
- **At less than £1,100 for a 32KB system, we think the Sorcerer is fair value for money.**

Practical Computing evaluation

	Yes/No NA	1	2	3	4	5
Ease of construction (where applicable)	NA					
Quality of documentation			✓			
Dealer support/maintenance				✓		
Can handle 32K of memory	Y					
Quality of video monitor (consider resolution and screen size)			✓			
SS-50 Bus	N					
S-100 Bus	Y					
Sockets for chips	N					
Numeric, calculator-type pad on keyboard	Y					
Large amount of removable memory, randomly accessible	Y					
Cassette tape recorder capability: Own	Y					
Built-in recorder	N					
Floppy disc capability	Y					
Communications capability (can talk to other computers)	Y					
Speed of instruction cycle	4MHz					
Ease of expansion					✓	
Low power consumption	Y					

	Yes/No N/A	1	2	3	4	5
Assembly language	N					
Basic language				✓		
Other languages	Y					
Compatibility with other systems				✓		
Reputation of manufacturer						✓
Appearance						✓
Portability					✓	
No. of software applications packages available	N				✓	
Hobby use						✓
Business use				✓		
Educational use						✓
Suitability for: Commercial applications				✓		
Home applications						✓
Educational applications						✓
Ability to add printer(s)	Y					
Ability to add discs	Y					
Ability to add other manufacturers' plug-in memory	Y					

Ratings
1 = poor; 2 = fair; 3 = average; 4 = good; 5 = excellent.
N/A = not applicable.

MUS MIC PLE

by Nick Hampshire

PEOPLE have been programming computers to play music for almost as long as there have been computers. It is a subject which is attracting a great deal of popularity among amateur computer users for a variety of reasons. It is an easy subject to break into since, with only minimal expertise and expenditure, anyone can program a computer to give quite an impressive performance.

Yet the subject is so vast that only a handful of the potential techniques have been explored. This opens the possibility of the amateur doing truly original research into the serious performance of music by computer. You don't need a sophisticated or expensive computer—much very original and exciting work has been done on machines as simple as the Kim 1. All that is required is a blend of programming ability and a modicum of knowledge of musical theory.

The basis of all sound, which obviously includes music, is the production of a variable pressure wave within the medium through which the sound is travelling. The sound we hear is due to three components of that pressure wave. The first and most important is the frequency or "tone" of the sound, which can vary between 10 and 8,000 cycles per second—frequencies outside that range are not audible to the human ear.

The second is the amplitude of the wave—the loudness of the sound; and, thirdly, the shape of the waveform or 'timbre'—it is this component which allows us to discriminate between the sound of, say, a piano and a trombone.

The simplest computer music programs control the frequency component. The resulting output is acceptable but very "buzzy" and somewhat similar to that produced by a cheap electronic organ. This is due to the fact that the output is usually a square wave of constant amplitude; the methods used, however, are interesting and worthy of looking at in greater depth.

The sound is produced by a loudspeaker attached via an amplifier to a single line of a computer output port, all the tone generation being done by the computer. A tone of a particular frequency is generated by turning the output line on and off a fixed number of times per second. This is done by a timed delay, so that the program delays, turns on the output line, delays, turns it off, delays, turns it on, and so on. Each tone is thus associated with a particular delay time.

Software delay

The method used to generate this variable delay depends on the computer being used. Some, like the Pet and Kim, have timers built within the I/O circuits, allowing the timing to be done by hardware; in other machines the timing must be done by software.

The software delay uses a timed loop, the timing coming from the microprocessor clock; since the delays are for a very short period, this program is written in machine code. It consists simply of loading a memory location or index register with a value which determines the delay time decrementing that value by one and branching back to the decrement instruction if the value stored in the memory location or index register is greater than zero.

So if the processor has a clock frequency of 1 MHz and each loop takes 10 clock cycles, 100 loops would give a delay of one-thousandth of a second and therefore a frequency of 500 cycles per second.

Programmable timer

If one was writing a frequency-only music program for the Pet, then one would use the capabilities inherent in the I/O hardware to generate the delay. The user port on the Pet uses a 6522 VIA chip which incorporates a programmable timer—the 6530 on the Kim also has the same capability.

This allows the programmer to generate a tone of a particular frequency by writing an appropriate delay value into the timer register of the 6522. Before doing this, however, the VIA must be initialised; we are using the timer to clock output pulses on to the CB2 pin from a circulating shift register within the 6522.

The shift register is thus first set in the

SIC RO, ASE

Listing 1

```
                    ;SYSTEM LOCATIONS
                    ACR = $ E84B        :REGISTERS OF 6522 ON PET
                    SR  = $ E84A
                    TIM2= $ E848
                    ;VARIABLES
1900                YTEMP               :TEMPORARY Y REGISTER
1901                TEMPO               :DELAY COUNT FOR TEMPO
                    ;
1910  A9 10         SETUP     LDA # 10
1912  8D 4B E8                STA   ACR
1915  A9 F0                   LDA # F0
1917  8D 4A E8                STA   SR
191A  A0 00                   LDY # 00
191C  B9 00 1A    GETNOTE     LDA   NOTE,Y
191F  8D 48 E8                STA   TIM2
1922  F0 20                   BEQ   END
1924  C8                     INY
1925  B9 00 1A    GETDUR      LDA   DUR,Y
1928  C8                     INY
1929  AA          DUR         TAX
192A  8C 00 19                STY   YTEMP
192D  A9 03       LOOP        LDA # 03      :Adjust for tempo
192F  8D 01 19                STA   TEMPO
1932  A0 FB       LOOP1       LDY # FB      :Microsecond delay
1934  88          LOOP2       DEY
1935  D0 FD                   BNE   LOOP2
1937  CE 01 19                DEC   TEMPO
193A  D0 F6                   BNE   LOOP1
193C  CA                     DEX
193D  D0 EE                   BNE   LOOP
193F  AC 00 19    RESTORE     LD    YTEMP
1942  D0 D8                   BNE   GETNOTE
1944  A9 00       END         LDA # 0
1946  8D 4B E8                STA   ACR
1949  8D 4A E8                STA   SR
194C  8D 48 E8                STA   TIM2
194F  60                     RTS

1A00              ;START OF SCORE TABLE
```

free-running mode, where each shift is initiated by an output from the timer. The shift register is then loaded with eight bits of data, four 1s and four 0s arranged as 11110000, so that for four timer output pulses the output is high and for the next four low, giving one complete waveform cycle.

All that remains is to load the timer with a value between 1 and 255, with 255 loaded into the timer and a 1MHz clock. One bit will be shifted on to the CB2 pin every 255 clock cycles and one complete waveform every eight shifts, or once every 2,040 clock cycles, to give an output frequency of 490·196 Hz. Loading the timer with 100 would give an output frequency of 1,250 Hz.

The ability to generate a delay and therefore a tone of the desired frequency is obviously a long way from a full music program. To do this we need to produce a specific sequence of tones or notes, where each note lasts for a specific length of time—the duration of the note—to give a musical score.

Each note and its accompanying duration are laid out as a table, with the first note at the top and the last note at the bottom. Each note takes the form of a number which, when loaded into the timer register or the delay loop, gives rise to a note of the correct frequency.

The duration is performed by a delay loop like the one used in the software tone generator, but this time capable of delaying several seconds if necessary; the length of the delay is determined by a number stored in the duration part of the score table.

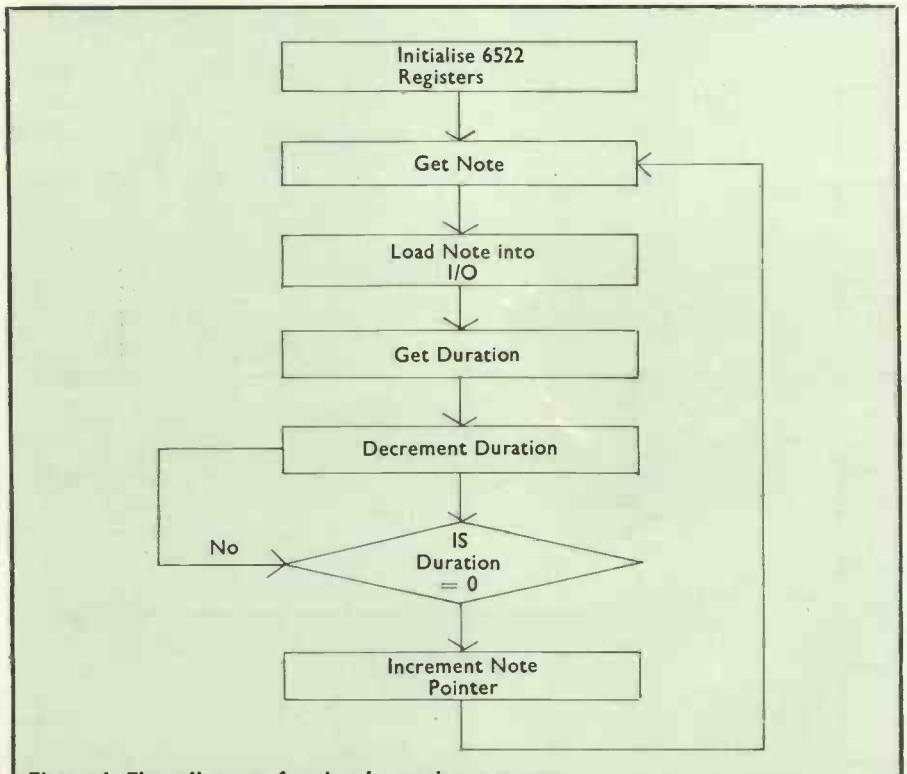


Figure 1. Flow diagram for simple music program.

Position pointer

After each note has played for a specific duration, a pointer to the current position in the note table is incremented and the sequence repeated with the next note, until all the notes in the score have been played.

Figure 1 illustrates this process and listing 1 gives a machine code version of this program written for the Pet with an amplifier on the CB2 pin. Figure 2 gives note and duration values for use by listing 1, and figure 3 gives the score for Auld Lang Syne.

This, however, is a very crude method of music generation, since there is no control over the other components of

(*continued on next page*)

(*continued from previous page*)

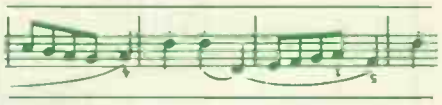
sound, amplitude and timbre—a square-wave output cannot give those two qualities. To give this precise control over frequency, amplitude and timbre we must use a digital-to-analogue converter, which converts a binary number from an eight-bit I/O port and converts it to a correponding DC voltage.

Figure 2. Note and duration values for use by listing 1.

Notes	D	= 2348Hz =	Hex 35 on note table
	C	= 2217Hz =	38
	C	= 2093Hz =	3B
	B	= 1975Hz =	3F
	A	= 1867Hz =	43
	A	= 1760Hz =	47
	G	= 1661Hz =	4B
	G	= 1568Hz =	4F
	F	= 1480Hz =	54
	F	= 1397Hz =	59
	E	= 1318Hz =	5F
	D	= 1244Hz =	64
	D	= 1174Hz =	6A
	C	= 1108Hz =	71
	C	= 1046Hz =	77
Durations	1	=	=40 Hex on note table
	3/4	=	=30
	1/2	=	=20
	3/8	=	=18
	1/4	=	=10
	3/16	=	=0C
	1/8	=	=08

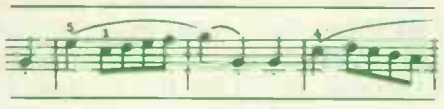
A simple D/A converter can be constructed from a resistor network, such as that in figure 4, and its output fed to an amplifier.

The purest and simplest musical waveform is a sine wave which gives a sound or timbre like a piccolo or flute, and to reproduce this sound the computer must be capable of generating a variable-frequency sine wave. If we draw a graph of a sine wave with the axis being time and amplitude, and divide the time axis into equal intervals, each interval will have a particular value for the amplitude.



The sine wave could thus be represented as a table of values and by going down the table sequentially and setting the voltage to that value, the wave could be re-constructed electrically. Thus, to produce a fixed-frequency waveform from a computer, all we need to do is store a table of the digitised values representing that waveform and load them one by one into the D/A converter. When the computer has read through the table, it starts all over again from the top.

The frequency of the waveform depends on the length of the table and the time taken by the computer to load each value into the D/A converter. Since the program will be in machine code, the most convenient size of table will be 256 bytes, or one page, since this requires a single byte pointer which will re-set automatically to zero after byte number 256.



If the table length is fixed and the time taken to load each byte of data into the D/A converter is constant, how do we vary the frequency? The trick is to use a variable increment for the frequency table pointer. So far I have assumed that every entry in the table is loaded into the D/A converter. If, however, we load only every other entry, the output is double the frequency. This allows a variable-length table but retains the advantages of the fixed-length 256-byte table.

Figure 3. Score table for listing 1 to play Auld Lang Syne, first few bars.

Beginning	Address	1A00	note	9F	duration 10
				77	18
				77	08
				77	10
				5F	10
				6A	18
				77	08
				6A	10
				5F	08
				6A	08
				77	10
				77	10
				5F	10
				4F	10
				47	30
				47	10
				4F	18
				5F	08
				5F	10
				77	10
				6A	18
				77	08
				6A	10
				5F	08
				6A	08
				77	10
				8E	10
				8E	10
				9F	10
				77	30

The frequency range is wide-ranging, from the lowest or fundamental frequency, using all 256 table entries, to a frequency 128 times greater—this is dictated by the Nyquist Sampling Theorum, which states that the maximum frequency cannot be greater than half the sampling rate.

The variable increment is achieved by adding a variable to the table pointer which could be greater or less than 1 and, since this variable defines the frequency, it can be our note input. The note dur-

Figure 4. Circuit for Digital to Analogue converter

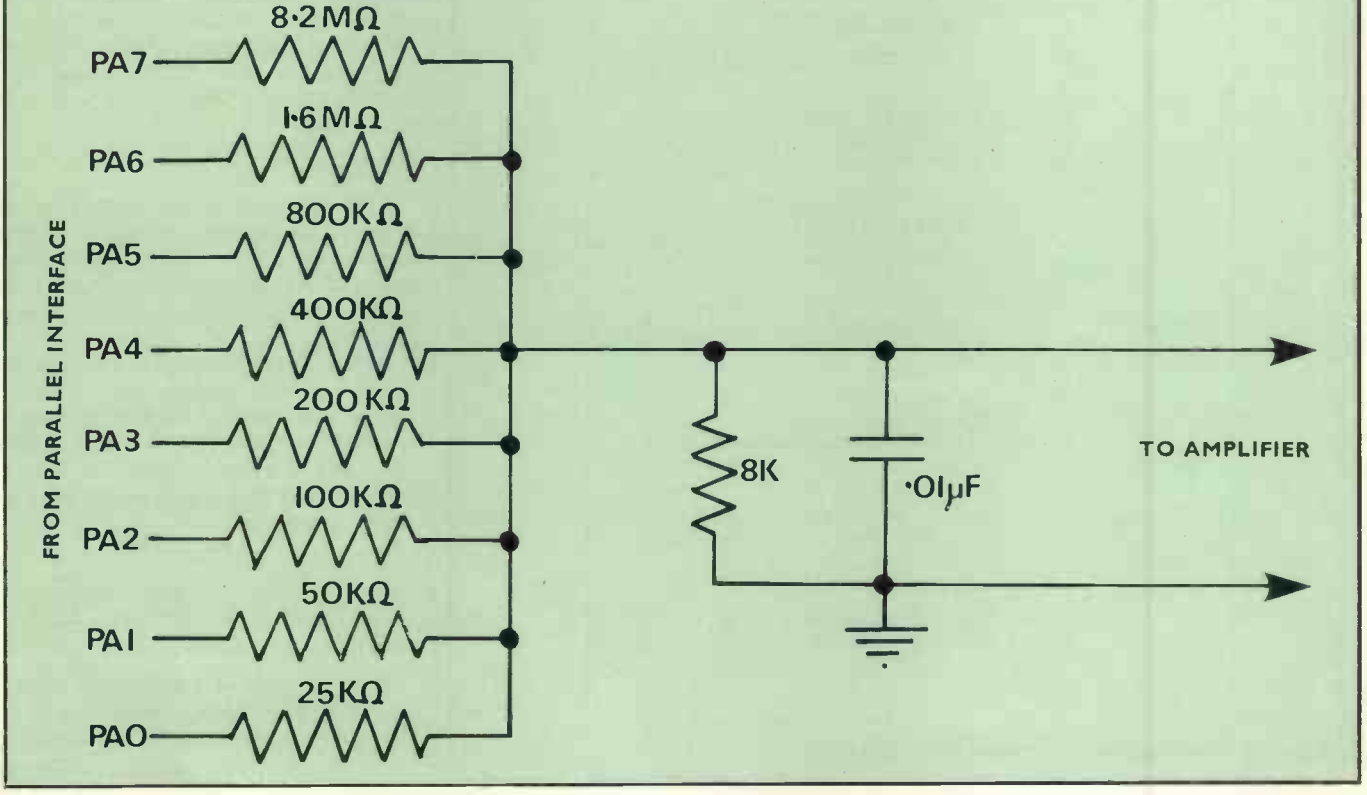
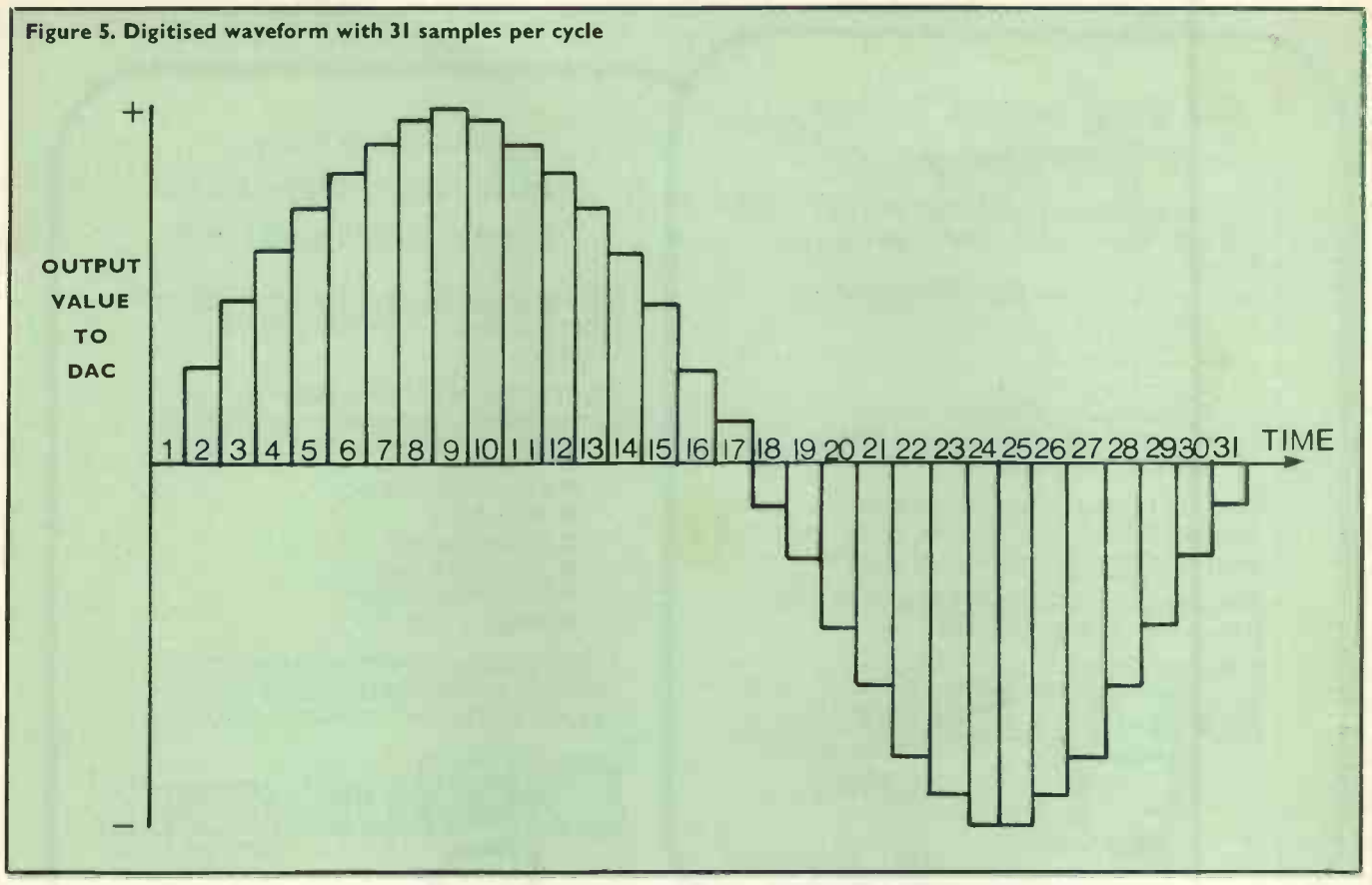


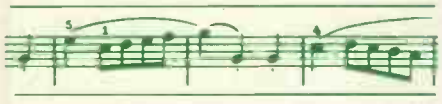
Figure 5. Digitised waveform with 31 samples per cycle



ation can be produced in a similar manner to that used in the square-wave music generator.

By using waveform synthesis and a D/A converter the computer can produce music with any required timbre by varying the waveform table. This table can be created by digitising an existing waveform, or created mathematically either from a simple function like a sine or by using the techniques of Fourier synthesis for more complex waveforms.

This allows the programmer to create theoretical musical instruments and then hear how they will sound without having to build one. This could be of great interest to the instrument maker and composer.



The last component required for high-quality synthesised music is a control of of the amplitude or loudness. This is extremely simple. All that is required is to multiply each value output to the D/A converter by a constant between 0 and 1. If the constant is 1, the output is of full amplitude; if of 0·5, the amplitude is reduced to half the maximum. Each note in the score thus consists of three components—the note, the delay or duration and the amplitude.

The principles proposed so far will enable the computer to produce music of fairly high quality but it can play only a single instrument at a time. If we could simulate three or four instruments playing together, the resulting sound would be far more impressive.

If we have, say, four instruments, the output of the four consists of four waveforms, each instrument having its own special timbre, each perhaps at different frequencies, sometimes all playing together, at other times as solo, duo or trio.

Feeding this sound into an oscilloscope, we can see that the resulting waveform is not four separate waveforms but a single wave of very complex shape.

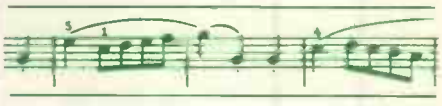
Two sources

To see what is happening we must go back to looking at sound as a pressure wave in, say, air. With two sources of sound, occasionally a high-pressure wave from one instrument may coincide with a low-pressure wave from another; the result is that they cancel each other and the resulting wave would be of normal pressure and thus have no sound.

What is happening is that the waves from each instrument are being added together so that if two high-pressure areas coincide, the resulting wave has the average pressure of the two. Thus to generate a computer quartet we would use four waveform tables and four scores to produce a value for each instrument for output to the D/A converter.

Instead of doing so, the four values are added together and divided by four to produce the average value; it is this which is output to the D/A converter.

The number of instruments which the computer can play simultaneously is limited to about four by the speed of the processor; with more instruments one is forced to reduce the maximum sampling rate, thereby reducing the range of frequencies available.



I have given a few ideas on how to get your computer to play music of a reasonable quality and I hope to hear from some of you who have tried writing your own programs.

There is considerable scope for modification and invention. You could display each note as it is played on a VDU screen, a feature which would make an ideal teaching aid. By using a random number generator and a table of weighted probabilities, the computer could be programmed to compose its own score.

Another variation would be to use the computer to control a light show in conjunction with the music generation.

Hard-copy units in the £1,000 price bracket

HAVING dealt with single-board computers and VDUs for less than £1,000 in the last two months, we now concentrate on hard-copy printers in the same price range.

As you become more involved with your system, you begin to realise that hard-copy is not a luxury but a necessity. In program development, you realise that program listings disappear from the edge of the screen and you need to see all the code in front of you.

Even if you operate without a printer during the development stage of your system, once you are ready to go live you will almost certainly find the absence of hard-copy facilities a severe handicap. For example, if you are producing invoices and have to keep transcribing details from the screen, it negates two of the main reasons for buying a computer system—speed and accuracy.

Having recognised that you need a printer, your problems are only beginning. For what do you look and who is in the market?

Newcomers

There are some newcomers to the market for low-cost printers, some offering a dedicated product which would not work very efficiently on competitive machines, such as Commodore with its Pet printer, whole others, such as Anadex, Axiom, and Heathkit offer printers which may be attached to most machines.

Otherwise the traditional suppliers are Centronics, a specialist company manufacturing printers exclusively, and the communications specialists such as Trend and Transtel, supplying 'teleprinters' for use as receive-only (RO) devices in Telex transmission.

Most of the products offered invariably will be matrix printers—with the alphabetic and numeric characters formed in a matrix of dots, say seven high by five across, rather than by means of wholly-formed characters with a printhead sweeping scross the paper.

In a 7×5 dot matrix printhead, seven impact needles are arranged vertically, their total being the height of a character. If for example, an 'E' is to be printed, as the printhead begins moving all the needles will be activated in the first position; only the top, bottom and middle needles in the second and third positions; and only the top and bottom needles in the fourth and last position.

Cost factors

The process is ideal for conversion to 'soft logic' and most printers now on the market boast microprocessor control. Some of the printers offered are of the non-impact type—thermal or electrostatic printers, such as the Centronics Microprinter, the SCI Model 1110-S, and the Axiom EX801/820. Advantages claimed for them are quietness, speed and reliability. On the debit side are the cost of specially-sensitised paper and the lack of multiple copying facilities.

Total cost of ownership, therefore, must be considered against the initial financial outlay for a printer. The costs include annual maintenance charges, paper and ribbon stationery, and printhead replacement or re-furbishing.

One term you are likely to encounter is vertical forms of format unit (VFU). It is a method of telling the printer the length of a form. The simplest VFU is probably the pre-set type in which the operator selects one of several standard form lengths. Older systems use an external punched paper tape loop, with different tape lengths corresponding to different form lengths, but modern VFUs normally are set under software control.

Continuous stationery can be moved through the printer by means of friction-feed as in the case of teleprinters, or sprocket-feed, in which case perforated paper is required. The edge perforations are engaged in the sprocket teeth situated either at the ends of the platen—the bar against which the print head needles strike the paper—or above it.

Some printers have upper-case characters only, while others will offer upper- and lower-case as standard, or as an option only. Where lower-case is offered it should be established whether this includes descenders for letters such as g, j, p, q and y; that requires normally a nine-needle printhead where a seven-needle printhead would otherwise be used.

Operating speeds

Operating speeds will be quoted in characters-per-seond (cps) but that is usually the maximum rate and is affected by factors such as baud rate and buffering technique. The larger the buffer, the greater the volume of data which may be transmitted from the computer at high transmission speeds. That may be highly desirable in time-sharing minicomputers but in the case of dedicated microcomputers it is something of a luxury.

Details of such terms as column-widths, interfaces, ASCII codes, baud rates and parity checking were given in last month's review of VDUs.

Anadex

ANADEX offers two printer models which might be of interest to hobbyists. The DP-8000 80-column and the DP-1000 40-column dot matrix printers sell for £575 and £465 respectively, plus VAT, to end-users.

Both models offer a choice of three interfaces—serial RS232C or 20mA current loop, or parallel. Transmission speeds on serial interfaces range from 110 to 9,600 baud by means of an integral selector switch. Input character codes of 10 or 11 bits are accommodated.

A Data Terminal Ready (DTR) handshake signal is generated to indicate when the internal buffer can accept data. Three lines (240 characters) of FIFC storage are provided. An optional buffer of 2,048 characters extra capacity for VDU dumps and other applications is available for £35.

The parallel interface accepts input data at a maximum closed loop rate in excess of 1,000 characters per second. Input data and all interface control signals are TTL (Centronics) compatible.

Characters are formed in a 9×7 dot matrix from a 96 ASCII character set. Anadex claims a printhead life expectancy of 100 million characters and a nominal speed of 112cps.

The DP-8000 will accept fan-fold, sprocket-fed paper 9·5in. wide for orignal plus three copies, loaded through the bottom or rear of the printer.

Other features include an out-of-paper detector, programmable forms length and skip-over perforations control to inhibit printing on the last 15 lines, up to eight vertical tab positions, and switchable double-width printing.

The DP-1000 has most of the foregoing features but is a 40-column printer and can be supplied with a tally roll take-up mechanism. With this feature and the use of pressure-sensitive, multiple-copy paper, one printed copy may be torn off as required and a record copy is rolled-up internally.

Anadex Ltd, Dorna House, Guildford Road, West End, Woking, Surrey. Tel: (09905) 6333.

(continued on next page)

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Centronics

CENTRONICS Data Computer (U.K.) launched the Microprinter-S1 early in 1977. Featuring a seven-bit serial RS232C interface and standard ASCII 96 upper- and lower-case character set, the S1 operates at rates from 50 to 9,600 baud and produces copy on aluminium-coated paper by discharging an electronic arc to penetrate the coating—less than one micron thick. Toners and ribbons are not required.

The printed characters, unlike those resulting from thermal printing, are impervious to light, temperature and humidity. The finished printed page, Centronics says, may be reproduced on any office copying machine. Up to 80 columns may be printed on 4¾in. roll paper. The S1 is equipped with a 192-character FIFO buffer and is factory-set for transmission at 1,200 baud (120cps), no parity, and one stop bit.

Standard features include software-selectable condensed and elongated characters (5, 10 or 20 characters per inch), software-controlled underlining, and out-of-paper audio alarm.

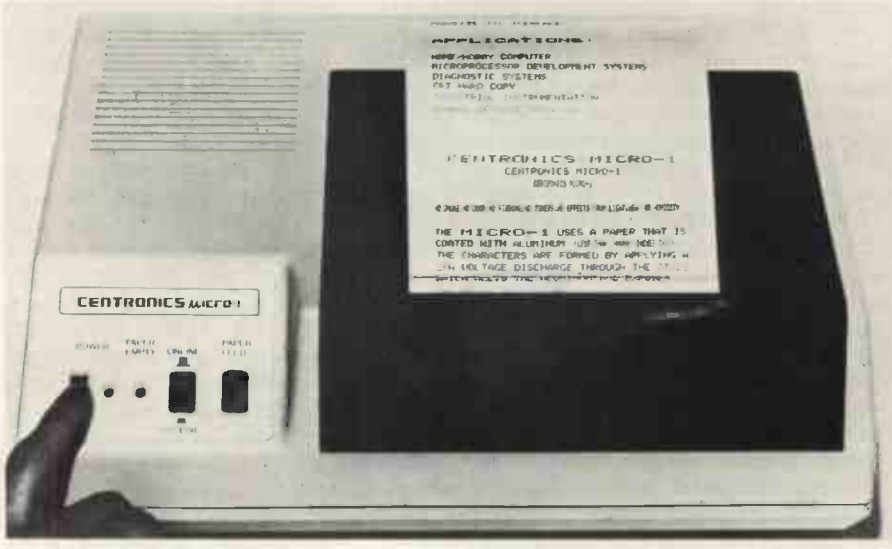
Another printer which falls just within the £1,000 limit is Model 779, costing £995 with standard parallel interface. A serial interface will add around £80.

The 779 operates at 60cps at a print density of 10 characters per inch or 100cps at 16·5cpi. Characters are formed in a 5×7 dot matrix from a 64-character ASCII set.

Forms handling is by means of pinch roll feed on roll paper up to 9·8in. (250 mm) diameter mounted at the rear of the printer. A ribbon cartridge contains a continuous ribbon in a mobius loop, which means that both sides are used on alternate passes over the printhead.

Operator controls include print switch, forms thickness, vertical and horizontal forms positioning, print density and power on/off.

Centronics Data Computer (U.K.) Ltd, Petersham House, Harrington Road, London SW7 3HA. Tel: (01) 581 1011.
Price: £475 with serial interface, £395 with parallel interface.



Commodore Systems

COMMODORE SYSTEMS began U.K. assembly of the Pet Microprinter in September, 1978 at Eaglescliffe.

Model 2023 supersedes the 2020, having been re-designed to offer significantly better quality and a highly-reliable printhead. The printer (80 columns 7×6 needle matrix impact) produces an average printing rate of 93cps.

It is designed as a dedicated Pet printer, printing all Pet graphics, including reverse and lower-case characters, and double-width capital letters. The printer is micro-processor-controlled and thus is capable of accepting format statements under program control for small business and engineering applications. **Price: £594.**

Model 2022 is a tractor-feed taking 8½in. plain paper and producing up to four copies for business applications such as mailing labels, standard customised forms, and salary cheques. **Price: £696.**
Commodore Systems Division, 360 Euston Road, London NW1. Tel: (01) 388 0621.

Heathkit

THE H14 is designed for use with H8 and H11A computers but can be used with most computers through its serial RS232C or 20mA current loop interface.

It uses a normal inked ribbon and impact matrix printhead to produce reports on regular paper. Characters are formed in a 5×7 dot matrix in upper- and lower-case with a 96-character ASCII set. Standard spacing is 10 characters per inch (80 columns) and selectable by hardware or software, with switchable 16·5 characters per inch spacing (132 column). Twelve characters per inch spacing is software-selectable only.

Standard line-spacing is six lines per inch, with eight lines per inch selectable by software. Maximum printing rate is 165cps and the printhead temperature is monitored after each line and then limited by slowing or stopping the printing. The maximum throughput is determined by print density and ambient temperature.

The sprocket paper feed takes edge-punched continuous fanfold stationery from 3 to 9·5in. wide. For forms control, 11in. form is selected at power-up.

The asynchronous bit-serial interface transmits data at rates from 110 to 4,800 baud with one start, eight data and two stop bits on 110 baud, and one stop bit on all other baud rates. The line buffer has a capacity of 256 characters.

Heath (Gloucester) Ltd, Gloucester GL2 6EE. Tel: (0452) 29451.
Price: £382·68.

Peripheral Hardware

MODEL 1110-S, designed and manufactured by SCI Systems Inc, is marketed here by Peripheral Hardware. It employs a new revolving printhead to achieve a print rate of 2,200cps, and, fitted with an integral 3,264-character buffer (24 lines by 36 columns), the contents of which may be printed in less than 1·5 seconds on 4in. wide aluminium-coated paper. Peripheral hardware claims that at speed it only takes 79 seconds to print Shakespeare's Hamlet.

The printing mechanism, available separately for OEM purposes, contains three matrix brushes in a revolving printhead and has only nine moving parts. The print cartridge can be replaced in a few seconds and a life of 25 million characters is claimed.

Supplied with CCITT-V24 (RS232C) or 20mA current loop interface, 5×7 dot matrix characters are printed 10 to the inch horizontally and seven to the inch vertically in black on a silver background from a 64-character ASCII set. Options provide for a 96-character ASCII set and 7×9 dot matrix characters.

Peripheral Hardware Ltd, Doman Road, Yorktown Industrial Estate, Camberley, Surrey. Tel: (0276) 62711.
Price: £745.

Personal Computers Ltd

THE AXIOM EX-801 is available from Personal Computers, the U.K. agents for Apple. It is an intelligent printer, designed around the Intel 8048 microprocessor, and offering 256-character buffering, 96-character ASCII set expandable to 256 characters, with user-programmable fonts, reverse printing, three character sizes for 80-, 20- and 40-column formats, and full-duplex capability.

A choice of serial RS232C or 20mA current loop, or parallel ASCII interfaces is available, together with options of a 128 ASCII character set, up to 2K bytes of user-programmable ROM (UV erasable type) which may be used to call subroutine blocks, and buffer expansion to 2K characters.

Each EX-801 has a case, power supply, character generator, low paper detector, bell, built-in self-tester and paper-roll holder. High-speed electrosensitive printing takes place at up to 160cps. **Price: £349; switchable serial/parallel interface £110.**

Model EX-820 is a plotter version of the EX-801 with high-resolution graphics generated by user commands in software. The user can define the size of each graphic field and can choose from three pre-programmed horizontal dot resolutions up to 128 dots per inch. Once the fields have been designed, the EX-820 formats graphic and alphanumeric printouts automatically to specifications. **Price: £699, including Apple interface card.**
Personal Computers Ltd, 194-200 Bishopsgate, London EC1. Tel: (01) 283 3391.

Transdata

MODEL 313 operates at a 30cps and has a 64-character buffer to allow data input during carriage return. The standard model uses a 96-ASCII upper- and lower-case character set and options are available for APL and CCITT No 2 (Baudot) codes. Characters are produced on to thermally-sensitive paper by an electronic process whereby the characters are formed from a matrix of 35 elements.

The platen assembly forms an electromagnet which is energised each time printing occurs by holding the metal head against the paper with equal pressure for the whole length of the platen. This eliminates maintenance adjustments of the printhead-to-paper position.

Transdata claims that the 313 has been designed to eliminate preventative maintenance and that no routine adjustments, lubrication or checks are required. The user may choose between RS232C or 20mA current loop serial interfaces.
Transdata Ltd, 11 Garrick Street, London WC2 E9AR. Tel: (01) 240 2713.

Transtel

MODEL AH has a standard serial CCITT V24 interface or, if required, an audio frequency modem, switch-selectable to operate at any three standard speeds up to 30cps.

Five- and six-level telegraph codes are available in addition to eight-level (8-bit) ASCII codes in 64, 96 or 128 character sets with upper- and lower-case, national character variations, weather symbols and bold or expanded characters by on-line control.

Characters are formed in a 5 × 7 or 5 × 5 dot matrix on original plus up to two copies of plain or pressure-sensitive paper in rolls or fanfold of up to 5in. diameter and six or 8½in. wide. A printhead life of 300 million characters is claimed, as is a sound level of 60db at a distance of one metre.

Other features include last-character visibility, half-line spacing (forward or reverse), 10 or 11 characters per inch and 6 or 4·4 lines per inch spacing, automatic carriage return and line-feed, underlining, odd or even parity checking, and 20-character answer-back option.

A number of accessories are offered such as low paper switch, power line filter, fanfold adaptor, paper winder and pedestal.

Transtel Communications Ltd, Swinton House, 324 Grays Inn Road, London WC1. Tel: (01) 278 3115.
Price: £895.

Trend Communications

THE TREND 800 uses standard teleprinter paper in rolls up to 5in. in diameter for printing on originals and up to three copies. Paper storage is contained completely within the printer.

Operating at up to 30cps, characters are formed in a 7 × 5 dot matrix with black/red printing provided by the use of a standard typewriter ribbon, at 10 characters per inch on 80 columns.

The user may select from one of two character sets, either CCITT International Telegraph Alphabet code 2 (5-level) with one or one-and-a-half stop bits, or code 5 (8-level) with one or two stop bits, all with odd or even strap-selectable parity. Optional answer-back is available in 31 characters.

The standard interfaces are CCITT V28/RS232C, double current, 20mA single current loop, and parallel. Serial interfaces are switchable from full- to half-duplex for transmission rates from 50 to 300 baud.

Character-viewing is provided by automatic advance on the platen on a pause in printing. When printing continues, the platen returns to its original line. An audible warning is sounded 10 character positions before end of line, and a paper-low indicator is included as standard. Forms control is by means of friction feed.

Operator controls power on/off, on-line/off-line, baud rate selection, print adjustment for multiple copies, and paper advance lever.

Trend Communications Ltd, St John's Estate, Tylers Green, High Wycombe, Bucks HP10 8HW. Tel: (0494) 40171.
Price: £870.

These pages represent an independent collection of news and views for owners of the Commodore Pet. If you wish to contact Pet Corner, send articles or ideas directly to us. We are not connected with Commodore or with the official Commodore-run Pet Users' Club, though we wish it well. We give space to Mike Lake, of the Independent Pet Users' Group (IPUG).

Some people apparently are unclear about the way Pet Corner operates. Here are the facts. In the editorial office we have an in-tray marked Pet pages. Into it goes all the news items and other Pet-orientated information we obtain. The bulk of the input is provided by Mike Lake, of IPUG, though he is by no means the sole source.

WE HAVE a Pet, we talk to many people with Pets, we receive press releases about Pet-compatible products, and we see Pet items from user group magazines around the world.

We have described Mike as the focus for the Pet pages because he is well-placed to channel Pet information to us. He does not edit the pages, though, and if you have a contribution, you can send it directly to us.

All clear? Incidentally, all of this also applies to the Tandy and Apple pages.

Calling all inventors

SOME Pet users are now meeting a serious problem with the user port. By the time you have added a parallel printer, a TV interface, the output for a sound generator, a light pen and all the other goodies, you will be a little tired of plugging and unplugging connectors. Add to this the risk of doing damage to the Pet when trying new ideas and you have a serious problem.

Ideally, we would like to have all these gadgets plugged-in together and be able to select one or combinations of them at any one time. The switching device should also isolate the Pet from any nasties which, might creep in from the outside world.

If this device could also display the status of the user port points—by LEDs perhaps—and buffer the output, we would all be happier, assuming a reasonable price, of course. If anyone dreams-up anything suitable, please let us know. We could either publish the circuit or have a prototype made.

News about IPUG

IPUG membership is now about 250 and still growing. Members seem to be divided equally between those in small businesses, education and hobbyists. With the price of Pets falling and with the new 4K Pet at £496, there could soon be many more private owners as well—after all, it is certainly the easiest way to learn about microcomputers.

The group is now offering a program exchange library for non-copyright material. It still has a renumberer, a parallel printer drive routine and a music program at £2·50 each.

Because of the wide spread of membership, certain individuals have agreed to act as regional organisers. If you live near them, they would certainly tell you more about IPUG and its activities. Remember membership is £2·50 for 1979 payable to IPUG and sent to Mike Lake at 9, Littleover Lane, Derby.

South-east	: John Nuttall, The Presbytery, West Street, Shoreham-by-Sea, Sussex.
North-east	: Jim Cocallis, 20 Worcester Road, Newton Hall Estate, Durham.
Herts	: Brian Bloomfield, Little Orchard, Hill Farm, Radlett, Herts.
Hampshire	: G A Parkin, Robert May's School, West Street, Odiham, Hampshire.
Berkshire	: A J H Walter, 7 Parkside Road, Thatcham, Newbury, Berkshire.
Liverpool	: John Stout, 6 College Avenue, Formby, Lancs. L37 3JJ.

If anyone would like to volunteer to help in other regions, Mike would certainly like to hear from them.

Mike has also been arranging discounts for members:

- Intex Datalog of Eaglescliffe is offering five percent off all purchases, including a dust cover for the Pet at £4·95. This must surely be a good buy; if you have not opened your machine lately, look inside—dust seems to be everywhere.
- Rockcliffe Bros of Liverpool will give 10 percent discount to group members on all books purchased there.

The Independent Pet Users' Group is keen to make contact with any other groups formed around other machines using the 6502 processor. There is much information which could be shared between the groups, especially on machine code programming.

Replies

Replies to some of the questions on the February Pet pages:

- **TV interfaces:** HB Computers in Kettering offers one at £45·99, DAMS of Liverpool has one at £25. We have seen neither so cannot comment on their performance.
- **Connectors:** HB Computers also has Pet connectors at £3 for 80-way, £1·60 for 12-way, and £2·55 for 24-way. As far as we know they do not have covers.
- **The cassette unit:** CBM has found a way to solve the partial erasure problem and the method, originating from its people in London, is being evaluated in the U.S. We'll try to keep you posted.

Floppies and printers

AT the recent Microsystems exhibition, Commodore displayed its new dual floppy system for the first time and Mike examined it. It has a capacity of 340K on two discs and is connected to the Pet through the IEEE port. The system was shown attached to the new 32K Pet which includes the full-size keyboard.

In use, the floppy proved to be fast and easy to use. Commands to it are similar to those for other IEEE devices, so users will find it very easy to adapt. Inside the box is an impressive array of electronics, including two microprocessors and 8K of disc operating system in ROM. This, of course, means that the floppy makes no demands on the Pet memory and leaves the full 32K on the Pet available for Basic programs.

At the show, Commodore demonstrated the loading of programs and the organisation of sequential files. Random-access files are promised for the production version of the system; whether this will require an enhancement of the present Basic is not yet clear. Obviously you wouldn't want to pay almost £800 for sequential filing, though—you would buy a faster cassette-type unit.

The unit on display suffered one or two minor hardware problems; an error light kept showing and embarrasing everyone, and there are still obvious shortcomings in the Disc Operating System. They should be fairly easy for Commodore to sort out, though. The price is £799 including VAT.

Commodore was not able to show the printer at the exhibition but latest photos and specifications would seem to indicate that it will be worth waiting for, even at the increased price of £696 for the tractor

(continued on page 57)

You'll laugh when you see how easy choosing a small business computer can be.

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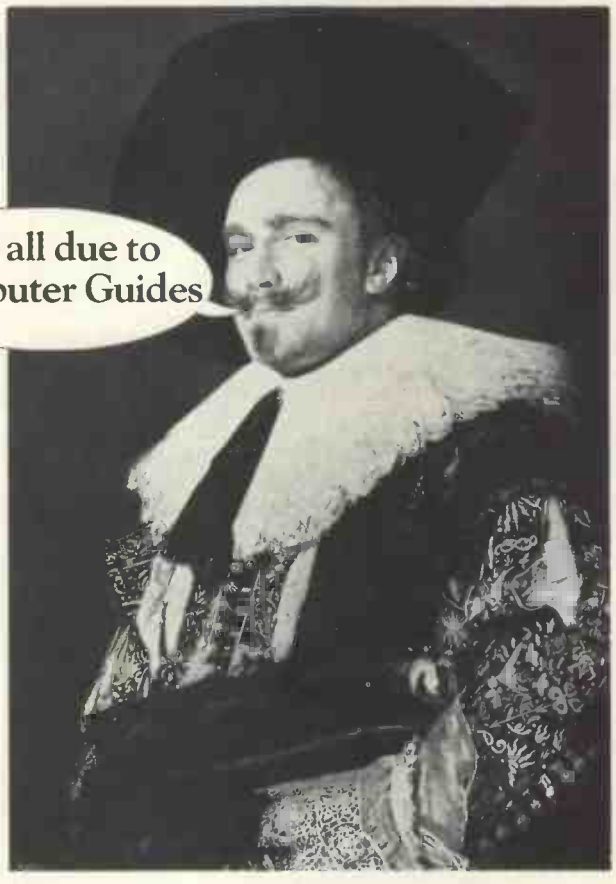
System Guide Tabulated data – notes on interpretation and other important guidelines relating to: confidence in supplier cost of acquiring system, support, ease of use, cost of applications, availability of languages and packages, growth paths/upgrading on-line facilities, interfaces to other systems.

Consultants Guide How to choose and use a consultant, listing of consultants.

Critical features Specification for tender, through shortlisting to contract, dealing with data communications, future developments.

Case Studies



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PC

(*continued from page 55*)

feed version. Those who have ordered the old version will be allowed to purchase the new printer at a reduced price.

The new 32K Pet was also impressive. The full-size keyboard is a joy to use and the green display was very relaxing to watch; let us hope this display is available on the production model.

Inside, the main logic board has been altered radically, allowing for 32K of RAM on board, 14K of ROM and room for another 8K of expansion ROM. The power supplies have also been modified, so presenting a far more powerful system in a much neater manner.

Input idea

IF YOU have had the problem of your program stopping because someone pressed RETURN without putting in anything for an INPUT statement, here is one possible method:

```
10 OPEN 1,0
20 INPUT 1,A$
```

Line 10 opens an input file from the keyboard. If RETURN is pressed during execution of line 20 than a null string, "", is returned. Don't forget to close the file when you have finished with it.

Listings

FOR a program listing on an IEEE printer, all you have to do is use the CMD instruction then LIST. Normally this cannot be done for a printer attached to the user port, though, but we have one easy way to do it. The program is first of all listed on a blank tape using the CMD instruction; it is then read back in as data by another program which lists it to the printer. This is how it looks;

```
POKE243,122:POKE244,2
LOAD A BLANK TAPE ON UNIT #1
OPEN1,1,1
CMD1
LIST
CLOSE1
RUBBISHBGFGTR
THE PROGRAM IS NOW "LISTED" ONTO TAPE.
TO GET IT OUT TO PRINT JUST RUN THE
LISTING PROGRAM
10 OPEN:B$="":PRINT"S";
20 GET#1,AS:IF(ST)AND64THENX=USR(O):END

30 IFA$=CHRS(13)THEN50
40 B$=B$+A$:GOTO20
50 PRINTB$:B$=""
60 IFPEEK(245)<24THEN20
70 X=USR(0):PRINT"S":GOTO20
```

More languages

WE HAD a letter asking if there is a PILOT implementation for Pet. We're checking U.K. availability but there is certainly one U.S. source—Peninsula School Computer Project, Peninsula School, Peninsula Way, Menlo Par, CA 94025 has a fully-documented Pet PILOT on cassette for about $20.

While we are on the subject of languages, Len Lindsay has found a Pet version of FORTH for $35. FORTH is a program development language. Writing programs in FORTH is easier and quicker than using assembler, and when you run them you'll find that the FORTH programs frequently perform better, by running faster than assembly code. The contact address is Programma Consultants, 3400 Wilshire Boulevard, Los Angeles, CA 90010.

Petty irritations

MARCH was a bad month for hitches and glitches as far as we were concerned. Here are the revised and hopefully correct versions of those two line number routines we printed:

```
RENUMBER
59900  REM LIST THIS PROGRAM, LOAD
       TARGET PROGRAM, "RETURN" 60000—
       RUN 60000
60000  INPUT "RENUMBER OLD LINE NUMBERS
       FROM ";L1: INPUT "THOUGH";L2
60010  INPUT "AS NEW LINE NUMBERS FROM
       ";L: "INPUT "IN STEPS OF"; D
60020  K=1025: 8=256
60030  N=PEEK (K+2)+6=PEEK(K=3)
60040  IF N=O OR N>L2 GOTO 6000
60050  IF N>=L1 THEN PRINT N,L: POKE K+2,
       L-INT(L/6)=6: POKE K+3,INT(L/6):
       L=L+D
60060  K=PEEK(K)+6=PEEK(K+1): GOTO 60030

0 REM AUTO LINE NUMBERER
3 NS= 100:REM THIS IS THE NEXT LINE
  NUMBER
4 PRINT "(CLR,3DOWN)";NS;
5 GET K$:IF K$="" GOTO 5
6 PRINTK$;:IF ASC(K$)<>13 GOTO
7 NS=NS+10:PRINT"3NS=";NS:PRINT"RUN
  3(HOME)"
8 POKE 525,4:FOR I=1TD 4=POKE525+1,
  13=NEXT=END
```

Formatting tricks

AN anonymous correspondent—signing as 'Pete the Pet Maniac'—sent some tips for programs. We tried some of them and most of them work, so from time to time we will print them.

Here are two money-handling functions to start. This simple statement will ensure that your variable Z is rounded-off to pounds and pence with two decimal places:

```
100  Z = INT (100 × A + .5)/100
```

This one eliminates the Pet habit of ranging text to the left—very irritating if you are trying for a column of figures to line up on top of each other:

```
100  A$ = STR$(INT(A))
110  IF INT (ABS(A)<1 THEN A$ = "1"
120  PRINT TAB (20-LEN(A$);A
```

This puts the decimal point in column 20—obviously you can choose that for yourself—and the variable A is ranged to the right around it.

Cursor control

MANY GAMES programs need the cursor to be moved to a particular point on the screen before something is printed-out. If cursor control characters are placed in every PRINT statement, far too much memory is used and a messy program is produced.

The best method to control the cursor is to define two character strings, one containing a string of 24 cursor down commands and the other 29 cursor across commands. A subroutine is written to return the cursor to HOME and then move it to the desired place on the screen.

In this program, which allows you to draw on the screen, the strings are set up in lines 100 and 150 and the position desired is determined in lines 850 to 1050; line 1100 then moves the cursor to the correct place. This line could be a subroutine if it is likely to be used in several places within a program.

Also note that lines 1150 to 1450 check the value in location 515; this location contains the representation of the last key pressed on the keyboard. To discover what all the representations are, keep peeking 215 while you press different keys.

```
                DRAWING PROGRAM

THIS PROGRAM ALLOWS YOU TO DRAW ON THE
SCREEN.  CONTINUOUS MOVEMENT IS OBTAINED
BY CHECKING LOCATION 515 FOR THE LAST
KEY DOWN.  IF PEEK(515)=255 THEN NO KEY
IS BEING PRESSED.

YOU WILL NEED TO TAKE OUT THE X=USR(0)
CODE IF YOU ARE NOT USING THE IPUG PRINT
ROUTINE FOR A SWTP PR40 PRINTER.  YOU
CAN, OF COURSE, MODIFY THE PROGRAM TO
PRINT ON ANY PRINTER YOU MIGHT HAVE.


 100 CD$="RQQQQQQQQQQQQQQQQQQQQQQQQQ"
 150 CR$="R]]]]]]]]]]]]]]]]]]]]]]]]]]]
]]]]]]]]]"
 200 PRINT"S          RARTIST'S PROGRAMR
"
 250 PRINT"QQPRESS 8 FOR UP, 2 FOR DOWN"

 300 PRINT"Q      4 FOR LEFT, 6 FOR RIGH
T"
 350 PRINT"Q      'RETURN' FOR RESTART"
 400 PRINT"Q      'SPACE' TO PRINT TO PR
40"
 450 PRINT"      RMAKE SURE IT'S CONNECT
EDR"
 500 INPUT"QQWHAT SYMBOL DO YOU WANT TO
DRAW WITH";C$
 550 C$=LEFT$(C$,1)
 600 PRINT"QQWHERE DO YOU WANT TO START?
"
 650 PRINT"Q1=TOP L, 2=TOP R, 3=BOTTOM L
"

 700 INPUT"4=BOTTOM R, 5=CENTRE";S%
 750 IFS%<1ORS%>5THEN650
 800 ONS%GOTO850,900,950,1000,1050
 850 P1=0:P2=0:GOTO1100
 900 P1=0:P2=39:GOTO1100
 950 P1=24:P2=0:GOTO1100
 1000 P1=24:P2=39:GOTO1100
 1050 P1=12:P2=19
 1100 PRINT"S";LEFT$(CD$,P1+1);LEFT$(CR$
,P2+1);"R R";
 1150 I%=PEEK(515):IFI%=255THEN1150
 1200 IFI%=50THENPRINT"]";C$;"QJR R";:GO
TO1150
 1250 IFI%=18THENPRINT"]";C$;"QJR R";:GO
TO1150
 1300 IFI%=41THENPRINT"]";C$;"R R";:GOTO
1150
 1350 IFI%=42THENPRINT"]";C$;"JJR R";:GO
TO1150
 1400 IFI%=6THENX=USR(0):GOTO1150
 1450 IFI%=27THEN750
 1500 GOTO1150
```

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Disc route with Percom

IF YOU are toying with the idea of floppy discs on your TRS-80—and who is not?—you could do worse than look for the name Percom.

Percom Data Co has a double-sided minifloppy drive which is fully-compatible with the Tandy single-sided drive and about $100 cheaper. It uses the Pertec FD-200, a reputable enough mechanism, and all you need from Tandy is TRSDOS release 2.1 and a 16K TRS-80 with Level II Basic.

You will also need a ribbon cable which Percom also sells. Percom does not like the standard Radio Shack disc connection and the Percom manual describes the Tandy cable as "not arranged in accordance with good engineering practice".

Percom also sells dual- and triple-drive versions, with which there is a free Percom cable.

The problem, of course, is that you will need a U.S. connection to buy the unit and possibly a converter to run it off the U.K. mains. Even so, prices look good—$399 for the single drive (stores about 140KB), $795 for dual drives. The cable, incidentally, will add about $25.

We hear Percom is looking for U.K. agents. Meanwhile, we have an address for a Dutch distributor—Compu 2000, Chrysanstraat 4, 1031, Amsterdam, or you can contact the manufacturer direct at 318 Barnes Drive, Garland, TX 75042.

Wobblies

We highlighted Nigel Dibben's troubles in March, and he has been documenting some more glitches on which readers might like to comment. Let us know if you also have any of these bugs.

- Try this after two hours' running:

```
10 FOR I = 1 TO 100: PRINT @ SQR(9);: NEXT
```

The answer should be 3, but Nigel reckons that one try in five gives an overflow error and one in 10 gives the odd response .660938

- Try it with LOG(9). The correct answer is 2.19722; one attempt in 10 produces —.82819 for Nigel.
- Exponentiation (up-arrow) gives similar results.

```
FOR X=1 TO 1000: PRINT@325,X,SIN(X): NEXT
```

Nigel's system has locked into loops at X=34, X=68, X=8.7 and various other values. In a series of 12 runs trying to pin down the error the results were:

```
?SN ERROR in sine line at eg X=34 .....6 times
Return to power-up (MEMORY SIZE?).....5 times
Closed loop, need to reset .....once
```

- This isn't a check but a warning; memory can sometimes be garbled for no apparent reason. For example, Nigel once gained the following two lines:

```
66NTP RESET
13878 :GOTO440
```

The latter could have been deleted by typing 13878 and ENTER; but the first one, in which the number had been over-printed, was of a higher number and blocked the program. All however, is not lost:

Type in a new line immediately before the garble with a distinctive text like:100 REM XXXXXXXXXXXXXXX
Look for this in the memory by entering:

```
FOR J=17129 to 25000 : PRINT PEEK(J); : NEXT
```

You will eventually find something like:
...88 88 88 88 88 0 100 75 74 129 130 29 29 29 29 64
This is an actual example. The line 0 is an end-of-line marker; 100 and 75 are LSB and MSB of the line pointer (start location of the next line pointer); 74 and 129 are the LSB MSB of the offending line number (i.e. 33098). 130 is line text (130 is code for RESET).
DELETE 33098. It will now be possible to DELETE 13878 and then repair the damage to the program.

Circles

WE HAD two interesting attempts on the circle-drawing front in response to Freddie Nicholls' request in the March page. Here's one from Nigel Dibben:

```
5 CLS
10 INPUT"ORIGIN IS TOP LEFT CORNER: ENTER
   COORDS OF CENTRE, RADIUS AND
   ECCENTRICITY (1 FOR CIRCLE)":XC,YC,E
20 A=2/3/R : AT=A : E=E*2.3 : REM CORRECTS
   FOR SHAPE OR GRAPHIC BLOCKS
30 X=XC+R*E*SIN(AT) : Y=YC+R*COS(AT)
40 IF X 128 AND X =0 AND Y 48 AND Y =0
   SET (X,Y)
50 AT=AT+A : IF AT 6.3 THEN 30
55 REM 6.3 IS ABOUT 2 × PI
60 IF A 0 THEN X=XC : Y=YC : A=0 : GOTO 40
70 IF INKEY$=CHR$(31) RUN ELSE 70
After the centre has been set, press CLEAR to rerun.
```

This is also his, not quite so neat but a little faster:

```
 5 CLS
10 INPUT "XC,YC,R,E"; XC,YC,R,E
20 FOR XC0 TO 127
30 Z = R*R — (X—XC) * (X—XC) : IF Z(0 THEN
   70
40 D = E* SQR(Z) /2.3
50 GOSUB 200
60 D= —D : GOSUB 200
70 NEXT
80 X=XC : D=0 : GOSUB 200
90 IF INKEY$ = CHR$(31) .RUN ELSE 90
200 Y=YC+D : IF Y⟩= 0 AND Y⟨48 SET (X,Y)
210 ETURN
```

You input centre co-ordinates which can be off-screen, radius and eccentricity —setting E=1 produces a perfect circle, E=2 produces an upright ovoid, E=.5 an elegant flat oval.

This is from Bob Williams and also seems to work:

```
 5 CLS
10 PI=3.142 : FY=2.42
20 PRINT, "CIRCLE DRAWING PROGRAM"
30 INPUT "HOW MANY CIRCLES — UP TO
   10";N
50 PRINT "THE SCREEN IS 128 UNITS WIDE
   AND 116 UNITS HIGH"
60 PRINT "MAXIMUM RADIUS FOR A
   COMPLETE CIRCLE IS 57"
70 PRINT "BUT YOU CAN SELECT ANY
   RADIUS YOU LIKE"
80 PRINT "AND ANY CENTRE YOU LIKE ON
   OR OFF THE SCREEN (TOP LEFT CORNER
   = ORIGIN; +Y IS DOWN)"
90 FOR I = 1 TO N
100 INPUT "KEY RADIUS, X,Y"; R(I), X(I)X Y(I)
110 NEXT I
120 CLS
130 FOR I = 1 TO N
140 FOR A = 0 TO 2 *PI STEP PI/(3*R(I))
150 SX = INT (X(I)+SIN(A)*R(I)): IF ABS
   (SX—63.5) ⟩63.5 GOTO 180
160 SY=INT (Y(I)/FY—R(I)*COS(A)/FY):IF ABS
   (SY—23.5) ⟩23.5 GOTO 180
170 SET (SX,SY)
180 NEXT A
190 NEXT I
200 GOTO 200
```

FY is the scale factor: the screen is 58 'x' units by 24 'y' units so FY = 58 ÷ 24 = 2.42

Bob suggests designing a clock with moving hands, based on a subroutine containing this. Do that successfully and we will print it.

He also has a tweak for the Nicholls' square-drawing program, again based on the 58/24 / 2.42 axis correction factor. If you change variables C and D in lines 8, 20 and 50 of the program to INT(C/2.42) and INT(D/2.42) respectively you should be able to get a *scale* drawing. For example, try INPUT A and C as 10 and B and D as 50.

This circle-drawing solution from A. Ellefsen of Ingatestone also looks neat. It is written for a Level II machine with 4KB memory:

```
10 CLS:INPUT"ENTER DIAMETER";D:CLS
15 FORX=.02TO6.5STEP2/D
20 SET((SIN(X)+1)*.5*D,(COS(X)+1)*.2*D)
30 NEXT
40 IFINKEY$=""THEN40ELSE10
```

He has used the idea in wallpaper design programs with random side lengths and screen positionings; it also looks good for 'filled-in' rectangles alternating between set and re-set commands.

Video wobble

AN ESSEX reader comments on the variation from one TRS-80 to another in the stability of the video picture. A test for your machine is to white-out the screen. On a good machine the picture will wobble at most only slightly on the edges of the frame and will not be upset by any but the most powerful RE interferences.

A poor machine under similar conditions will be so unstable that graphics containing more than 75 percent white cannot be used.

A friend has reported that replacing the video cable with low-loss co-ax removes the ghosting on the characters and helps reduce the wobble but this involves opening the video unit and is the kind of modification which destroys guarantees.

Skelly is last stop to U.S.

ALAN THOMAS' father founded Radio Supplies by pushing a barrow round the streets of Swansea to sell wireless sets. Little did he know that one day his business would be selling the most sophisticated equipment available in the U.K.

The shop flourished, was handed from father to son, and now Alan Thomas can claim proudly to be the first Tandy dealer appointed in Wales.

Radio Supplies is on the outskirts of Swansea, at 80 Gower Road, Sketty. As well as Tandy, it also supplies Pet and Apple II systems.

The bulk of business is still from the shop's radio and television interests. Thomas did not need, financially anyway, to become involved with microcomputers, and one would not have thought that there was a great call for them on the outskirts of Swansea. So why did he do it?

"I saw the Horizon programme, *The Chips are Down*, on television one night", he says, "and it had a great influence on me. The next morning I said to my wife 'Microcomputers, they are the thing'."

With his mind made up that it was to be a serious venture, Thomas enrolled for a computer course at the local university, to learn something about the new product he wanted to sell.

Enlightened

"I came out feeling more enlightened. I was eager and ready to get my hands on the things", he said.

He became a Tandy dealer last April and orders were received as soon as the machines were available.

"I put the computers in the window and that was how I met John Cox, our programmer. He walked past the shop and almost did a backward somersault. Finding a computer on sale in Skelly was the last thing he expected".

Cox is a lecturer in computing at the Polytechnic of Wales and with his partner, Roger Willis, has his own software consultancy, Computer Development Services. Cox is responsible for all the software—except the ready-made programs—sold with Thomas' systems.

So far he has developed programs for small businesses, including estate agents, and has written payroll and dedicated programs for paper and PVC cutting, which requires a high degree of accuracy.

Natural addition

After the Tandy system had proved successful, the "Pet seemed a natural addition", says Thomas. "We then contacted ITT, because I was fascinated with the Apple II system. We haven't seen the latest production, though, because of supply problems.

Thomas is selling around 10 computers a month—not bad for someone who has been in the business for a year. Customers are from all over the U.K., not just Wales.

As well as selling computers, Thomas also does a good trade in manuals, software cassettes and peripherals, such as the add-on memory for Pet and, more recently, disc drives for the Tandy.

Thomas has become something of a computer freak. "I love the enthusiasm about it all, particularly from the magazines and hobbyists. My father and I are both radio hams, and the fact that programs are being developed for radios is really exciting. I would like to put part of the business on to a computer.

"We have a large colour TV rental interest and there's the payroll. The main reason we haven't done it yet is because of the software. By the end of the year, though, we hope to have it up and running".

The future looks bright for Thomas and Radio Supplies. "We're not sure where we'll go from here", he says "but there's no doubt the business will grow because of microcomputers".

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Source for ideas and help

THE Pet and Tandy pages we have begun in recent issues have obviously proved acceptable as far as readers are concerned. This month we start a regular page devoted to the third member of the top-selling triumvirate in personal computing.

We have invited Andy Witterick of the U.K. Apple Users' Group to kick off and you can treat him as the focus for contributions, c/o *Practical Computing* at 2 Duncan Terrace, London N1 8BJ. The users' group, incidentally, is run from the offices of Keen Computers.

THIS is a new column which hopefully will run on a regular basis but that depends largely on you and the amount of response we receive.

Obviously, the first problem to be overcome is communication. The purpose of this feature is ideas and help. You can contribute. This is a users' page. What we need are ideas—on programming improvements, on hardware and so on.

Problems you encounter may not be peculiar to you but it is likely others will have met them also, and we may all benefit from their discussion. We are not averse to printing any complaints you may have about Apple, either.

Moves are afoot to set up the U.K. Users' Group on a national basis. Such groups exist for the Pet and Tandy TRS-80, so why not for the Apple II? It is one of the biggest-selling micros in the U.K., after all, and many hobbyists use it, as well as people using it commercially.

Library aim

What will the group do? Primarily, we hope to provide an information exchange for Apple users, as well as some kind of clinic to handle minor hardware problems and programming advice. A newsletter on a regular basis should be feasible, provided enough contributions are forthcoming.

What else? A program library is one suggestion in our office at the moment.

An essential pre-requisite will be some kind of meeting. This will be of interest to all concerned and should really get the group started. No date has been fixed, as this will really depend on the amount of interest shown. At the moment, June appears to be the earliest possibility. With Apple users all over the U.K. it will have to be somewhere central; probably not London—users in the North are likely to have to travel, so it looks like the Midlands. Perhaps the group needs a regional structure?

Now it is up to you to contact Andy Witterick, 5 The Poultry, Nottingham (telephone 0602 583254). He will send you a membership application form.

The bad news. To cover costs, there will be a membership fee; the group hopes to keep it to £5 or so.

News and views

THE MARKET in the U.K. being something like two years behind that in the States, plenty of imported bits and pieces are starting to appear here. One of the manufacturers, Mountain Hardware, has produced an Apple clock which will remind enthusiastic programmers to stop for tea. We have no information about delivery but its doubtful whether it will be immediate.

They are available, though—Keen has one. It keeps the time and date in 1/1000-second increments continuously. Calendar clock and event-timer functions are accessed easily from Basic, using routines carried in on-board ROM.

Mountain Hardware reckons the clock is indispensable; it is certainly useful. The clock is crystal-controlled for accuracy and has an additional re-chargeable battery to keep it ticking during downtimes.

Something which has been annoying many people is delivery on the Apple. We have been told that its new factory is now on-line, so delivery problems and delays should soon be resolved.

Hands up all those who bought an Apple with a minimum of memory and now want more. Many of you—right? Well, upgrade kits are now available. Each contains 16K RAM, an assembly manual, and a RAM tester on cassette.

Simple task

Putting it together is simple since the chips are of the plug-in variety. Cost of the kit is £120 and it should now be available at your local dealer or from Keen Computers, Nottingham.

I noticed a moan in the February Pet Corner about the 6502 software manual being too advanced for many people who want to begin machine code programming. So, for would-be masochists, here's a plug for Rodney Zaks' *Programming the* 6502. Like the rest of his books, it is not only well-written but, more important, comprehensible.

Superchip

AN ORGANISATION in Texas called Eclectic Corp has what sounds like a handy add-on for Apple. Modestly called the Superchip, it's a plug-in $125 mod which provides instant enhancement of Apple output.

It has a 'character edit' cassette which allows you to define your own symbols easily—for music? foreign alphabets? maths? games?—while providing a bagfull of other goodies. They include full ASCII with lower-case, vertical text and graphics mixed with horizontal text and graphics, reverse video, and, if you really insist, upside-down text.

Eclectic is at 2830 Walnut Hill Lane, Dallas TX 75229. Check shipping charges before ordering.

Pursuit

HERE IS a short game on 'pursuit' lines written by Ray Poynter. It's in Applesoft and that's all I'm going to say, except that it is good.

```
]LIST

10  TEXT : HOME
11  INPUT " ENTER COPS AND ROBBES
 SPEEDS ";D,H: REM  1,1.2 WI
LL MEAN ROBBERS ESCAPE,1.2,1
 WILLMEAN COPS WIN
12 H = H / D
13  INPUT " ENTER DISTANCE ";DIST

15  HGR2
30 TH = 0
40 N = 0
50 ST =  ATN (1) / (D * H + D + 1
0)
55  REM  ST = STEP
60 X = 0:Y = 0
70  HPLOT 95,95
1000 TH = TH + H * ST
1010 S1 =  COS (TH) - X
1020 S2 =  SIN (TH) - Y
1023  REM  PLOTTING USING 190 -95
*X-95 ALLOWS US TO MOVE ORIG
IN TO CENTRE
1025  HPLOT 190 - 95 *  COS (TH) -
95,190 -  SIN (TH) * 95 - 95

1026  REM  PLOT NEXT STEP IN CIRC
LE
1030 R =  SQR (S1 ^ 2 + S2 ^ 2)
1035  REM  R=DISTANCE FROM COPS T
O ROBBERS
1040  IF R < .1 THEN 2000
1050 X = X + S1 / R * ST
1060 Y = Y + S2 / R * ST
1070  HPLOT 190 - 95 * X - 95,190
 - 95 * Y - 95
1075  REM  CALCULATE DIRECTION OF
 ROBBERS FROM COPS AND PLOT
COPS ONE STEP CLOSER
1080  IF N < DIST THEN N = N + 1:
 GOTO 1000
1500  POKE  - 16303,0: POKE  - 16
300,0: HOME : VTAB 6: HTAB 6
: INVERSE : PRINT "THE VILLI
AN ESCAPES"
1510  FOR J = 1 TO 5000: NEXT
1520  NORMAL : POKE  - 16304,0: POKE
 - 16299,0: POKE  - 16297,0:
 END
2000  POKE  - 16303,0: POKE  - 16
300,0: HOME : VTAB 6: HTAB 6
: INVERSE : PRINT "";"THE VI
LLIAN IS APPREHENDED"
2005  FOR J = 1 TO 6000: NEXT
2010  NORMAL : POKE  - 16304,0: POKE
 - 16299,0: POKE  - 16297,0
```

APPLE DESIGN
THE MICRO C

THE first part of our interview with Steve Wozniak, founder of Apple Computers and principal designer of its products, ranged last month over the background to Apple and its meteoric rise. Our interviewer, Robin Bradbeer, then extracted from Steve some views and opinions about the microcomputer world.

RB: Steve, you said you regarded Apple 2 as 'the first non-kit computer'. Do you want to elaborate?

SW: Well, now of course there's the Commodore Pet and the Radio Shack TRS-80. We don't really think those two have equalled our machine, certainly not in its capability.

RB: Surely they're slightly different concepts?

SW: They are based on the same principle—a low-cost computer for the home, ready-to-use, plug-in-and-go, good manuals. Many of the newcomers fall down on good documentation; even so we didn't have good manuals in the beginning ourselves. We have them now—there's no substitute for good documentation.
Honestly, though the capability of the other two machines is just not as great. The development software available was just not as great, the application software was not in such good shape, the machines have video display limitations, they don't have colour, they don't have high-resolution graphics. I still say we have the best graphics of any of the small computers.

Similar approach

RB: How about the hobby machines following the S-100 approach?

SW: Processor Technology is an interesting case; the Sol took a similar approach to the Apple 1. It was a keyboard which you just plugged into the video terminal. With Apple 1 you didn't get a case; you do with Sol but it's based on a S-100 bus, and that's the ways things will go. Remember the original Altairs were based around teleprinters, because that was how it had been for years. Now it's video which really caught on in the hobbyist world. The Sol is basically an 8080 system with the Processor Technology VDM board and a keyboard all in a nice case. It was the hottest thing going because that's what people wanted.
I think the term is 'friendly'; Sol looks like an integrated computer system. In fact, the Apple 2 almost beat it, and when it came out it had a little more going for it than the Sol. It had a plastic case, it was well-designed, it looked more together, it had colour graphics, of course, and it had the right RAMs.

RB: You really pushed Apple 2?

SW: I admit it—"Here it is, the first computer really suitable for the home". The first advertisements showed the Apple 2 in somebody's kitchen and people started buying it; that really put us on the road. It really wasn't until we came out with our disc that our sales really took off. We were the only people really delivering a complete disc system.

Disc important

RB: What do you think of the idea of having the disc integral with the system rather as with the Compucolor 2?

SW: Yes, I like it. There are many advantages. The disc is so important, though. I remember when Shugart first came out with the floppy disc; I was still with H-P and we didn't even have the Apple 1 designed.
We looked at the Shugart manuals to design a very simple interface but we never really got round to it until two years later, when we wanted to expand the Apple 2 peripherals. We felt that a disc was what it really needed, so I pulled out the old design and finally incorporated it.
The floppy disc is really the way to use the system. The minifloppy is a real credit to Shugart and its ingenuity. It was the first low-cost peripheral of that power that really gives you a good system, and it's so important for a personal computer that it makes sense to build it in.
Yes, I like the Compucolor approach; the concept is really good if they can get the manufacturing and reliability right.

Graphic ideas

RB: It looks as though they have taken a few of your ideas and incorporated them, the colour graphics in particular?

SW: Well, Compucolor had a machine out about the same time as the Apple 2. It was a different style from the one it has now; it had rather more capability. The colour scheme is rather different. They have a built-in CRT so they are able to generate higher resolution and more

Steve Wozniak

ER MUSES ON OMPETITION

colours. They have dedicated more video RAMs to the system.
Compucolor originally wanted to come out with an $800 system which had very limited colour graphics. But for some reason they haven't been able to sell. I think there are problems with the disc being so close to the CRT—perhaps they have shielding problems, I don't know. If that machine had been built with Apple ideas, then I think it would have been a real winner.
What the world is really looking for is the machine with the best video resolution and the best colour possible. When you think about it, all it is is RAMs. It's not more complicated, it's just how much RAM you want to spend money on—and RAM is getting so cheap.

RB: What do you think the next generation of computers will have? For example, what do you consider the minimum RAM content of any personal computer?

SW: Well, 16K is our minimum now. No-one in their right mind would order a 4K Apple. Disc operating systems call for quite a bit of RAM. The TRS-80 and the Pet are in a rather difficult position because they were not really designed for upgrading like that to a helpful memory capacity, but Apple 2 was designed to plug 48K into the main board. That was unheard of.
I think we can see the time when we'll want more than 64K and that's going to be a real problem with some of the current microprocessors.

More storage

RB: What do you think about the 16-bit micro?

SW: Well, we could go to one for Apple. But then you have problems with some of the current 16-bit machines which don't really address any more memory than the 8-bit micros. The Intel 8086, for instance, uses a segmentation scheme but you are still stuck with about 65K bytes in any one segment.

RB: Zilog is talking about a lot more storage than that on the Z-8000, I believe?

SW: Yes, they use a 23-bit addressing system with various different addressing modes. In fact, that's probably the first big step forward. But then if it's available you want 256K bytes. If I generate an instruction which refers to a data field offset from some base register by up to 64K, I can use a normal 16-bit offset. If I exceed that, however, I can use a 23-bit offset and address as much memory as I want.

So hot

RB: When you were with H-P did you meet its 16-bit microprocessor?

SW: Before I left I saw a description of one called the MC² that was in SOS. At the time they were talking about 7MHz operating speeds although I think it's been reduced a little. The addressing modes and the instruction set looked to be very similar to other microprocessors around.
If it had been released as a "hobbyist" type product it would have been so hot; it would really have caught on because it was so powerful. But H-P used it only for internal use. There must be a couple of different processors running around the divisions of H-P.

RB: Isn't it a shame H-P doesn't sell its processor products outside the company?

SW: Yes. When I was beginning to get into processors H-P had SOS and NMOS 16-bit chips going and would have been way ahead.
H-P isn't a components manufacturer, though, and it would probably have been a bad move to enter the microprocessor component market. When the Z-80 appeared it was an advance on the other products around and Zilog went into the black within one year of producing it. It really sold like hot cakes. Zilog has a really good pulse on the market and where it is heading.

RB: Do you think that the memory management approach is one good way of handling 16-bit machines?

SW: The Z-8000 is still a 16-bit bare address machine with a segment register. At least you have the large offsets available in the instruction set, if you were coding in absolute. Now nobody really codes in absolute any more.

RB; Will you stay with 6502-based products—the first two machines both used this microprocessor?

SW: That was a total accident.

RB: As it was the first chip you picked up, would you have done the same thing if somebody had given you a 6800?

SW: It didn't really matter. My first version of the Apple 1 was designed with the 6800 but then I read in a magazine that the 6502 was a little better, and it was also sold over the counter. Any microprocessor with a reasonable instruction set could have been used.

RB: Do you think that that was the way most personal computer manufacturers chose their processors?

SW: Yes. Most of the small computer manufacturers were starting when the Altair came out; Altair used the 8080, and many followed them. When I say the 6502, I thought that it was really nifty, and I wanted to do something which hadn't been done before. It was largely accidental. But when the large companies step in they think about it—they are more concerned about the supply than the raw performance.

Popularity

RB: The 6502 is becoming more and more popular. Is this because people like you are using it, or is it because it is just a good processor?

SW: Well, Apple has done an awful lot for the 6502. Now three companies are making it—Rockwell, Synertek and, of course, MOS Technology—it is getting around the OEM world.

RB: How significant is Europe in your marketing?

SW: Europe is a significant proportion of our sales, most of the systems going into small businesses. In the U.S. it's more of a market for personal computers in the home. The TV video systems are different.
PAL we can live with—it's not too different from NTSC—but the French system SECAM is another thing altogether. It's a pity the world doesn't use the same standard, though it's doubtful if we'll ever get one video standard, the same as we probably won't get one standard bus structure.

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CONTENTS

CHAPTER 5

MAT A = B ± C

```
10 DIM  A(3,2), B(3,2), C(3,2), D(2,3), E(3,3)
```

	1)	2)
A(1,	4·3	0
A(2,	8·5	4
A(3,	9·4	4·3

	1)	2)
B(1,	1·5	−2·7
B(2,	3·6	7·8
B(3,	8·4	4·3

	1)	2)
C(1,	2·8	2·7
C(2,	4·9	−3·8
C(3,	1	0

	1)	2)	3)
D(1,			
D(2,			

	1)	2)	3)
E(1,			
E(2,			
E(3,			

SUPPOSE YOU WANT EACH ELEMENT OF ARRAY A(,) TO BE THE SUM (OR DIFFERENCE) OF THE TWO CORRESPONDING ELEMENTS IN ARRAYS B(,) AND C(,). YOU COULD ACHIEVE THIS AS FOLLOWS:

```
200  FOR  C = 1 TO 2
210  FOR  R = 1 TO 3
220  LET  A(R,C) = B(R,C) + C(R,C)
230  NEXT  R
240  NEXT  C
```

MINUS SIGN IF THE DIFFERENCE IS WANTED

BUT YOU COULD DO THE WHOLE THING WITH A SINGLE "MAT" INSTRUCTION LIKE THIS:

```
100  MAT  A = B + C
```

OR MINUS

ARRAYS B(,) AND C(,) WOULD BE UNDISTURBED: ARRAY A(,) WOULD END UP AS SHOWN AT THE TOP OF THIS PAGE.

NOTICE THAT A, B & C ON LINE 100 HAVE NOTHING TO DO WITH THE ORDINARY VARIABLES A, B & C; THE WORD "MAT" TELLS *BASIC* YOU MEAN *ARRAYS* A(,), B(,) & C(,).

IF THE *CURRENT* DIMENSIONS OF THE TWO ARRAYS NAMED ON THE RIGHT OF THE EQUALS SIGN ARE NOT IDENTICAL THEN *BASIC* REFUSES TO OBEY THIS INSTRUCTION.

```
110  MAT  A = B + D
```

DIM B(3,2) vs D(2,3)

ILLUSTRATING BASIC PAGE 80

THE ARRAY NAMED ON THE LEFT OF THE EQUALS SIGN MUST HAVE DIMENSIONS AT LEAST AS GREAT AS THE *CURRENT* DIMENSIONS OF THE ARRAYS NAMED ON THE RIGHT. THUS LINE 130 BELOW IS WRONG; LINE 140 IS ALLOWED BUT WOULD CAUSE *BASIC* TO RE-DIMENSION ARRAY E(,) SO THAT IT HAD 3 ROWS AND 2 COLUMNS; IT WOULD THEN BE A MISTAKE TO REFER TO E(3,3). IMPLICATIONS OF RE-DIMENSIONING ARE DISCUSSED ON PAGE 79.

```
130  MAT  D = B + C
140  MAT  E = B + C
150  LET  E(3,3) = 13
```

IN SOME (BUT *NOT* ALL) *BASICS* YOU ARE ALLOWED TO HAVE THE NAME OF AN ARRAY ON BOTH SIDES OF THE EQUALS SIGN; FOR THE SAKE OF "PORTABILITY" DON'T DO IT.

```
160  MAT  A = A + A
170  MAT  A = A - C
180  MAT  A = C - A
```

DON'T RISK IT

THE FORM OF THIS INSTRUCTION MAY NOT BE VARIED. DON'T TRY ADDING EXTRA SIGNS AND LETTERS.

```
190  MAT  A = -B + C
200  MAT  A = B + C + F
210  MAT  A = -B
```

MAT A=C-B

MAT X=B+C
MAT A=X+F

MAT A=(-1)*B
SEE OVERLEAF

CHAPTER 5

MAT A = ("SCALAR" EXPRESSION) ☆ B

```
10  DIM  A(3,2), B(3,2), C(4,3), D(2,2)
```

	1)	2)
A(1,	15.6	4.5
A(2,	-9	0
A(3,	6	-6

	1)	2)
B(1,	5.2	1.5
B(2,	-3	0
B(3,	2	-2

	1)	2)	3)
C(1,			
C(2,			
C(3,			
C(4,			

	1)	2)
D(1,		
D(2,		

SUPPOSE YOU WANT EVERY ELEMENT OF ARRAY A(,) TO BE THREE TIMES THE VALUE OF THE CORRESPONDING ELEMENT IN ARRAY B(,). YOU CAN ACHIEVE THIS FAIRLY SIMPLY AS FOLLOWS:

```
200  FOR  C = 1  TO  2
210  FOR  R = 1  TO  3
220  LET  A(R,C) = 3.0 * B(R,C)
230  NEXT  R
240  NEXT  C
```

BUT YOU COULD DO THE WHOLE THING WITH A SINGLE "MAT" STATEMENT LIKE THIS:

```
100  MAT  A = (3.0) * B
```

ARRAY B(,) WOULD REMAIN UNDISTURBED AND A(,) WOULD NOW BE AS SHOWN AT THE TOP OF THIS PAGE. EVERY ELEMENT HAS BEEN SCALED BY THE *SCALAR* (*i.e. NON-VECTOR or NON-MATRIX*) EXPRESSION IN BRACKETS.

NOTICE THAT A & B ON LINE 100 HAVE NOTHING TO DO WITH THE SIMPLE VARIABLES A & B; THE WORD "MAT" TELLS *BASIC* YOU MEAN *ARRAYS* A(,) & B(,). BUT *INSIDE* THE BRACKETS A & B *WOULD* BE SIMPLE VARIABLES: LINE 130 BELOW WOULD HAVE EXACTLY THE SAME EFFECT AS LINE 100 ABOVE; (A/B) REPRESENTS THE SCALAR QUANTITY (3.0).

```
110  LET  A = 6
120  LET  B = 2
130  MAT  A = (A/B) * B
```

THE ARRAY NAMED ON THE LEFT OF THE EQUALS SIGN MUST HAVE DIMENSIONS IN THE "DIM" STATEMENT AT LEAST AS BIG AS THE *CURRENT* DIMENSIONS OF THE ARRAY NAMED ON THE RIGHT. THUS LINE 140 BELOW IS WRONG: LINE 150 IS ALLOWED BUT WOULD CAUSE *BASIC* TO RE-DIMENSION ARRAY C(,) SO THAT IT HAD 3 ROWS AND 2 COLUMNS: IT WOULD THEN BE A MISTAKE TO REFER TO C(4,2). IMPLICATIONS OF RE-DIMENSIONING ARE DISCUSSED ON PAGE 79.

```
140  MAT  D = (0.5) * B
150  MAT  C = (-1) * B
160  LET  C(4,2) = 13
```

IN SOME (*NOT* ALL) *BASICS* YOU ARE ALLOWED TO NAME THE SAME ARRAY ON BOTH SIDES OF THE EQUALS SIGN: FOR THE SAKE OF "PORTABILITY" DON'T DO IT:

```
170  MAT  A = (-X) * A
```

DON'T DO IT!

THE EXPRESSION IN BRACKETS MAY BE AS COMPLICATED AS YOU LIKE AS LONG AS IT REPRESENTS A SINGLE SCALAR VALUE:

```
180  MAT  A = (-X+SQR(3*B(2*I,J))) * B
```

THE FORM OF THIS INSTRUCTION IS STRICTLY AS SHOWN IN THE HEADING OPPOSITE. SOME ERRORS OF FORM ARE ILLUSTRATED BELOW:

```
185  LET  X = 3
190  MAT  A = X * B
192  MAT  A = -(X) * B
194  MAT  A = (X) * (Y) * B
196  MAT  A = B * (X)
```

THIS IS THE FORM FOR "MATRIX MULTIPLICATION". SEE PAGE 88

MAT A=(-X)*B

MAT A=(X*Y)*B

MAT A=(X)*B

MAT A = TRN(B)

```
10  DIM  A(3,2), B(2,3), C(3,3), D(2,2)
```

	1)	2)
A(1,	4·2	−3·8
A(2,	15·6	8·7
A(3,	0	−4

	1)	2)	3)
B(1,	4·2	15·6	0
B(2,	−3·8	8·7	−4

	1)	2)	3)
C(1,			
C(2,			
C(3,			

	1)	2)
D(1,		
D(2,		

SUPPOSE YOU WANT THE *ROWS* OF ARRAY A(,) TO BE THE SAME AS THE *COLUMNS* OF ARRAY B(,) — IN OTHER WORDS YOU WANT A(,) TO BE THE *TRANSPOSE* OF B(,). YOU COULD COPY THE ELEMENTS ONE BY ONE LIKE THIS:

```
200  FOR I = 1 TO 2
210  FOR J = 1 TO 3
220  LET A(J,I) = B(I,J)
230  NEXT J
240  NEXT I
```

NOTE THE POSITIONS OF SUBSCRIPTS: (J,I) & (I,J)

BUT YOU COULD DO THE WHOLE THING WITH A SINGLE "MAT" INSTRUCTION LIKE THIS:

```
100  MAT  A = TRN(B)
```

ARRAY B(,) WOULD BE UNDISTURBED; ARRAY A(,) WOULD END UP AS SHOWN AT THE TOP OF THIS PAGE.

NOTICE THAT A & B ON LINE 100 HAVE NOTHING TO DO WITH THE SIMPLE VARIABLES A & B; THE WORD "MAT" TELLS *BASIC* YOU MEAN *ARRAYS* A(,) & B(,).

THE ARRAY NAMED ON THE LEFT OF THE EQUALS SIGN MUST HAVE DIMENSIONS IN ITS "DIM" STATEMENT AT LEAST AS BIG AS THE *CURRENT* DIMENSIONS OF THE ARRAY NAMED ON THE RIGHT. THUS LINE 110 OPPOSITE IS WRONG; LINE 120 IS ALLOWED BUT WOULD CAUSE *BASIC* TO RE-DIMENSION ARRAY C(,) SO THAT IT HAD *THREE* ROWS AND *TWO* COLUMNS (NB. NOT 2 ROWS & 3 COLUMNS) AND IT WOULD THEN BE A MISTAKE TO REFER TO C(3,3).

ILLUSTRATING BASIC PAGE 84

IMPLICATIONS OF RE-DIMENSIONING ARE DISCUSSED ON PAGE 79.

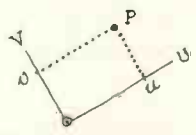
```
110 MAT D = TRN(B)
120 MAT C = TRN(B)
130 LET C(3,3) = 13
```

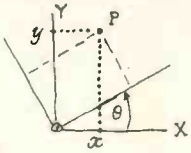
YOU MAY NOT NAME THE SAME ARRAY ON BOTH SIDES OF THE EQUALS SIGN: IN OTHER WORDS YOU MAY NOT TRANSPOSE A MATRIX ON TOP OF ITSELF:

```
140 MAT B = TRN(B)
```

BUT SOME *BASICS* DO ALLOW THIS. AS AN EXERCISE IT MIGHT AMUSE YOU TO WRITE A ROUTINE FOR REPLACING AN ARRAY BY THE TRANSPOSE OF ITSELF ~ BUT WITHOUT COPYING IT FIRST TO SOME OTHER ARRAY (IN OTHER WORDS YOU SHOULD TRANSPOSE THE ARRAY "IN-SITU"). IT IS TRICKY BUT NOT IMPOSSIBLE.

TRANSPOSITION IS A USEFUL OPERATION IN MATRIX ALGEBRA: IN PARTICULAR FOR TRANSFORMING COORDINATES FROM ONE SET OF AXES TO ANOTHER. THE SIMPLEST EXAMPLE OF THIS IS ILLUSTRATED BELOW.





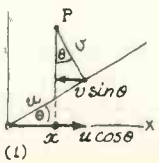
THE COORDINATES OF POINT P RELATIVE TO U & V ARE u & v RESPECTIVELY. WHAT ARE THE COORDINATES OF P RELATIVE TO AXES X & Y ?

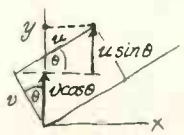
USING TRIGONOMETRY:

$$x = u\cos\theta - v\sin\theta$$
$$y = u\sin\theta + v\cos\theta$$

WHICH MAY BE WRITTEN IN MATRIX FORM AS BELOW:

$$\begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix} \begin{bmatrix} u \\ v \end{bmatrix} \quad \ldots(1)$$





ALSO USING TRIGONOMETRY IT IS JUST AS SIMPLE TO FIND A PAIR OF EQUATIONS YIELDING u AND v IN TERMS OF x AND y:

$$\begin{bmatrix} u \\ v \end{bmatrix} = \begin{bmatrix} \cos\theta & \sin\theta \\ -\sin\theta & \cos\theta \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} \quad \ldots(2)$$

NOTICE THAT EACH OF THESE SQUARE MATRICES IS THE TRANSPOSE OF THE OTHER.

IT IS GENERALLY TRUE OF ORTHOGONAL AXIS TRANSFORMATIONS THAT TO REVERSE THE TRANSFORMATION YOU SIMPLY *TRANSPOSE* THE TRANSFORMING MATRIX. IN TEXT BOOKS MATRICES ARE OFTEN INDICATED BY LETTERS IN BOLD TYPE AND TRANSPOSITION BY A *PRIME*. THE TWO EQUATIONS ABOVE MIGHT BE SHOWN AS: $\mathbf{X} = \mathbf{T}\mathbf{U}$ AND $\mathbf{U} = \mathbf{T}'\mathbf{X}$.

CHAPTER 5

MAT A = ZER

```
10  DIM  A(3,4) , B(2,3)
```

	1)	2)	3)	4)
A(1,	0	0	0	0
A(2,	0	0	0	0
A(3,	0	0	0	0

	1)	2)	3)
B(1,	1	1	1
B(2,	1	1	1

YOU MAY MAKE ALL ELEMENTS OF AN ARRAY ZERO LIKE THIS:

```
200  FOR  R = 1 TO 3
210  FOR  C = 1 TO 4
220  LET  A(R,C) = 0
230  NEXT C
240  NEXT R
```

BUT YOU COULD DO THE WHOLE THING WITH A SINGLE "MAT" INSTRUCTION LIKE THIS:

```
100  MAT  A = ZER
```

WHERE "ZER" IS SIMPLY A WORD SHORT FOR ZERO, AND LETTER A HAS NOTHING TO DO WITH THE SIMPLE VARIABLE A. THE WORD "MAT" TELLS *BASIC* YOU MEAN ARRAY A(,).

TAKE CARE WITH THIS INSTRUCTION AND WITH "CON" AND "IDN" DESCRIBED BELOW. THE ARRAY NAMED ON THE LEFT OF THE EQUALS SIGN IS ASSUMED BY SOME *BASICS* TO RETAIN ITS *CURRENT* DIMENSIONS WHICH MAY BE SMALLER THAN THOSE IN ITS "DIM" STATEMENT. SO UNLESS THIS IS THE VERY FIRST "MAT" INSTRUCTION TO BE OBEYED IT IS SAFER TO USE THE ALTERNATIVE FORM:

EXPRESSIONS ALLOWED HERE

```
110  MAT  A = ZER(2,3)
```

WHICH HAS THE EFFECT OF RE-DIMENSIONING THE ARRAY NAMED ON THE LEFT OF THE EQUALS SIGN AS WELL AS SETTING ITS ELEMENTS TO ZERO. IMPLICATIONS OF RE-DIMENSIONING ARE DISCUSSED ON PAGE 79. IF YOU DO USE EXPRESSIONS FOR DIMENSIONS, MAKE CERTAIN (PERHAPS USING "INT") THAT YOUR EXPRESSIONS YIELD INTEGRAL RESULTS. SOME *BASICS* USE THE *NEAREST* INTEGER TO THE RESULT BUT OTHERS TAKE THE *INTEGRAL PART* OF THE RESULT.

ILLUSTRATING BASIC PAGE 86

MAT A = CON

THE ONLY DIFFERENCE BETWEEN THIS INSTRUCTION AND "MAT A=ZER" IS THAT THE RESULTING ARRAY IS FULL OF 1'S RATHER THAN 0'S.

```
120   MAT  B = CON(2,3)
```

"CON" IS SHORT FOR *CONSTANT*. YOU CAN SET ALL ELEMENTS TO ANY CONSTANT IN TWO "MAT" INSTRUCTIONS.

```
130   MAT  A = CON(2,3)
140   MAT  B = (-5)*A
```

ALL ELEMENTS OF B(,) SET TO -5

MAT A = IDN

"IDN" IS SHORT FOR *IDENTITY*. (AN "IDENTITY MATRIX" IN MATRIX ALGEBRA IS ANALOGOUS TO *UNITY* IN ORDINARY ALGEBRA: THIS IS DEMONSTRATED ON PAGE 91.) THE IDENTITY MATRIX HAS 1'S ON THE *DIAGONAL* (WHERE ROW & COLUMN SUBSCRIPTS ARE EQUAL) AND 0'S *OFF THE DIAGONAL* (WHERE SUBSCRIPTS ARE *UN*EQUAL). HERE IS ONE WAY TO PROGRAM IT:

	1)	2)	3)
A(1,	1	0	0
A(2,	0	1	0
A(3,	0	0	1

```
200   FOR R = 1 TO 3
210   FOR C = 1 TO 3
220   LET A(R,C)=1-ABS(SGN(R-C))
230   NEXT C
240   NEXT R
```

BUT YOU CAN DO IT WITH A SINGLE "MAT" INSTRUCTION:

```
150   MAT  A = IDN(3,3)
```

IDENTITY MATRICES ARE ALWAYS SQUARE

YOU MAY LEAVE OFF THE DIMENSIONS AND HAVE JUST "MAT A=IDN" BUT ONLY IF THE *CURRENT* DIMENSIONS OF A(,) ARE EQUAL.

YOU MAY ALSO HAVE *EXPRESSIONS* FOR DIMENSIONS INSTEAD OF WRITTEN INTEGERS AS ABOVE. FOR EXAMPLE "MAT A=IDN(X,2*Y+3)". BUT THE RESULTS OF BOTH EXPRESSIONS MUST BE THE SAME WHEN *BASIC* EVALUATES THEM BECAUSE THERE IS NO SUCH THING AS A *NON*-SQUARE IDENTITY MATRIX. FURTHERMORE YOU SHOULD MAKE CERTAIN YOUR EXPRESSIONS CAN ONLY YIELD INTEGRAL RESULTS FOR THE REASONS GIVEN OPPOSITE.

CHAPTER 5

MAT R = A * B

HERE IS A SIMPLE ILLUSTRATION OF "MATRIX MULTIPLICATION" WITHOUT THE USE OF A "MAT" INSTRUCTION.

THERE ARE 3 SALES-PEOPLE EACH SELLING 4 PRODUCTS; THEIR WEEKLY ACHIEVEMENT IS TABULATED LIKE THIS:

SALESMAN / PERSON	PRODUCT			
	MAGLETS	SCROPERS	GIMPLES	NUCKERS
MR. HOGG	5	2	0	10
MS. BURNTBRA	3	5	2	5
M. CHAUVIN	20	0	0	0

WEEKLY SALES: FORM A(3,4)

THE LIST OF PRICES AND SALES COMMISSIONS (IN MONEY; NOT AS A PERCENTAGE) IS TABULATED LIKE THIS:

PRICE LIST: B(4,2)

PRODUCT	PRICE	COMMISSION
MAGLETS	1.50	0.20
SCROPERS	2.80	0.40
GIMPLES	5.00	1.00
NUCKERS	2.00	0.50

"INNER PRODUCTS"

SO THE MONEY BROUGHT IN IS:

MR. HOGG 5×1.50 + 2×2.80 + 0×5.00 + 10×2.00 = 33.10
MS. BURNTBRA 3×1.50 + 5×2.80 + 2×5.00 + 5×2.00 = 38.50
M. CHAUVIN 20×1.50 + 0×2.80 + 0×5.00 + 0×2.00 = 30.00

AND THE COMMISSIONS EARNED ARE:

MR. HOGG 5×0.20 + 2×0.40 + 0×1.00 + 10×0.50 = 6.80
MS. BURNTBRA 3×0.20 + 5×0.40 + 2×1.00 + 5×0.50 = 7.10
M. CHAUVIN 20×0.20 + 0×0.40 + 0×1.00 + 0×0.50 = 4.00

IF THIS WERE PUT ON THE COMPUTER THE WEEKLY SALES ACHIEVEMENT COULD BE STORED IN ARRAY A(,), THE PRICE LIST RESIDING IN ARRAY B(,), AND THE RESULTS SENT TO ARRAY R(,) PRIOR TO PRINTING. THE PROGRAM MIGHT CONTAIN THE FOLLOWING CODE:

```
10  DIM A(3,4), B(4,2), R(3,2)
20  MAT R=ZER(3,2)

200 FOR I = 1 TO 2
210 FOR J = 1 TO 3
220 FOR K = 1 TO 4
230 LET R(J,I)=R(J,I)+A(J,K)*B(K,I)
240 NEXT K
250 NEXT J
260 NEXT I
```

COLUMNS OF B(,) = COLUMNS OF R(,)
ROWS OF A(,)
COLUMNS OF A(,) = ROWS OF B(,)

THE SAME RESULTS

	1)	2)
R(1,	33.1	6.8
R(2,	38.5	7.1
R(3,	30	4

THE COLUMNS OF R(,) WOULD THEN CONTAIN THE "LONG-HAND" RESULTS ABOVE.

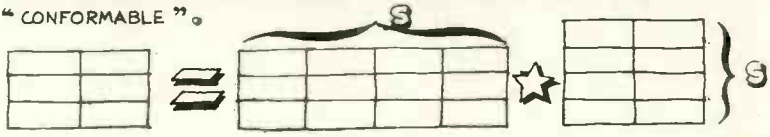
ILLUSTRATING BASIC PAGE 88

THE CODE FROM LINE 200 TO 260 COULD BE REPLACED BY THE SINGLE "MAT" INSTRUCTION:

```
100    MAT  R = A * B
```

THE ROWS OF A(,) ARE CUMULATIVELY MULTIPLIED BY THE COLUMNS OF B(,). WHAT GOES INTO R(r,c)? ANSWER: THE INNER PRODUCT OF THE r^{th} ROW OF A(,) AND THE c^{th} COLUMN OF B(,).

FOR THIS "MAT" INSTRUCTION TO WORK AT ALL IT IS IMPERATIVE FOR ARRAYS TO HAVE CURRENT DIMENSIONS MAKING THEM "CONFORMABLE".



$$R(r,c) = A(r,s) \star B(s,c)$$

Nº OF ROWS IN RESULT — SAME "INSIDE" DIMENSION — Nº OF COLUMNS IN RESULT

IN THE EXAMPLE OPPOSITE A(,) HAS DIMENSIONS (3,4) AND B(,) HAS DIMENSIONS (4,2), SO THE "4" ON THE "INSIDE" MAKES A(,) & B(,) CONFORMABLE. BUT IT WOULD BE TOTALLY WRONG TO HAVE:

```
110    MAT  R = B * A
```

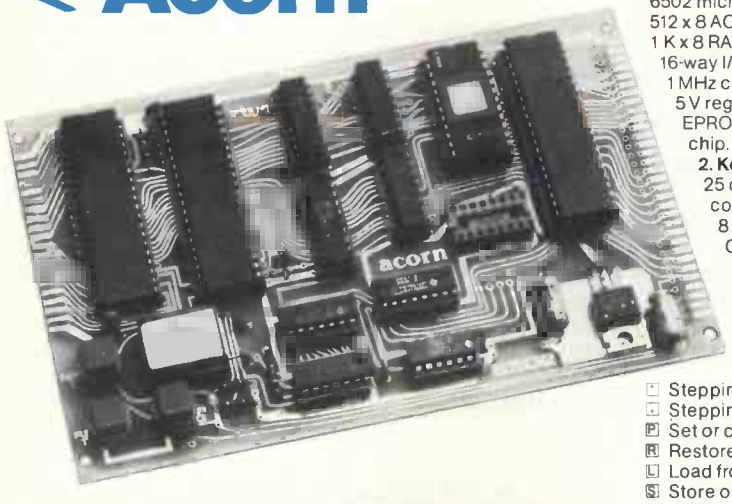
IN ORDINARY ALGEBRA $a \times b = b \times a$ MULTIPLICATION IS "COMMUTATIVE" BUT IN MATRIX ALGEBRA $b \times a$ MAY NOT EVEN *EXIST*. IN THIS EXAMPLE LINE 110 IS COMPLETE NONSENSE.

PROVIDED THAT A(,) & B(,) *ARE* CONFORMABLE, ARRAY R(,) IS RE-DIMENSIONED TO HAVE AS MANY ROWS AS THE CURRENT *FIRST* DIMENSION OF A(,) AND AS MANY COLUMNS AS THE CURRENT *SECOND* DIMENSION OF B(,). IF THESE DIMENSIONS EXCEED THOSE IN THE "DIM" STATEMENT FOR R(,) THEN *BASIC* REPORTS AN ERROR AND STOPS WORK. OTHER IMPLICATIONS OF RE-DIMENSIONING ARE DISCUSSED ON PAGE 79.

YOU ARE NOT ALLOWED TO VARY THE SIMPLE FORM OF THIS INSTRUCTION AND YOU MAY NOT NAME THE SAME ARRAY ON BOTH SIDES OF THE EQUALS SIGN.

```
120    MAT  P = A * P
```

Introducing Acorn



A professional MPU card

Designed as a general purpose industrial controller based on the 6502 MPU, this card is complemented by a matching Eurocard hex keyboard and CUTS standard cassette interface, to create the new. . .

Acorn Microcomputer

This compact stand-alone micro-computer is based on standard Eurocard modules, and employs the highly popular 6502 MPU (as used in APPLE, PET, KIM, etc). Throughout, the design philosophy has been to provide full expandability, versatility and economy. Take a look at the full specification, and see how Acorn meets your requirements

Acorn technical specification

The Acorn consists of two single Eurocards:

1. MPU card
6502 microprocessor
512 x 8 ACORN monitor
1 K x 8 RAM
16-way I/O with 128 bytes of RAM
1 MHz crystal
5 V regulator, sockets for 2 K EPROM and second RAM I/O chip.

2. Keyboard card
25 click-keys (16 hex, 9 control)
8 digit, 7 segment display
CUTS standard crystal controlled tape interface circuitry

Keyboard Instructions:
M Memory Inspect/ Change (remembers last address used)
↑ Stepping up through memory
↓ Stepping down through memory
P Set or clear break point
R Restore from break
L Load from tape
S Store on tape
G Go (recalls last address used)
RST Reset

Compact, easy to use Acorn Monitor includes the following features:

- System program
- Set of sub-routines for use in programming
- Powerful de-bugging facility displays all internal registers
- Tape load and store routines

Acorn – with real expandability!

The standard Acorn is fully expandable to 65 K of memory, and the Acorn bus is available on the 64-way edge-connector. Whether you're a beginner in the field, an ambitious home computer buff, a development engineer, a teacher or a businessman, the Acorn and its family of modules will provide a practical solution in virtually every situation.

Future expansion for Acorn includes the following software and hardware.

Software
Basic Interpreter, assembler, dis-assembler, editor, TTY and disk operating system.

Hardware
Memory-mapped VDU system (with upper and lower case ascii graphics and hardware scroll) floppy disk controller for 5¼ in and 7 in disks, a memory card with 8 K bytes of static RAM (2114) and 4 K bytes of EPROM (2716) a PROM programmer (for all types of PROM usable on ACORN a full ascii keyboard, a backboard for the ACORN bus, and a Eurocard racking system.

Acorn Operating Manual

With Acorn, you'll receive an operating manual that covers computing in full, from first principles of binary arithmetic, to efficient hex programming with the 6502 instruction set. The manual also includes a listing of the monitor programs and the instruction set, and other useful tabulations; plus a selection of 12 interesting and educative program samples.

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Cambridge (0223) 312772.

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☐ (qty) Acorn Microcomputer(s) (Acorn MPU card with 1 K RAM and keyboard card with cassette interface, in kit form, with assembly instructions) at £65.00 plus £5.20 VAT

☐ (qty) Acorn Microcomputer(s), as above, assembled and tested at £75.00 plus £6.00 VAT

☐ (qty) Acorn controller(s) (minimum configuration MPU board with 6502, RAM I/O, TTL logic and capacitor-controlled clock at £35.00 plus £2.80 VAT

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I enclose a cheque for £..... (indicate total amount) made out to Acorn Computers Ltd.

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☐ Please send me further details of this and other Acorn options

Name_____

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● Circle No. 170

Another runner from the Nelson stable

The Home Computer Revolution

by Ted Nelson (published by the author; distributed in the U.K. by The Computer Bookshop; paperback, 224 pages; £2·75).

WHEN the history of home computing is written, Ted Nelson will probably receive more than a passing reference. He was responsible for an early and highly-effective piece of propaganda called *Computer Lib/Dream Machine*—it's a tabloid publication which you start reading as *Computer Lib* but turn it round and you have a complementary but different book called *Dream Machine*.

It is impossible to review that but try showing it to unconvinced guests/lovers/parents/teachers and it is sure to elicit at least some reaction. Nelson is more style than content, though, and this review of his second much more conventional book will give some idea of what he is like.

Evangelist

We invited an anglicised American to read it. His immediate reaction was to recall his youth in the States—specifically the 'religious evangelism' phenomenon there—with men and women proclaiming Jesus as their saviour and their key to heavenly happiness in mass meetings called revivals.

Have we telegraphed too soon his impression of this book? Correction—it's not a book, it's a tract.

Nelson publishes his own books and this one looks professional enough. He declares that he is "thought by some to be a spokesman for the coming social revolution of home computers and computer graphics".

He is a man of very strong opinions. They are exciting opinions, expressing his impassioned beliefs in the microcomputer, the personal computer, the home computer—he calls them "dinky computers" but we can't all be perfect. If he talks the way he writes, and the style indicates that he does, he must be very uncomfortable, or invigorating, to have around.

He writes exclusively about the U.S. market—the biggest, most dynamic, most creative, most consumer-orientated in the world, all of which is true. He says it will absorb 10 million of these 'all-purpose machines' by 1980—from 50,000 in 1977; an interesting prediction.

He says that pent-up demand, suppressed maliciously or unintentionally by major manufacturers, will account for this. His comments about IBM particularly are especially vitrolic.

What does Nelson see as the uses now of very small computers?

- Animated cartoons and pictorial games.
- Sending letters (via screens or cassettes).
- Automatic telephone dial-up (or stacking incoming or outgoing calls).
- Audio control of the household sound system.
- Household control of appliances.
- Personal planning, (daily, weekly, monthly schedules, menus).
- Speech recognition.
- Music synthesis.

And what about the next five years?

- Computers in your pocket.
- The games get 'serious' (his heading).
- Creative facilities and alternative choices.
- Control of audio and visual equipment in your home.
- Photography, automotive use, home heating.
- Electronic mail.
- Magic environments (his heading again).

Spot the applications which are not self-indulgent. This is a social revolution? An introspective and introverted personality would become even more so in Nelson's new world. How does the personal computer bring people closer together, understand one another's problems, make the world a true global village?

Fireworks

The unstated theme running through the book is the avoidance of people and how to keep them at a distance, preferably at the other end of a wire, fibre optic strand or laser beam.

That is not to say that his predictions will be wrong but it would be sad if most of them are correct, or if there are no other developments or implications. His ideas are fireworks, his enthusiasm is infectious but his emphasis is misplaced.

Conclusion

- **In spite of our reservations about the opinions expressed in this book, its sheer pyrotechnic vitality forces us to recommend it. Beware of the revivalist meeting tone, though.**

Small Systems Computer Sourcebook

edited by J. C. Boonham (Rococo Press, 1978; 148 pages; A4 softback; £6·50).

WITH a never-ending stream of microprocessor products coming to the market, it is time a reference book should attempt to extract order out of chaos. The *Sourcebook* aims to do that—and it's British.

It is edited—and the word deserves the stress—and it consists of a thick sandwich of manufacturers' technical data between an introduction to microcomputer technology, and a few thoughts on them and a glossary of terms.

It also has ambition to spare. "Every effort has been made to introduce newcomers to computing to the essential elements and special terminology of the subject. . . will save hours of searching for all those involved or wishing to become involved with mini (or micro) computers."

The book is beautifully and professionally produced, which makes a pleasant change from many micro-biased publications. It is organised, sensibly, into hardware and software; there are attempts to categorise hardware into microprocessors, microcomputers, evaluation and development kits, peripherals and bulk storage devices.

Distinctions

The software breakdown is also reasonable and distinguishes operating systems, editors and utility programs, assemblers, high-level languages, and (most essential) games.

Despite an abundance of indices our reviewer found information extremely hard to find. The presentation is disappointing and the difference between American creativeness, if a little too brash sometimes, and British enthusiasm is highlighted clearly by the overwhelming small black print.

Information, too, varies between adequate and almost non-existent. One supposes that this is not the editor's fault—more a reflection on the manufacturers' literature.

Another major failing is the almost total lack of costings, apart from a section on the cost aspects of both hardware and software, which is much too general. It is a fast-moving business, of course, and costs change quickly, but the introduction claims that the section on cost aspects "presents a very good guide to current prices"; we think it doesn't.

Staggering range

The editor could easily have divided the various products into expense categories, as with food guides. At the moment one could be forgiven for thinking an Apple costs the same as a PDP-11/03.

The complete lack of criticism limits the potential market of the book to those who are reasonably familiar with a number of microcomputer systems.

All of that, though, is subsidiary to a consideration of what information is in the book. For a start, there are summaries of 200 hardware items—minicomputers, home computers, microcomputers,

add-on boards for memory and peripheral control, microprocessor development systems. The range is staggering, from a reasonably big mini like the Honeywell Level 6/43 at one end to Ohio Scientific EPROMs at the other.

Along the way there is a plethora of names and products of which you will not have heard. On the other hand, you will look in vain for Tandy TRS-80 or the Commodore Pet—absolutely baffling omissions, we thought.

The section on software is more impressive, not so much in terms of its scope—the games section is slim to the point of emaciation, since Pet and TRS-80 are excluded—but more as an unusually concise summary of what software there is.

Conclusion

● **If you need to reference individual products, the** *Sourcebook* **is a fine summary. It is well-printed but poorly-presented, and in no way is it for the novice.**

An Introduction to Personal and Business Computing

by Rodnay Zaks (published by Sybex, 1978; paperback, 242 pages; £5·75).*

IT WAS NOT always the case but there are now many books in the microcomputer field, and naturally they all claim to be the best of their kind.

Sadly it is sometimes difficult to ascertain exactly what kind that is. Most of the books do not make it clear at whom they are aimed, and some imply they are aimed at one section of the market and are, in fact, aimed at a totally different one.

Books on microcomputers almost invariably claim they are aimed at the hobby market but most are far too detailed for that.

There is considerable scope for a definite introduction to small computers, and *Practical Computing* has reviewers beavering away all over the country on various candidates.

Rodnay Zaks ought to be a good contender. He is a personable, youngish Frenchman who lives in Paris and California, knows the denizens of Semiconductor Valley intimately, has designed microprocessors and complete systems, and now runs a publishing and lecturing outfit, Sybex.

He also writes many of the books Sybex publishes, and all-in-all that puts him on the crest of the microroller.

Little omitted

His latest offering is refreshingly clear, too. It is larded with helpful photographs and diagrams which give the reader a good feel for the subject. For a change it errs towards the simplistic rather than the esoteric and to our eyes it omits little as an introduction to personal and business computing.

We have some reservations, though. First, there are some typographical errors which not only are irritating but in some cases make the text incomprehensible.

For example, in discussing check digits, it has 'N²' printed where it should have 'N' and that makes the remainder of the paragraph almost impossible to understand.

Further, a number of terms are used which are not explained—"fusible link technology" receives our award for brain-numbing phrase of the year.

Preferences

One of the reviewers also objected to some of the personal preferences on view. For example, "One says nibble for four bits"; this reviewer does not, but not everyone who read the book for us agrees.

After all, why shouldn't one say 'nibble' for four bits? Who needs to use a term meaning four bits anyhow? And who decides the standards? If the micro world wants to call four bits a nibble, why shouldn't it?

The only other real criticism is that the book is aimed specifically at the American market. Not only is it biased towards American systems, many of which are not available in the U.K., but also all the prices are given in dollars.

That is not merely a parochial objection, as anyone who has tried to convert the U.S. price of a Pet into sterling has discovered.

The economics of personal computing are very different in the States, and that fact can affect many of the conclusions Zaks makes. There is still a need for a British introduction, looking at things from the relatively-expensive and still embryonic state of the U.K. end of personal computing.

That aside, we think it is a fine book. Its structure is particularly good. The chapters lead the reader by the hand through a fictitious computer-based society at home and at work—"all of the facilities described can be implemented technically today"—into a hands-on first-taste of using a Tandy-like home computer; past some blessedly short chapters on technology, how micros work, and the essentials of programming.

Conclusion

● **This is a good book, recommended as a basic introduction. Not quite as soft perhaps as James White's elegant** *Your Home Computer*. **Buy both, if you can afford them, if you're just getting started.**

* *The book is available widely from specialist bookshops. This is the price from The Computer Bookshop but we have seen it occasionally for 50p less.*

The BASIC Handbook

by David A. Lien (published by Compusoft Inc, 1978; 360 pages; $14·95).

DAVID LIEN is a lecturer and technical writer; among other things his credits include one of the *Users' Manuals* for the Tandy TRS-80, a fine low-level introduction to this Basic-based microcomputer.

The BASIC Handbook is a good idea. Subtitled 'an encyclopaedia of the Basic language', the book covers every commonly-used Basic statement, function, operator and command. Each has a page to itself and the book is arranged alphabetically.

So it starts with 'A'—"used in the TRS-80 Level 1 and other variations of Palo Alto Tiny Basic as an abbreviation for the ABS function"—and it ends with 'WAIT', "used in some computers to suspend program execution for a specified time".

That's not all, of course. For each entry there is a description telling you what it is, what it does, and whether it is specific to only a few computers. Then there's a short test program and sample run, so that you can check whether your computer recognises this word; if there are any programming limits about crafty use of the word they are also given.

Clear and precise

Lien's aim was to provide a book to let you run practically any Basic program on practically any popular computer, or at least to tell you why the program won't run. As the introduction says, "top priority will be given to that information which will help users solve this incompatibility problem".

In general, the handbook is highly successful. Some of the programs we have been sent by readers wouldn't run when we keyed them into our own PDP-11; the handbook helped us determine why, and in most cases showed an alternative route to the programmer's intended result. The explanations and the layout are both clear and precise; it's a book that is easy to use.

Lien covers "all or nearly all of the functions" in 50 Basic dialects. In addition, the book includes some of the characteristics of 24 other Basics. There is only one significant quibble about this stunningly comprehensive list—the Digital Equipment Basic and Basic-Plus are omitted, even though Basic-Plus-2 is in the second group of partially-covered implementations. The PDP-11 and the RSTS operating system are used widely; these Basics, which run under RSTS, are also very popular.

We also encountered a handful of Basic words for which the explanations could be fuller and we've sent Compusoft our notes—with the book you get a comment form to return. We could not find any omissions, though.

Conclusion

● **A good and wide-ranging supplement to Basic texts. Recommended. You might have to write to the States for it—the address is PO Box 19669, San Diego, CA 92119—though a U.K. distributor is being signed.**

Winner's effort is impressive

CHOOSING the winners of the *Practical Computing* Christmas competition was no easy task for the judges. With prizes worth more than £5,000 at stake, there was a large entry. Almost 200 valid projects had to be examined.

The judging was done in three parts. First, the editorial staff read all the entries and created shortlists for each of the three categories—education, business, and domestic.

That reduced the list to some 24 projects in each group, and they were re-evaluated to produce the nine finalists—three in each of the categories.

Those nine were invited to prepare system flowcharts. The final selection was made by Dennis Jarrett, managing editor, working with Brian Collier of Dicoll, the principal prize contributor and the man whose company will be putting together the top prize, the LSI-11 system.

Each of the finalists was assessed by four criteria:

- Originality: we were interested in imaginative projects showing originality either in the application to be handled or the way the problem was solved, and preferably both.
- Credibility: some entries were simply implausible. Note that we made a distinction between credibility and practicality; some perfectly sound, believable applications were tackled in a totally unrealistic way.
- Clarity: a significant and usually under-rated aspect of putting together computer systems is the fact that the computerisation will have to be explained to someone. In this case, of course, it had to be explained to us, and we marked down entries on which we had to work for comprehension.
- Practicality: this was the hurdle at which most entrants fell badly. All the winners and runners-up have ideas which in our opinion could be put on a small computer without too much difficulty.

Business

Mike Stanley of Wrexham wins the top prize for his MONITOR system. MONITOR is one of the most convoluted acronyms we have met. It stands for Multi ONgoing Information Technique for Online Retrieval. We did not allow that to effect our assessment of this carefully-thought-out application of computers to the taxi business.

Mike works in a private hire firm and his system is a set of modules to look after the organisation, operation and accounting of the firm on an interactive basis.

It is a good application for a small computer. It was presented impressively on the flowcharts, it makes excellent use of the computer, and, above all, it looks as though it will work, and work well.

The runners-up are **G Bligh,** Portland, Dorset and **David Green** from Basildon, Essex. Bligh had a very topical application—searching for and controlling oil slicks. From his work with H M Coastguard, he was able to advocate a case for the use of small computers at local coastguard stations to calculate the search area for marine casualties and oil pollution, and to assess subsequently the best course of action to deal with slicks.

Green proposed the use of a microcomputer to facilitate some of the calculation and management tasks which have to be performed on cargo ship by the officers who run it.

Since the use of on-board computers has so far been restricted largely to navigational aids, we found his ideas for calculating cargo loading and weight distribution an intensely practical use for a low-cost computer.

Other applications he would computerise include propellor efficiency—the most efficient trim to obtain the maximum thrust; real distance calculations, perhaps with accurate ETA; sightings; and perhaps some simple local weather forecasting.

Education

This category covered systems for education—for computer-assisted learning and for computer-aided school management. We did not place entries from schools automatically into this group. Some entries in it were not from schools, and many entries from schools figured in the two other categories.

The winner was **J R Ennals,** head of history at Sweyne School, Rayleigh, Essex. His project is computer simulation of historical situations for teaching purposes, a project apparently well-advanced at the school. We were impressed because of the thought which had gone into the project; not the least of its spin-offs are some interesting thoughts about the relationship between game-playing, logic and language structure.

Ennals sent details of four interesting games, covering the Norman Conquest, Russian Revolution, Wedgwood Potteries, and a simulation of the Voyages of Discovery in the 15th and 16th centuries.

Mary Russell of Kingston-upon-Hull was only just beaten by the Ennals entry. Mary was not 15 years old when she put together her proposal for the use of computers in remedial education, and the way she had approached the problems belied her youth and inexperience.

She appreciated the potential for instant response by the computer, seeing it providing quick and positive feedback in a situation where learning and teaching are both difficult. Vocabularly, grammar and arithmetic are three highly-amenable areas Mary listed for computerisation.

The other runner-up was **Elizabeth Moore,** of Theale, Berkshire. Believing that the most important years of the life of a developing child are between birth and the age of six, she sought uses for a small computer in the nursery and infants' schools.

The aim is to monitor the progress of each child, relating it to past experience and then designing further learning experiences in the future. Elizabeth characterised this as 'computer-assisted management of learning' and we think it could work to a child's benefit.

Domestic

We were seeking uses for computers in the home but we widened the term 'domestic' to include some systems clearly nothing to do with business or education.

Our winner falls into that class. **Janet Hill** submitted it on behalf of a group of sixth-form pupils at Stratford-on-Avon Grammar School for Girls. With another school in Stratford, they surveyed the facilities available locally for the disabled.

The entry was a proposal to computerise the information, using it as an instantly-available electronic directory.

Janet emphasises the speed of access to information and the ease of updating, two factors we also regard as important for this socially-valuable computer application. As for the practicality of it, the system would be maintained and operated by the school team with enquiries received by telephone.

Claire Gaeth lives only two miles away from our office in north London. Her entry offers diet management for diabetics. Balancing food values can be a complex problem, since an excess of blood sugar can be very serious for a sufferer.

Claire is diabetic and so knows the difficulty. Her entry was probably the best-presented entry on the shortlist and her flowcharts were almost detailed enough to allow coding to start instantly.

The entry from **Nigel Greenwood** of Heckmondwike, Yorkshire represents a complete contrast, though it was also presented beautifully and the clarity of the exposition does him great credit.

His system is an integrated domestic computer organised to look after most of the paperwork of the home—everything from address book to household bills—while at the same providing some sensible central functions, like a clock with displays around the house as required, and, of course, TV games.

This was one of many entries on this subject. We chose Nigel's for the shortlist because it was tackled so comprehensively and so well documented.

1979 MICRO-COMPUTER SHOW

INCORPORATING THE DIY COMPUTER FAIR

Bloomsbury Centre Hotel, London, 5-7 July

In addition to the Exhibition, which will display a wide range of the latest microcomputer products, there will be three one-day seminars. Brief details are as follows:

Thursday 5 July.
Microprocessors in light industry.

Basic information for the businessman, who is contemplating the use of micros to improve productivity and his product.

Friday 6 July.
Personal Computers in Business.

How a small business can be administered more efficiently and profitably by the use of personal computers.

Saturday 7 July.
Do-it-yourself Computers.

For the Home Computer enthusiast and hobbyist. Presentations given at this seminar are likely to be of a more technical nature than the previous two days.

Speakers will include:

Portia Isaacson (USA), Adam Osborne (USA), Howard Kornstein (Intel), Keith Baker (University of Sussex), John Coll (Oundle School), Mike Gurr (BOC), Guy Kewney (Computing), Clive Loveluck (Ulster Management Centre), Barry Standring (Intext).

Seminar registrations may be made for one, two or all three days.
Please note that all exhibition stands have now been sold.

Admission to the Exhibition will be by ticket only – £1 each.

On Saturday, the DIY Computer Fair day, children under 14 will be admitted for 50p each. Seminar participants will be given a complimentary exhibition ticket. A special offer of 3 tickets for £2 is available on tickets purchased in advance. All ticket requests (3 or more) *must* be accompanied by a stamped addressed envelope.

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● **Circle No. 171**

Program of the Year Award

Practical Computing welcomes you to its first Program of the Year Award, in which you have a chance to write a program and make some money in the process.

Awards

Two classes of awards will be given:

- A Grand Prize—to the best overall entry.
- A first prize in each of the five categories listed below, plus on extra prize awarded to the best entrant under 18 on June 15, 1979.

The *Grand Prize* winner will receive *The Practical Computing Program of the Year Challenge Cup* and a cheque for £100.

First Prize winners will receive the *Category Winners' Cup* and a cheque for £50.

First Prizes will be awarded for the following categories:

1. Business and administration
2. Sciences and mathematics
3. Computer Art
4. Games and simulations
5. Education projects

In all there will be seven winners—the Grand Prize and the Best Under-18 Entry plus the five First Prizes.

What you have to do

The judges are looking for good programming projects. By this we mean a program (or groups of programs) characterised by:

- an imaginative and/or useful *application*—we do not want elegantly-coded programs which do nothing
- full *documentation*—we need some evidence of a thoroughly thought-out approach.

How to enter

A project may be submitted by an individual or a team and any number of entries may be submitted, provided each conforms to the rules and provided each includes the following:

- a completed *entry coupon.*
- A complete *description* of the program, which must conform to the *Guidelines for Documentation. You must keep one copy for yourself, as no entries can be returned.*
- The program must have been tested thoroughly and run successfully on a computer, and entries should be accompanied by a listing of the program and samples of the output produced.

Guidelines for Documentation

The documentation must be good enough to allow someone else to use the program easily; as well as being complete and comprehensive, it must also be readable, preferably typed.

The program description must be organised as follows:

Cover page

Program title, entrant's name and address.

Single-page summary

Program title, category, the computer and programming language used, the configuration needed to run the program (how much memory is necessary, types of input/output needed, auxiliary storage requirements), and an outline of the purpose or objectives of the program, the problem it solves, and its restrictions or limitations. Include any features which distinguish this program from others of the same type.

Statement of the problem

This section states what the problem is, though not HOW you solve it, which follows on your next page.

Program description

This is a statement of how the problem was solved, what methods you used, the number of instructions involved, and the time required to run the program on your computer. You should include a flowchart using standard flowcharting symbols and techniques.

Input/Output

Sample input formats and fully-documented output samples for the reports produced should be included.

Operation

This section covers the operation of your program. If it requires any user intervention during the run, or any special preparation before it, this should be noted here; your file formats, if you use them, should also be included.

Appendices

We must have a listing of the source program, sample input/output forms, and the results of several runs which show the features of your program. Please do *not* send punched cards, floppy discs, or paper tape.

All documentation and supporting data of your project should be bound—for example in a cardboard folder or ring binder. Please remember that we consider the documentation of projects to be as important as the development and debugging of the program.

All entries become the property of *Practical Computing* and cannot be returned. World rights transfer to *Practical Computing*. Royalties will, of course, be paid if the programs are marketed subsequently, subject to agreement with the authors.

All projects will remain confidential until the end of the competition. The winners will be published in the September issue of *Practical Computing*. The judges' decision is final and no correspondence will be entered into.

All entries must be received by Friday, June 15, 1979.

Competition entry coupon

Name .....

Address .....

Date of birth (if under 18) .....

Project category(ies) .....

All entries must be accompanied by this coupon.

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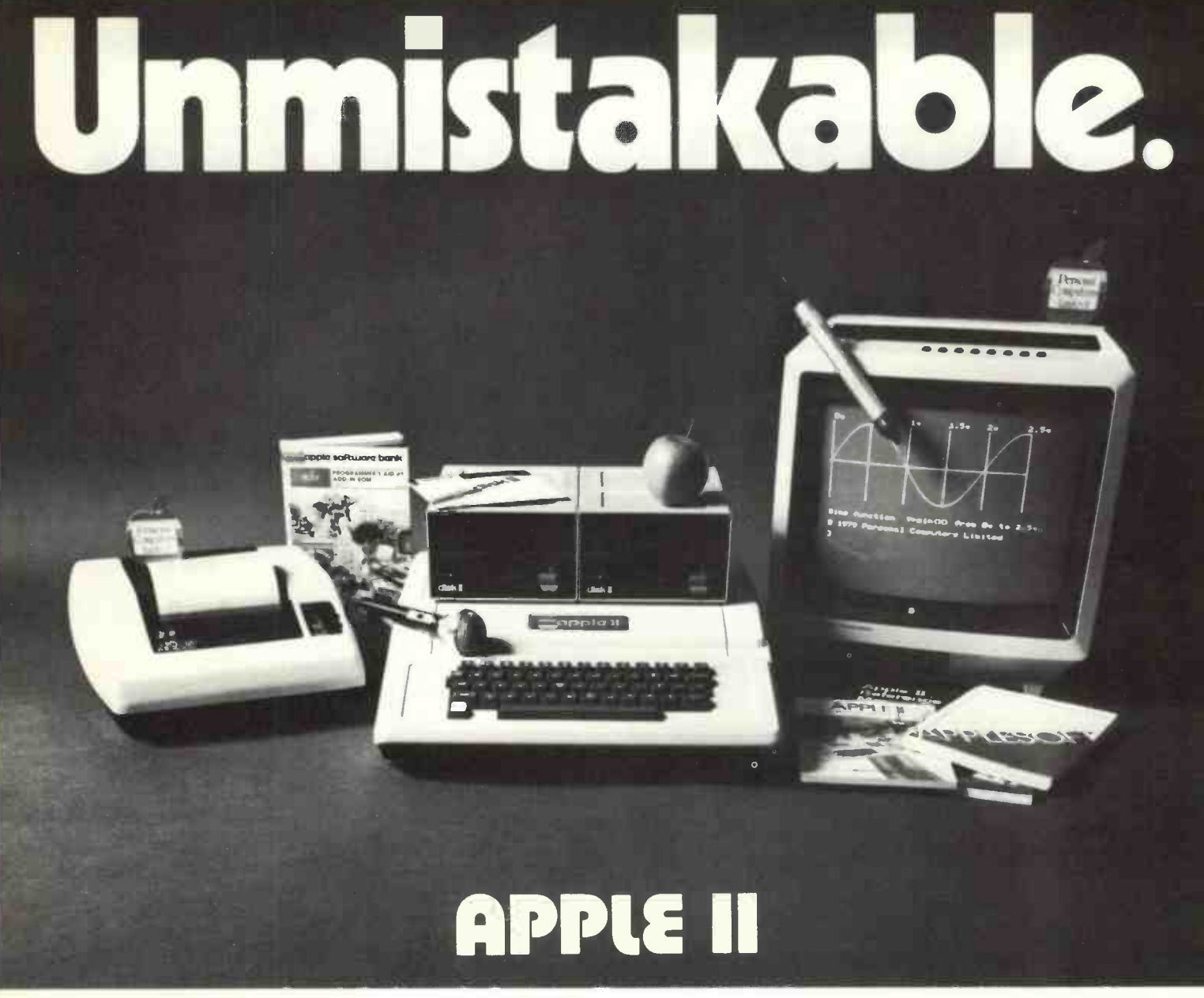
Unmistakable.



APPLE II

Try a comparison test.
Look at the features of Apple II. It still has 8 I/O ports, high and low resolution graphics, a mini assembler, A/D paddles, fantastic Basic, Disks and the best documentation in the business.

Intelligent interface cards.
They're neat. The high speed serial card, printer card and communication card all have elegant documentation. There is also easy-to-use software that mean taking B.C.D. from instrumentation, connecting your favourite printer or talking to a time-sharing computer, is childs play. Apple makes things easy.

Plus:

* Say hello to Apple and let Apple talk back. Explore voice recognition, computer voice recognition and computer voice production. You can now have large vocabularies.
* Perhaps you'd like to be reminded that it is a special day or would like to chase overdue accounts. Apple clock card is simply the best. It is the most advanced on any personal computer.
* Draw graphics with the light pen.
* Make chips for your own software with the Eprom burner. Apple naturally has spare sockets for this.
* Make interfaces with the prototyping boards.
* Use Apple's incredible 'programmers aid' hardware option. More thought and care from Apple for you to use.

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Robin Woods, Isher-Woods, Luton. Tel. 0582 424851
Tom Piercy, Topmark Computers, Huntingdon. Tel. 0480 212563
Steve Cooper, Creative Vision, Leeds. Tel. 0532 458444
John Page, P.I.P.S. Computer Services, Newcastle. Tel. 0632-482 359
Alan Wood, Apple Corner, London. Tel. 01-580 5304

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● Circle No. 174

New pattern for learning

THE EXPLOSIVE GROWTH of the use of the microprocessor in industry, with automation of many processes now done partly or wholly by hand, will have a great influence in the qualities required of people working with automated systems.

Many traditional skills will be supplanted—others will be required. As a result we must re-think radically how we educate children, especially those not destined for higher education; equally important, we will have to consider how we should re-train our existing workforce.

There will be a steady rise in numbers of 18-year-old students over the next four years, up to a peak of around 950,000. There will then follow a rapid decline to approximately 600,000 by the early 1990s, a decrease already being anticipated in primary schools.

There is, however, more to these statistics. It would appear that the fall in birthrate is concentrated in those areas of the population involved in unskilled or semi-skilled jobs; there is no equivalent drop among professional families.

The inference is a severe drop in the large working-class family and, bearing in mind an approximate correlation in the jobs of parents and children, this should manifest in the early 1990s as a sharp drop in unskilled school leavers aged 16 and over, with little or no drop among those aspiring to higher education.

Acute problems

Over the next decade, however, there will be acute problems. Many school leavers at 16-plus are unable to find jobs now and the situation will worsen over the next few years, with school-leavers representing a larger and larger proportion of unemployed.

Britain supposedly has a complete educational system in that for any industrial or scientific activity of the nation we can point to a sector of the system which provides the appropriate expertise. Unfortunately, some activities are catered for far better than others.

Consider one example where the system works well—medicine. The student takes O and A levels at school, followed by a degree at university and a period in a teaching hospital.

In the case of a professional engineer, the training at school and university is equivalent to that of the doctor, but frequently the industrial training (post-degree) is neglected or even omitted. The system works well, up to a point, and then fails.

Finally, take the case of those not destined for higher education, people who leave school after O levels or CSE. Those aspiring skilled craftsmen receive the worst possible deal from our educational systems; their examination subjects are far removed from the skills required to achieve professional competence.

At A level, physics is a deep and difficult subject, opening exciting vistas

by Bob Cooke

into the fundamental nature of matter. For the non-specialist, however, courses tend to be watered-down versions of what is, in essence, a vocational subject. This is broadly true of any non-vocational version of vocational subjects taught at school to non-specialists.

Re-training

Industrialists have bemoaned the lack of 'practical' career-orientated courses in schools. Yet in the present economic climate it is almost impossible to finance this type of education, which, by its very nature, must be 'equipment-orientated' and therefore capital-intensive.

Perhaps some way could be found to persuade local business groups, chambers of commerce, educational foundations and the like to back such schemes.

An aspect of education often overlooked is re-training during a person's working life. Lip-service is paid to it but almost nothing is done and very little money is available. It could be that the strength and efficiency of middle management in France and Germany is a tribute to the fact that those countries pay a great deal more heed to the need for re-training.

Automation on a large scale is inevitable, as was the Industrial Revolution, and future historians will no doubt take the same view. Massive investment in automation is necessary if our industry is to be competitive; it is also desirable from a social point of view because many repetitive and tedious jobs are ideal candidates for automation.

The frequently-held views that automation is (a) complicated, and therefore (b) expensive, leading to (c) unreliability, are no longer valid; especially with the advent of the microprocessor, cheap and reliable automatic control is now within the grasp even of small companies.

There are those in industry who are concerned that widespread use of automatic processes will lead to greater unemployment. Clive Jenkins has estimated that by 1990 approximately one million clerical workers will have lost their jobs because of micro-based word processing.

Other areas Jenkins regards as susceptible include printing, manufacturing and retailing. Banking and insurance would need only 60 percent of the present workforce by 1990, and the motor industry would also be effected seriously.

Jenkins has some suggestions to combat some of this unemployment, particularly by an increase in the staffing of service industries like the National Health Service, and split-shift working with increased leisure time and more adult education.

It is interesting to note that by 1990 we will be in a period of sharp population decline as far as 16- to 18-year-olds are concerned. By comparison with the mid-'70s, a higher proportion will be academically able, so fewer will be available for unskilled work.

Progressive

The ideal scenario has planned automation introduced progressively to compensate for the lack of unskilled labour. At the same time, increased productivity will create more wealth to re-train skilled workers to handle automated machines.

At present, the Government takes the view that the threat to employment from applications of microprocessors is by no means certain, and failure to apply the micro will inevitably lead to loss of jobs. It argues that if we do not implement the new technology with sufficient speed, our international competitors will damage the economy of the U.K. seriously.

As cheaper and more easily-serviced automatic systems are introduced, the steady increase in wealth which should result will increase the supply of specific types of specific jobs—skilled workers to attend to automatic machines, highly-skilled workers to make them, software professionals to program them to function efficiently and to make them as versatile as possible.

How can the schools prepare pupils of all abilities for the age of the micro? What can be done to prepare those whose jobs will be in jeopardy?

The first steps must introduce pupils to microprocessor design applications, and at all levels of complexity, bringing together some subjects which may already be taught, such as computer studies and electronics.

Unfortunately, such subjects are taught

(continued on next page)

Dr. Bob Cooke is a teacher in Advanced Physics at Newfield School, Sheffield. He is concerned about the lack of public awareness regarding the microprocessor revolution. He is the owner of a Nascom-1 and an avid computer hobbyist. He has written one other paper on the impact of microprocessors in remedial education. The paper printed here is entitled *The Education Implications of the Microprocessor*.

(continued from previous page)

by different departments—computer studies by a science or maths department and electronics under the auspices of craft or science. Both subjects should reasonably be brought together under a new department—of technology—which could offer other subjects more in keeping with industry demands.

It would have benefits at all levels, from an introduction to automated processes for the potential skilled worker to writing complex programs for the more academic student. The stress on applications would be welcomed by industry if we are to believe Sir Monty Finneston's Committee of Enquiry into the Engineering Profession.

How can we prepare these people who will lose their jobs as a result of microprocessor application? A society which employs automatic processes to the best economic effect inevitably will need fewer people per machine; but with a growing economy which should result from automation, more machines will be required.

Such people will also require re-training to a more skilled level. A machine-tool operator may be replaced by a tape-controlled machine but those in charge of it must be fully-acquainted with its operation; and the associated software will require systematic maintenance by trained professionals.

On a more academic level, for Britain to attain a prosperous position, we will have to train designers of automatic machinery and automated factories.

New areas

To summarise, there is a strong argument for the formation, in schools, of automonous technology departments. Their functions would be to provide a series of studies including computers and programming, control systems, automatic control and electronics; the courses would be available at all levels to cover the eventual operator of automatic machine tools, as well as the system designer.

The examining boards, who are usually very slow to change, must also be made aware of new subject areas—O and A levels in Control and Automation?

The new departments will be funded directly by local authorities or by donations from foundations or industry. Perhaps the established arts and humanities departments should have reduced budgets, so that a strong unified approach to microprocessor technology may begin.

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Ordering and invoicing

FOLLOWING the last two months' surveys of stock control and accounting software and systems, this month we look at order processing and invoicing.

In most companies those functions are inseparable from the sales ledger (accounts receivable) and stock control functions. It's easy to see why. An order is having your customer ask for some goods and services for which he will pay you some money—or an equivalent in service.

In most cash/goods-across-the-counter transactions, you say: "I would like three cartons of chocolate biscuits, please". If they are available they are brought to the counter, a total cost is rung on the cash register and the amount is required from you.

In the run-of-the-mill corner shop, you hand over the cash, and a receipt and the biscuits are passed to you. In another shop, you may not want to pay cash, so you hand over your appropriate charge card.

In both cases, a sale has been made, one going immediately into 'cash' in the sales ledger, the other into 'accounts' receivable'. In both cases, too, stock has been reduced. Order processing and invoicing have been performed.

Ideally, order processing should:

- Check the customer's credit—has he established a reputation for prompt payment or has he lodged an amount from which the cost can be deducted?
- Check whether the item wanted is available—if it is, deduct the amount sold from the stock-in-hand; if not, back-order more and tell the customer about it; there is one more option between those two, i.e., the item is in stock but the total in the stock-in-hand will fall below a 'safe' level if the item is withdrawn, so a decision has to be made whether to supply the item or back-order it.
- Calculate VAT, discounts.
- Value everything ready for printing an invoice.
- Update the sales ledger with the appropriate values.

Invoicing, on the other hand, is simplistic and is usually an integral part of the order-processing cycle. What is needed is a form on which the relevant data for the customer is printed neatly and is easily understood, with a polite exhortation to pay.

There is the tangled dependency of the order processing/invoicing/sales ledger/stock control functions. We have tried to extract only the two in which we are interested but beware that frequently those two often will operate properly, or not at all, without the other pieces of the system. We have noted this where we could in the following summaries.

INVOICING

Micro Software Systems, 242 Heath Road, Grays, Essex.

THIS SOFTWARE is part of the Stock Controller Suite which Micro Software sells for £850, excluding VAT. The Stock Controller Suite is an extensive set of software for inputting stock data, amending files, and generally keeping track of stock and re-order levels.

The invoicing section of the software draws the invoice form on the VDU and the user fills-in the missing information—date, customer number, item number, and quantity. When the invoice is correct, it is printed-out and the stock levels adjusted.

ORDER ENTRY/INVOICING

Wilcox Computers Ltd, Rackery Lane, Llay, Wrexham, Clwyd.

TO RUN on the Wilcox Series II (with 32K RAM, two floppies, VDU and printer), the software and hardware together cost about £8,200 (plus VAT).

The order entry section uses customer and stock files to do a customer credit check, a stock availability check, check for discount rates, calculate VAT, and handle non-stock items—when stock normally is not carried but obtained for a particular order.

Invoices are produced either while an order is being processed or saved for later printing. Special features include a message facility, VAT summary, AUTHORISATION printout on the invoice where the total exceeds the customer credit limit, and credit note printing.

VIDEO-ORDER and VIDEO-BILL

Video Software Ltd, Stone Lane, Kinver, Stourbridge, Worcester DY7 6EQ.

AS WITH VIDEO-STOCK, VIDEO-PURCHASE and VIDEO-DEBT—reviewed in the March and April, 1979 issues of *Practical Computing*—the VIDEO-ORDER and VIDEO-BILL software packages are supported on the machine-independent VIDEO operating system. The price of the software varies from £1,000 to £5,000, depending on options chosen.

With VIDEO-ORDER, orders are entered via the VDU and placed in the Outstanding Orders File. Orders may then be released for despatch manually or automatically. Despatch notes may be printed. Available for display on the VDU are the details of individual outstanding orders or the outstanding orders of a specific customer or product.

VIDEO-BILL can be operated on a pre-despatch or post-despatch basis. The user can display customer ledger accounts and product details, including stock levels. Pricing, discounting, and VAT calculations can be made. The hard-copy printout is the invoices.

INVOICING DEBTOR LEDGER SYSTEM

Microsolve Computer Services Ltd, 125-129 High Street, Edgware, Middlesex HA8 7HF.

DESIGNED to run on an Apple II with 48K, two floppy discs, a VDU monitor, and matrix printer, the invoicing debtor ledger system costs £3,500 (excluding VAT).

The invoicing section is embedded in another system, debtor ledger this time. The system maintains a customer file and a products file from invoices produced automatically.

It also handles process payments from customers and makes invoice adjustments for returned goods, bad debts and the like.

The system has a maximum capacity of 3,400 invoices—raised per month plus unpaid carry-forward from the previous month.

Writing a new chapter

10 IF AGE <40 GOTO NEXT ARTICLE

20 IF AGE >60 READ ON

A PERSON approaching retirement age is bombarded with help and advice culminating in a sheaf of papers from the pensions office within a few months of the appropriate birthday.

It is difficult to appreciate what all the fuss is about—you don't feel any different and your mirror reports that you look very unlike a pensioner. Then the fateful day arrives when you have to stop working. Suddenly, a chapter in your life closes, a chapter in which events to a large degree have been influenced by other people.

Own choice

Now you have to begin to write a new chapter in which the events will be of your choosing. Inwardly, you know that you have only a limited time to complete that chapter.

Admittedly, there are a thousand-and-one things to be done which have been left undone for lack of time—decorating, turning-out the attic, gardening, helping in the house. At a guess, they will occupy about three to six months, then you will be at a loose end again.

The easiest and most tempting course is to take it easy; re-furbishing memories of people you worked with and may never see again, of victories won and contracts lost, of quotations, prices, and events from donkey's years ago.

by Ken Hall (retired)

What is more difficult, but more lasting and rewarding, is to live for the future but that requires a positive effort. In computer terms clear the screen, wipe the tape clean, make a determined effort to clear part of your memory and fill it with new ideas.

It would be easy to suggest that owning a microcomputer is no more than an old man's foible but that is to underestimate the work involved. You have to learn a new language, in your own time and by yourself.

You may have to search into that deep store of remembered facts to find again your knowledge of mathematics, trigonometry and geometry. It is no use going back to your old school textbooks but the sound grounding we old codgers had in the basics is just the right preparation for a beginner in computing.

It is just possible that you might like to take up electronics at the point where you left 'wireless' many years ago but the construction of even the simplest computer, however small, is far different from the making of a two-valve amplifier for a crystal set. It is probably better to go for a ready-to-work computer rather than to mess about trying to assemble a delicate and intricate kit.

What are you going to do with a microcomputer when you have bought it?

Exciting

First, you have to learn the language your particular computer understands, so it is essential that you make sure the apparatus you buy has a very simple and complete set of tuition instructions. Stick to that and master it; don't go to the library and borrow books on the subject—their language may be different from that used by your computer and this can be terribly confusing.

The next stage will undoubtedly be playing games. Toddling down the road for a weekly game of crib with old Harry can become a bit of a bore and it can be

difficult to vary or break-off the connection. Your computer will not be offended if you give it a miss for a week, or change your game from Backgammon to Vingt-et-un or Star Wars.

What will be even more exciting will be to write your own games programs. How about creating a programme for two-up or Noughts and Crosses, Tippit, Fox & Geese or Nine-men-Morris? That would really tease you and stretch your skills to the maximum.

Life is about fighting, even after retirement, and those who give up the fight pass on. What better stimulus than to go to bed with the problem of a stuck program and wake up to know that you can crack it completely?

Many options

All that may not so far justify the purchase of a micro, even when you have written programs to deal with your household expenses, your pension and the last stages of your mortgage. If you have bright grandchildren, though, you will not lack company as they arrive to play on Grandad's new computer. You could even persuade yourself that you are contributing to their education.

Most people in our age group with enough interest in the future to read this magazine and to consider the acquisition of a computer will already have some kind of hobby. With a computer you can update the value of your stamp collection, listing those items you still cherish and transferring them from one list to another as you buy them.

Wine-makers can record their most successful recipes, the progress of fermentation and the state of the cellar. Gardeners can plan the rotation of crops for years ahead and check progress.

Handymen can design the next piece of work, composing it on the computer screen in every detail. Sporting types can record games won and lost, evaluating their handicaps as they go. Gamblers can write a program to allow for form, the going, past performance and jockey effect right to the last minute, with a view to improving on previous expensive hunches.

Will you be able to make something on the side from the use of a computer? Why not try? First you must master the technique completely, prepare programs and make them work. Then there may be someone in your area who needs some help—a small employer with payroll and tax, a shopkeeper with VAT problems, a beginner in computing who just needs a little push to get over a sticky patch. For all of these you have to be good at the job, very good—there must be no possibility of error or bungling.

So, invest in a microcomputer. Choose your machine with great care after looking at all the alternatives and reading all the reviews you can find. Seek advice from a number of suppliers—and don't hurry over that part of the process. Make sure that you understand fully the basic instructions and make use of back-up books and tapes. If you plan to expand your system, check that compatible equipment is easily available.

When you get your own computer home and set it up, lock yourself away for a time with it. Study hard, work at it, ignore the disparaging remarks of others and don't spread it around that you are a computer person until you have mastered it completely. Then you can blossom as the local computer expert.

Rewarding

You will have a hard time initially; you may even despair but you have plenty of time available in which to crack the problem. You have expertise in dealing with difficulties and you will certainly have a lot of fun.

Computer programming used to be considered a young person's field and any computer exhibition will be full of bright young minds spouting learned ideas in strange languages. Nevertheless, there are older people who are exploring what computers have to offer, and finding it very rewarding. In fact, it is just the thing for someone who has been cut adrift from a previous existence and is looking for a new, exciting, and teasing life.

So –

```
999 IF AGE > 60 GOTO
    COMPUTERS
```

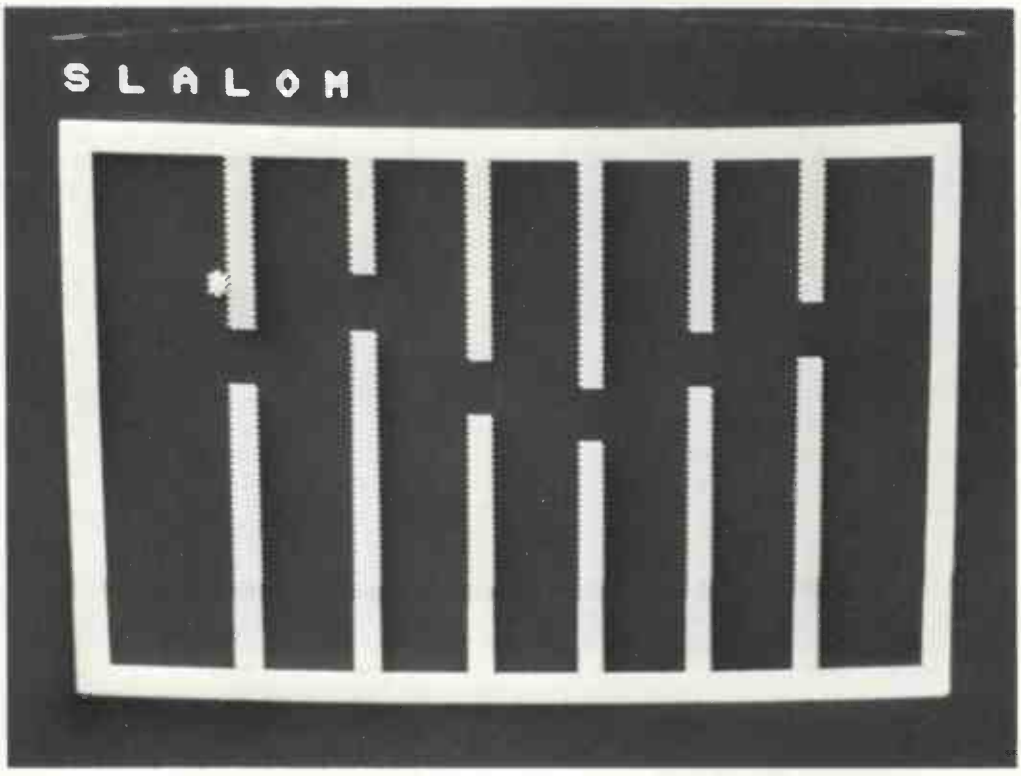
How to ski the safe way

DO YOU fancy yourself as an Ingemar Stenmark? The object of Slalom is to guide a 'skier', represented by a highly-mobile asterisk, through a series of gates in the shortest possible time.

The skier moves in diagonal steps, bouncing off any boundaries he hits but passing through the gates which close behind him immediately.

You can use the keyboard to reverse the up-down or right-left direction in which the skier

by Lewis Corner



is moving. With skill and judgment, the skier's performance can be improved substantially.

At the beginning of each run you specify whether you want a new course, or another run on the previous one. We found a small bug in Lewis's program —on the first run of the day you have to set a new course. Different levels of skill are catered for by offering gates of three widths.

When the course has been completed the time taken is shown, setting a target for other players to challenge.

The program listed is for the Commodore Pet and we have used the coding conventions outlined on the Pet page in previous issues. It should be possible to devise versions to run on any microcomputer with a screen display, suitable graphics and an internal clock.

Slalom has apparently proved popular with children and adults who appreciate its rapid movement, competitive nature, and the opportunity to develop and exercise skill in guiding the skier.

In the listing we have indicated graphics as follows:

[CLR] ....clear screen
[HOME] ....cursor home
[R] ....reverse field
[DOWN] ....cursor down

```
200 DIM GD(7),GL(7),GR(7)
210 FOR G=1 TO 6:GD(G)=1+5*G:NEXT
300 PRINT"[CLR] S L A L O M[DOWN,DOWN]"
310 PRINT"DURING PLAY[DOWN]"
320 PRINT"KEY Z TO REVERSE UP/DOWN MOTION"
330 PRINT"KEY M TO REVERSE LEFT/RIGHT MOTION"
340 PRINT"NEW COURSE ? KEY Y (YES) OR N  (NO) [DOWN,DOWN]"
350 INPUT R$
360 IF R$="N" THEN 500
370 PRINT "[DOWN]"
371 PRINT"GATE WIDTH ? KEY W (WIDE)"
372 PRINT"                M (MEDIUM)"
373 PRINT"                N (NARROW)"
375 INPUT R$
380 IF R$="W" THEN GW=4:GOTO 400
381 IF R$="M" THEN GW=3:GOTO 400
382 IF R$="N" THEN GW=2:GOTO 400
383 GOTO 370
400 FOR G=1 TO 6
410 GL(G)=INT(RND(.6)*15+1)
420 GR(G)=GL(G)+GW
430 NEXT
500 PRINT"[CLR]S L A L O M[DOWN]"
510 FOR I=1 TO 38:PRINT"[R]";:NEXT:PRINT
520 FOR I=1 TO 19
525 PRINT" R ";SPC(36);" "
530 NEXT
540 FOR I=1 TO 38:PRINT"[R]";:NEXT
600 FOR G=1 TO 6
605 S=1+5*G
610 PRINT"[HOME,DOWN,DOWN]"
620 FOR I=1 TO 19
630 IF I>GL(G) AND I<GR(G) THEN PRINT:GOTO 650
640 PRINT SPC(S);"[&]"
650 NEXT I,G
700 I0=10:J0=1
710 LR=1:UD=-1
720 G=1
730 T=TI
1000 I1=I0+UD:J1=J0+LR
1010 IF J1=36 THEN 1500
1020 IF I1>GL(G) AND I1<GR(G) AND J1=GD(G)-1 THEN 1300
1050 IF I1=0 OR I1=20 THEN UD=-UD:I1=I1+UD
1060 IF J1=GD(G-1) OR J1=GD(G) THEN LR=-LR:J1=J1+LR
1070 GOSUB 1400
1100 GET C$
1110 IF C$="Z" THEN UD=-UD:GOTO 1000
1120 IF C$="M" THEN LR=-LR:GOTO 1000
1130 GOTO 1000
1300 J1=J1+1:GOSUB 1400
1310 J1=J1+1:GOSUB 1400
1320 FOR I=1 TO GW-1
1330 POKE 32768+40*(GL(G)+2+I)+GD(G),176+G
1340 NEXT
1350 G=G+1
1360 GOTO 1000
1400 POKE 32768+40*(2+I0)+J0,32
1410 POKE 32768+40*(2+I1)+J1,42
1420 I0=I1:J0=J1
1430 RETURN
1500 GOSUB 1400
1510 T=INT((TI-T)/60)
1520 PRINT"[HOME]";SPC(20);"TIME";T;"SECS"
1530 FOR I=1 TO 3000:NEXT
1540 GOTO 300
1550 END
```

Cassettes for work and play

Bridge Challenger

Cassette for Tandy, Apple, Pet. Produced by Personal Software. Available from most dealers. Price, around £10.

BRIDGE CHALLENGER, according to its brochure, is designed for all players from novices to experts. As a bridge player and avid reader of any publication which prints bridge puzzles, I was delighted to find a piece of software which would generate problem after problem.

I ran the bridge software on our Pet computer. There are two parts to the software. The first gives hands to play; the other is a dealer program which can be used to deal specially-selected hands and save them on cassette.

The first part of the program sets up a hand produced at random using a random number generator in the computer.

For example:

	N	S
	S AQJ2	S 7
	H KJ107	H 9843
	D K5	D AQ987
	C AQ9	C 876

It then asks you what contract you want to play in. I choose 4H. If you don't like the look of the hand you can tell the computer to go to another hand, or you can revolve the hand and play East/West instead of North/South.

Also a good contract is 3NT on this hand, so having made 4H you can get the computer to play you against 3NT.

Once you have decided your contract, the computer makes its lead and you play against it. After making or failing to make the contract, the computer displays the full deal. In this instance, it was:

	N	
	S AQJ2	
	H KJ107	
S 109653	D K5	S K84
H A2	C AQ9	H Q65
D 643		D J102
C K105	S	C J432
	S 7	
	H 9843	
	D AQ987	
	C 876	

You are then asked if you wish to play the hand again or move to another. The dealer program on the cassette is a new game. It allows you to deal specially-selected hands and save them on cassette.

With Dealer you can either set up the deal yourself—good for copying from bridge magazines—or cheat. Yes, cheat. You can give the computer a range of high card points (e.g, 20-38) and it will deal hands only within that range of points.

In summary, the computer never tires of giving you hands and it is great for practice and passing hours of your time. My only complaint is that the computer often takes a time to decide what card to play and that can be frustrating.—R.H.

Eliza Doctor

Cassette for Commodore Pet. Available from most Pet dealers. Manufactured by Petsoft. Price: £10.

IN THIS simulation of artificial intelligence, you speak to the psychiatrist, Eliza, and she is supposed to answer you intelligently. She has a set routine of questions and answers which, unfortunately, tend to arise at inappropriate moments.

We did not have much luck with the "intelligent" conversation, an example of which went like this:

Eliza: "Do you have any problems?"
Me: "Yes, I hate my mother".
Eliza: "Do you think you have any psychological problems?"
Me: "What's that if it's not psychological?"
Eliza: "I'll ask the questions"—and so on.

Petsoft says the program is not guaranteed to solve your problems and if you do have any real problems you will probably be more frustrated than soothed by this program.

It was developed originally to run on mainframes and Petsoft claims to have succeeded in putting it on to 8K "without losing anything important". Except, in our opinion, its marbles.—K.F.

Backgammon

Cassette for Commodore Pet. Available from most Pet dealers. Manufactured by Petsoft. Price: £8.

THE excellent graphics definitely place this above other Backgammon programs. Initially, it asks how many players there are, indicating that you can play with the computer, or against a human opponent.

The screen displays an actual simulation of a backgammon board, with the bar in the middle. Unfortunately, there are no instructions with the cassette—at least, we received none—so it is a matter of trial and error to discover the code for getting off the bar and moving to home.

We can reveal that to get a counter off the bar you key-in B, space, and number you are going to, and, to get home, F, space, number you are coming from. The computer rolls the dice for you and you key-in the number to which you want to move.

On the whole, a very enjoyable program to pass the time.—K.F.

Star Trek III

Cassette for TRS-80. Written by Lance Micklus. Available from Mad Hatter Software, 219 Washington Ave., Chelsea, Mass 02150.

TAKING our TRS-80 to a country house session, we played many of the games available on cassette. One which held everyone's unswerving attention was Star Trek III. Attention is what you need, believe me.

The object is to explore as much of the galaxy as possible—a description of the galaxy is given in three-dimensional co-ordinates—locate the five Class M planets and destroy as many of the 20 Klingon invaders as you can.

You must complete your mission and return to star fleet headquarters before Stardate 2500. You start in a quadrant which has a starbase and docking there concludes the game. Your performance is evaluated—perfect score is 100.

We started casually, thinking this was another rather innocuous game, learned and mastered quickly. No. The first four attempts destroyed our ship, had us drummed out of the corps, demoted us and destroyed our ship again. Our performance score ranged from 2 to 28.

Seeing that we were indeed faced with a more complex game, pencil and paper and two more troopers were requisitioned. Attacking the problem logically, we found the five Class M planets, destroyed 18 Klingon ships, and whizzed back to starbase well within our time limits.

We three were than awarded a 92 performance score and all promoted to Admiralty. Here's the bad news—in a sense; all this took four hours but we were riveted and if you have the time and the inclination to master the game, it seemed like no time at all.

You are provided with screenloads of information in formats which make you believe that you are on the Enterprise.

Calling-up Uhura, Scotty, Spock and the others, getting damage reports, energy reports, weaponry reports, sensors (long-range and short-range) reports, science reports—they're all important and vital to the success of the mission.

The fun was figuring the logical progression you should take to maximise your finds and minimise the damage you sustain in battle.—R.W.

Financial Analysis

Cassette for Commodore Pet. Available from most Pet dealers. Manufactured by Petsoft. Price: £9·50.

THE PROGRAM copes with three types of financial analysis:

- Calculating the present value or future value of an annuity;
- Calculating the present value or future value of a lump sum;
- Calculating the price or yield to maturity of a bond.

Before you continue all terms are defined.

The most interesting part of the program for many people will be the annuity calculation. Using it, you can calculate your pension, new life insurance policy—anything which accrues interest from, say, monthly payments received. You can have a complete listing of each period to payment schedule.—K.F.

Stepper motor control using Kim-1

In part one of this Kim project we investigated some of the ways in which small motors could be used. This month the control of small stepping motors is considered.

As the name suggests, the rotation of the stepping motor is in discrete steps. Each step is a pre-determined number of degrees, typically between 3·75 and 90, or between 96 and four steps per revolution. This means that it is not possible to specify an infinite range of positions.

On the other hand, stepping motors show no cumulative error. Remember from part one that if you pulse a DC motor for a set period, any number of factors could prevent the motor rotating the exact amount expected. Extra load, low batteries, or friction in the motor bearings could all affect the extent of the rotation, writes **Nick Hampshire.**

If the first rotation was 30 degrees plus or minus 2 degrees, and the second was also 30 degrees plus or minus 2 degrees, then the total rotation would be 60 degrees plus or minus four degrees.

Precise movement

With a stepping motor the first step of 30 degrees might have an error of one degree. The second step would 'flip' it round to the 60-degree position, but this would be 60 degrees plus or minus one degree. When the DC motor has completed one full rotation the total error is plus or minus 24 degrees; for the stepper it is still one degree.

This lack of cumulative error makes the stepping motor useful in a number of applications where precise movement is required. For example, they are used often to move the read/write head of a floppy-disc unit in and out, the same track being found repeatedly with no effort. A number of matrix printers use stepper motors to scan the dot head across the page, one step for each column in the character matrix.

Close accuracies

Close accuracies are obtainable when stepping motors are used in numerically-controlled machine tools; this is achieved by making the motor drive turn a threaded shaft, and the movable item is tapped so that is can be pulled or pushed by the shaft rotation. If the pitch of the thread is 0·1in. and a 100-step motor is used, each step represents a movement of only one thou.

This is the idea behind this month's program. If an X-Y plotter is constructed using threaded rod and stepping motors, the code could be used to generate lines given a list of co-ordinates. Figure 1 shows how such a plotter could be made. If the paper is held on a static bed, one of the principal problems of plotter design is the need to move the whole apparatus to pull the second plotting dimension backwards and forwards with the first-dimension motor.

In the design of figure 1 the paper flat-bed is moved left and right in the X direction on runners by one stepping motor, while the pen is moved up and down in the Y direction across the paper.

Without the facilities of a full engineering workshop and using only DIY materials, a certain amount of play in the design could be expected. One consequence is a reduced requirement for a minute step size. It follows that using threaded rod with a fairly coarse pitch will probably be an advantage. In any case, cheap stepping motors have a limited rotation rate and it would take a long time to draw a picture of any useful size.

Reducing play

Two things can be done easily to reduce play in the plotter. The first is to ensure that the paper bed and the penholder cover the maximum length of runner. This will reduce the degree of lateral movement they can make.

Secondly, some mechanism should be found to take-up the slack always present between a thread and its nut. To reduce this, some form of tension must be applied to the bed and penholder. A tension spring would be an obvious choice, but they will apply more force as they expand. A second solution would be to attach a cord to the moving parts and hang a weight on the end; well, the design isn't very compact anyway.

Simplest way

The simplest way to drive a stepping motor is to pass a current through each of the coil windings in the motor in the correct order. Each winding magnetises temporarily one of a number of 'teeth' around the inner surface of the motor cylinder body. The output shaft is connected to a permanent magnet rotor. When the current is connected first, a magnetic flux is set up in the stator teeth and the rotor aligns with the magnetic field produced. The stator is made so that every alternative tooth is magnetised by the same coil.

If the other coil is energised and the first released, the flux will shift to an adjacent tooth and the rotor will be pulled round, to align with that. Rotation is produced by energising the coils alternately. The windings are centre-tapped so

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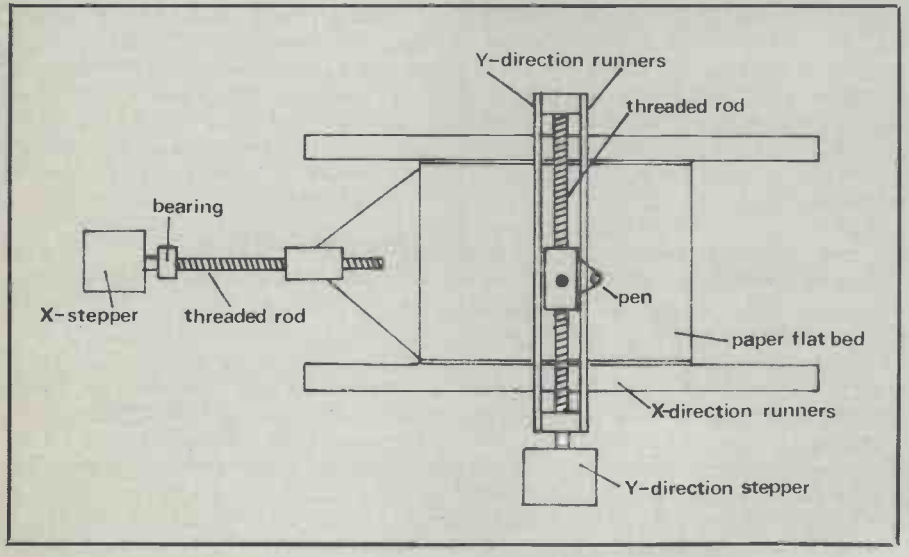
Figure 1. Plotter design



(continued from previous page)

that they can be magnetised either north or south, producing a four-phase control which will pull the rotor in the desired direction.

It is, therefore, essential to power the coils in the correct order. This data will be supplied with the motor. Even if it is not, it is a simple matter to power each wire in turn until a combination is discovered, so that each step is of the same magnitude and direction. To rotate the motor in the other direction the wires are powered in the reverse order.

As the load is very similar to a solenoid or relay the driver circuits used in part 1 are equally suitable to drive stepper motors (figure 2).

Program listing 2 shows four subroutines to drive two stepping motors from the same eight-bit parallel port. The first four bits PA0–PA3 will drive the X motor. The top four bits PA4–PA7 will drive the Y motor. XPLUS and YPLUS are subroutines which step either the X or Y motor forwards independently one place when called. XMINUS and YMINUS step the X and Y motors in the other direction when called.

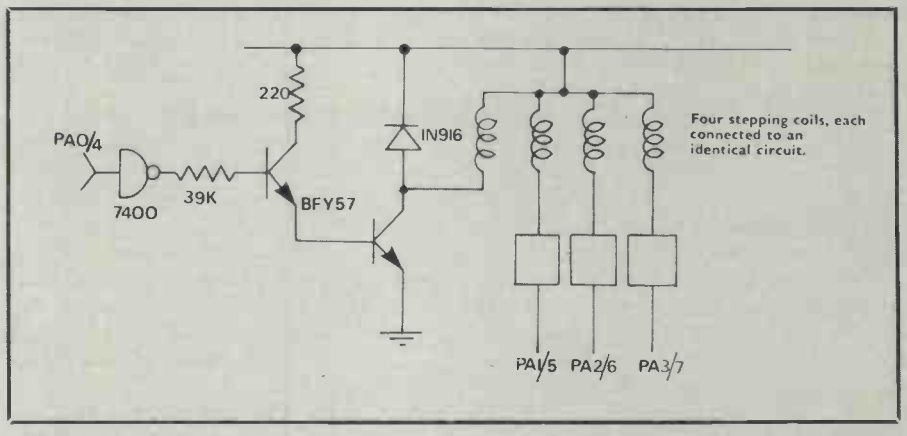


Figure 2.

Switching currents

In part one reasons were given for using an active low scheme for switching the coil currents. STEPX is a variable in which only one of the bottom four bits is low, and all the rest are high. When XPLUS is called this location is shifted one place to the right and the carry bit, previously set, is shifted in at the top. If the zero bit is shifted out of the byte it is re-loaded with zero in bit three.

Next the current contents of the output port DA are loaded into the A-register and exclusively ORed with $0F to set all four bottom bits leaving the Y motor unaffected. Then ANDing with STEPX puts the now-shifted zero bit back into the output port. XMINUS shifts the contents of STEPX left one place before changing the value in DA. When the zero bit enters the fourth bit position STEPX is loaded with its bottom bit set. YPLUS and YMINUS work in the same manner.

Listing 1 and listing 3 show an algorithm to draw vector lines using a set-up such as the X-Y plotter. Listing 3 is a machine code version of the Basic program. It is loadable directly into the Kim-1 microprocessor. Listing 1 is given instead of a flow-chart of the algorithm, as it is simple enough to be understood easily. In any case the program is written in Pet Basic, and, using the same machine code routines, is fully-functional in its own right. The Basic program was written first and the algorithm debugged using all the facilities of the bigger machine—a process which could easily have taken years using only the Kim. I then pretended to be a Basic compiler and converted the Pet program into assembly-code.

When writing programs in machine code it is important to keep the amount of complex arithmetic to a minimum; it is hard to code and slow to run. This is true especially of floating point calculations. You will notice that, apart from a single divide by two, the only arithmetic involved is addition and subtraction.

Because of the requirements of real-time computer graphics, a number of techniques for drawing lines with low computational overheads have been developed. The various methods used commonly, such as 'Digital Differential Analyser', 'Symmetric Digital Differential Analyser' and 'Binary Rate Multiplier', are described in chapter 3 of Newman and Sproull's book *Principles of Interactive Computer Graphics*, published by McGraw Hill in its Computer Science Series. Various algorithms for fitting curves to a set of points using only simple calculations also exist.

Effective variant

The algorithm described here is a particularly effective variant of the Digital Differential Analyser for drawing a line from one pair of co-ordinates (X1 and Y1) to another pair (X2 and Y2). These pairs are read into the Basic program at statement 60, or obtained from a list of co-ordinates in the code program. The last pair of co-ordinates in the code pro-

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gram are negative—this stops the plotting. In both programs all the co-ordinates are positive, with the origin at (0,0).

At GQ, the start of the code program, the user ports are set up with INIT. Then the start of the co-ordinate table is transferred from START to START1. This

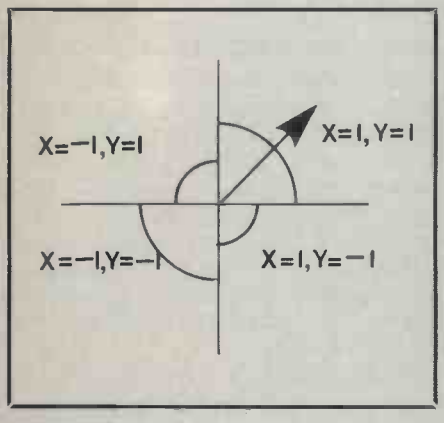


Figure 3.

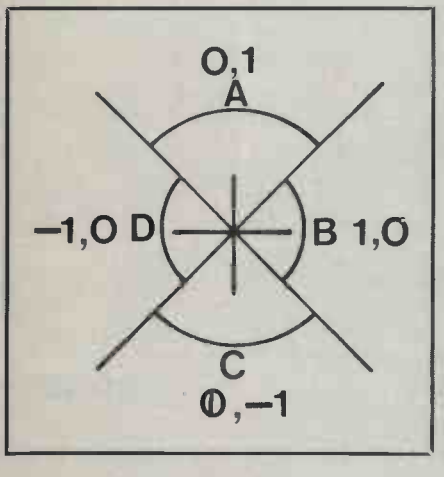
means that the program can be started many times by running from GO. INIT puts an initial value into DA to lock the motors and also sets PB0 low. This will be set high when the plot is over.

The next stage in the algorithm is to determine which is the best approximation to a diagonal, closest to the line (fig. 3). If A1=1 then X will step right, left if A1= −1. The same is true for Y and AO.

This is determined easily. If the difference between X2 and X1 (XD) is positive, then X will step right (S110); if negative then left (S130). If Y2–Y1 (YD) is positive Y will step upwards (S120) otherwise downwards (S140).

Each chunk of machine code corresponding to a single Basic statement is preceded by a label with the same numeric value as the statement number. All the variables have the same names in the two programs, and the plotting arithmetic is done to 16-bit precision—eight bits would have given a very poor plot resolution; 16-bit addition or subtraction is simply a matter of adding or subtracting the two

Figure 4.



low-order bytes, having first cleared or set the carry bit.

The operation is then repeated with the high-order byte. In keeping with the 6502 convention, the low-order byte is stored first in the pair. The quantity of machine code generated is reduced further by making many of the comparisons either less than zero (<0) or greater than or equal to zero (>=0); this condition may be tested for with a single instruction.

If the top bit of the high order byte is set the number is negative; otherwise it is positive. BPL tests this bit and jumps if it is clear.

Plot direction

The next stage in the algorithm calculates the nearest horizontal or vertical line to the desired plot direction. The X motor will go left(S0=0,S1= −1)or right (S0=0, S1=1): or the Y motor will go up (S0=1,S1=0) or down(S0= −1,S1=0). (figure 4).

If the absolute value of XD (XE) is greater than the absolute value of YD (YE), it is either in quadrant B or D (S240–S260). If XD is also positive then it is quadrant B (S260)—otherwise D (S250). Similarly if Y is greater than X it is either A or C (S200–230). If YD is positive then A (S220)—otherwise C (S200).

At the same time LG (longer) is loaded with the longer of the two plot distances and SH (shorter) with the lesser of the two.

The absolute value of the variables XE and YE are computed in machine code by transferring the values if they are positive (if XD>0 then XE=XD). If the number is negative it must be complemented and one added before the result is stored (else XE= −XD). Complementing a byte is done by exclusive ORing with $FF. One is added normally.

Axis movements

The algorithm plots the line either by stepping both motors in the direction of the best diagonal, or one motor only in the direction of the best horizontal or vertical line. The ratio of diagonals to axis movements determines the slope of the line. If they are all axis movements then the line was at 0, 90, 180, or 275 degrees to the vertical. If they were all diagonal, then the line was at 45, 135, 225, or 315 degrees to the vertical.

Each iteration around the loop S355 to S430 will step one or both motors in the relevant direction. The total number of iterations (TT) is equal to the number of plotted points in the longest direction (LG). Each time around the loop CT determines whether the current ratio of used-up diagonals to axials exceeds the overall ratio of diagonals to axials (S360). When TT reaches zero all the points are plotted and the program returns to S60.

If more diagonals have been used, an

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axial is made next (S370–S380), calling subroutine S1000. Otherwise a diagonal is plotted (S390–S400), calling subroutine S2000. Both S1000 and S2000 transfer the step directions into Z1 and Z0 and call S3000. This in turn calls the code subroutines stored in the Pet memory — XPLUS, XMINUS, YPLUS and YMINUS, with calls of the Basic system function SYS.

A delay is introduced at this point to allow for the mechanical inertia of the motors (S3070 or DELAY at $0268)— the delay will have to be altered for different makes and sizes of stepping motor.

Reducing delay

The co-ordinates set in the program draw a duo-decadon as in figure 5. With the delay values used it takes 100 seconds to plot the 2,600 points. The circuits were tested with 15-degree motors manufactured by Eastern Air Devices Inc model LD20ACM-12 motors. They have 20 ohm windings with a maximum working voltage of 28 volts (1·4 amps), giving a maximum output torque (turning ability) of 38 oz. in.

The fastest rotation rate of these motors is about 50 steps per second (125 rpm). If too much load is placed on the shaft the rotor fails to step round but if it does step, even if at reduced speed, the cumulative accuracy is maintained. If the motors are to be driven from the Pet, the driver circuits can be attached to the user port J2. The processing time of the Basic interpreter means that the steps have a much greater delay; this can be reduced by removing the diagnostic print statements 1010 and 2010.

Many applications

Statements S5160 to S5540 are decimal values of the bytes in listing 2. Statements S5070 to S5140 are a machine code loaded. The code is transferred from the data statements into the 'unused' #2 tape buffer. Statement S5010 sets the user port to an output by poking $FF into the control register at 59459, and then initialising the outputs to %01110111 by poking 119 into the data direction register (DA on listing 2) at 59471.

Stepping motors are ideal in numerous applications where accuracy and repeatability are prime considerations. They have been used, therefore, in the design of many forms of small computer peripherals and are most useful for robot and computer-controlled arm and manipulator construction. As they become cheaper and more readily obtainable their use will spread, particularly since they are so readily interfacable to microprocessors.

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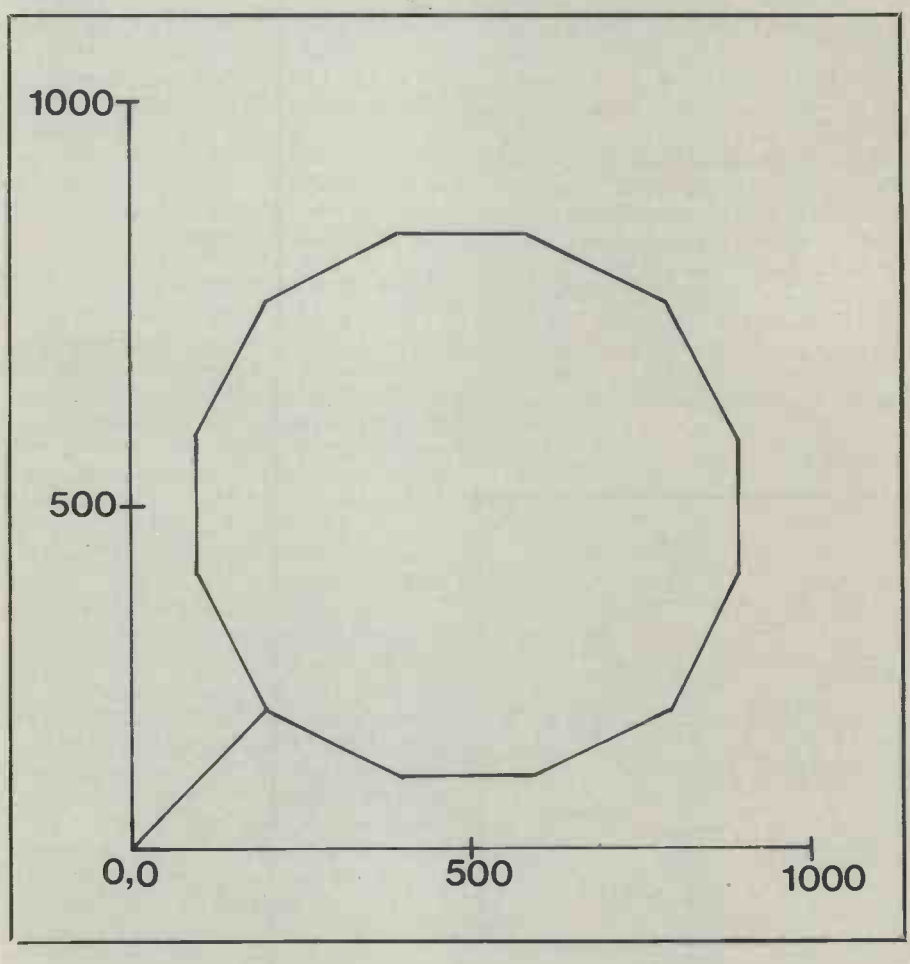
Figure 5.



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Listing 1

```
G

 10 REM BASIC PROGRAM DEMONSTRATING
 20 REM LINE DRAWING PROGRAM FOR
 30 REM STEPPING MOTORS ON THE KIM-1
 40 REM MICROCOMPUTER.
 50 GOSUB 5000
 60 INPUT "INPUT (X1,Y1),(X2,Y2)";X1,Y1,X2,Y2
 70 REM DISPLACEMENTS IN X AND Y
 80 XD=X2-X1
 90 YD=Y2-Y1
100 REM CALCULATE NEAREST DIAGONAL
110 A0=1
120 A1=1
130 IFYD<0 THEN A0=-1
140 IFXD<0 THEN A1=-1
150 REM CALCULATE NEAREST HORIZ/VERT
160 XE=ABS(XD)
170 YE=ABS(YD)
180 D1=XE-YE
190 IF D1>=0THEN 240
200 S0=-1
210 S1=0
215 LG=YE
216 SH=XE
220 IF YD>=0THEN S0=1
230 GOTO 270
240 S0=0
250 S1=-1
255 LG=XE
256 SH=YE
260 IF XD>=0THEN S1=1
270 REM
275 PRINT "XD YD XE YE D1 S1 S0"
276 PRINTXD;YD;XE;YE;D1;S1;S0
280 PRINT "ACROSS=";A1;A0
290 PRINT "UP/DOWN";S1;S0
295 PRINT"  X    Y"
300 REM SET-UP COUNTERS
310 TT=LG
320 TS=SH
330 UD=LG-SH
340 CT=SH-LG/2
350 REM WHILE MORE POINTS DO
355 IFTT=0GOTO60
360 IFCT>=0 THEN 390
370 CT=CT+TS
375 GOSUB 1010
380 GOTO410
390 GOSUB 2010
400 CT=CT-UD
410 TT=TT-1
430 GOTO 355
1000 REM HANDLE S1 AND S0
1010 PRINT S1;S0
1020 Z1=S1
1030 Z0=S0
1040 GOSUB 3010
1050 RETURN
2000 REM HANDLE A1 AND A0
2010 PRINT A1;A0
2020 Z1=A1
2030 Z0=A0
2040 GOSUB3010
2050 RETURN
3000 REM CALL USER STEP ROUTINES
3010 IFZ1=0THEN3040
3020 IFZ1=+1THEN SYS(826)
3030 IFZ1=-1THEN SYS(849)
3040 IFZ0=0THEN3070
3050 IFZ0=+1THEN SYS(867)
3060 IFZ0=-1THEN SYS(894)
3070 FORDL=1TO10:NEXT
3080 RETURN
5000 REM SET USER PORT TO OUTPUT
5010 POKE 59459,255
5020 REM INITIALISE STEP
5030 POKE 59471,119
5040 REM READ MACHINE CODE PROGRAM
5050 REM INTO TAPE BUFFER #2
5060 REM THE LOADER PROGRAM
5070 READ AD,NO
5080 FOR NN=1TO NO
5090 READ NX
5100 POKE AD,NX
5110 AD=AD+1
5120 NEXT NN
5130 REM THE MACHINE CODE
5140 DATA 826,86
5145 REM XPLUS
5150 DATA56
5160 DATA 110,140,3
5170 DATA 176,5
5180 DATA 169,247
5190 DATA 141,140,3
5200 DATA 173,79,232
5210 DATA 9,15
5220 DATA 45,140,3
5230 DATA 141,79,232
5240 DATA 96
5250 REM XMINUS
5260 DATA 56
5270 DATA 173,140,3
5280 DATA 42
5290 DATA 44,142,3
5300 DATA 208,2
5310 DATA 169,254
5320 DATA 141,140,3
5330 DATA 76,69,3
5340 REM YPLUS
5350 DATA 56
5360 DATA 173,141,3
5370 DATA 106
5380 DATA 44,143,3
5390 DATA 208,2
5400 DATA 169,127
5410 DATA 141,141,3
5420 DATA 173,79,232
5430 DATA 9,240
5440 DATA 45,141,3
5445 DATA 141,79,232
5450 DATA 96
5460 REM YMINUS
5470 DATA 56
5480 DATA 46,141,3
5490 DATA 176,5
5500 DATA 169,239
5510 DATA 141,141,3
5520 DATA 76,114,3
5530 REM VARIABLES
5540 DATA 247,127,16,8
5550 RETURN
9999 G=867
10000 PRINTPEEK(G);:G=G+1:GOTO10000
READY.
```

Listing 2

```
                                ;STEPPING MOTOR DRIVER ROUTINES
                                ;RE-LOCATED FOR THE PET
                                ;USING VECTOR PLOTTING PROGRAM
                                DA      =59471
                                ;RESIDES IN TAPE BUFFER #2
0000                                    *=$33A
                                ;
                                ;STEP X MOTOR 1 POLE ON
033A  38                        XPLUS   SEC
033B  6E 8C 03                          ROR STEPX
033E  B0 05                             BCS XP1
0340  A9 F7                             LDA #$F7
0342  8D 8C 03                          STA STEPX
0345  AD 4F E8                  XP1     LDA DA
0348  09 0F                             ORA #$0F
034A  2D 8C 03                          AND STEPX
034D  8D 4F E8                          STA DA
0350  60                                RTS
                                ;SET X MOTOR 1 POLE BACK
0351  38                        XMINUS  SEC
0352  AD 8C 03                          LDA STEPX
0355  2A                                ROL A
0356  2C 8E 03                          BIT TESTX
0359  D0 02                             BNE XM1
035B  A9 FE                             LDA #$FE
035D  8D 8C 03                  XM1     STA STEPX
0360  4C 45 03                          JMP XP1
                                ;SET Y MOTOR 1 POLE ON
0363  38                        YPLUS   SEC
0364  AD 8D 03                          LDA STEPY
0367  6A                                ROR A
0368  2C 8F 03                          BIT TESTY
036B  D0 02                             BNE YP1
036D  A9 7F                             LDA #$7F
036F  8D 8D 03                  YP1     STA STEPY
0372  AD 4F E8                  YP2     LDA DA
0375  09 F0                             ORA #$F0
0377  2D 8D 03                          AND STEPY
037A  8D 4F E8                          STA DA
037D  60                                RTS
                                ;STEP Y MOTOR 1 POLE BACK
037E  38                        YMINUS  SEC
037F  2E 8D 03                          ROL STEPY
0382  B0 05                             BCS YM1
```

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Listing 2—continued

```
0384  A9  EF              LDA #$EF
0386  8D  8D 03           STA STEPY
0389  4C  72 03     YM1   JMP YP2
                    ;PROGRAM VARIABLE LOCATIONS
038C        F7      STEPX .BYTE $F7
038D        7F      STEPY .BYTE $7F
038E        10      TESTX .BYTE %00010000
038F        08      TESTY .BYTE %00001000
0390
SECOND PASS FINISHED O.K.
SYMBOL TABLE
      14
DA       E84F    XPLUS   033A
XP1      0345    XMINUS  0351    XM1     035D
YPLUS    0363    YP1     036F    YP2     0372
YMINUS   037E    YM1     0389    STEPX   038C
STEPY    038D    TESTX   038E    TESTY   038F
END OF ASSEMBLY

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```

Listing 3

```
                    ;PROGRAM TO DRIVE THE STEPING
                    ;MOTORS AS AN X-Y PLOTTER
                    ;COORDINATES HELD IN TABLE FROM
                    ;START
                    ;
                    ;SYSTEM LOCATIONS
                    DA      =$1700
                    DDA     =$1701
                    DB      =$1702
                    DDB     =$1703
                    C64D    =$1706
                    SR      =$1707
                    KIMMON  =$1C00
                    ;PROGRAM VARIABLES
                    ;INITIAL COORDINATES FROM TABLE
0000                X1      *=*+2
0002                Y1      *=*+2
0004                X2      *=*+2
0006                Y2      *=*+2
                    ;COORDINATE DIFFERENCE
0008                XD      *=*+2
000A                YD      *=*+2
                    ;ABSOLUTE VALUES OF XD & YD
000C                XE      *=*+2
000E                YE      *=*+2
                    ;DIFFERENCE OF XD AND YD
0010                D1      *=*+2
                    ;STEP DIRECTIONS
0012                S0      *=*+1
0013                S1      *=*+1
0014                A0      *=*+1
0015                A1      *=*+1
0016                Z0      *=*+1
0017                Z1      *=*+1
                    ;MISC - PLOT
0018                LG      *=*+2
001A                SH      *=*+2
001C                TT      *=*+2
001E                UD      *=*+2
0020                CT      *=*+2
0022                TS      *=*+2
                    ;MISC - DRIVE
0024        F7      STEPX   .BYTE $F7
0025        7F      STEPY   .BYTE $7F
0026        10      TESTX   .BYTE %00010000
0027        08      TESTY   .BYTE %00001000
                    ;START OF LOOKUP TABLE
0028        95 02   START   .WORD COORDS
002A                START1  *=*+2
                    ;SETUP PROGRAM
002C  20  7A 02     GO      JSR INIT
002F  A5  28                LDA START
0031  85  2A                STA START1
0033  A5  29                LDA START+1
0035  85  2B                STA START1+1
                    ;NEXT COORDS FROM TABLE
0037  A0  00        S60     LDY #0
0039  A2  00                LDX #0
003B  B1  2A        S60A    LDA (START1),Y
003D  95  00                STA X1,X
003F  C8                    INY
0040  E8                    INX
0041  E0  08                CPX #8
0043  D0  F6                BNE S60A
0045  A5  2A                LDA START1
0047  18                    CLC
0048  69  04                ADC #4
004A  85  2A                STA START1
004C  A5  2B                LDA START1+1
004E  69  00                ADC #0
0050  85  2B                STA START1+1
0052  A5  05                LDA X2+1
0054  10  03                BPL S80
0056  4C  8D 02             JMP HALT
                    ;DISPLACEMENT IN X AND Y
0059  A5  04        S80     LDA X2
005B  38                    SEC
005C  E5  00                SBC X1
005E  85  08                STA XD
0060  A5  05                LDA X2+1
0062  E5  01                SBC X1+1
0064  85  09                STA XD+1
0066  A5  06        S90     LDA Y2
0068  38                    SEC
0069  E5  02                SBC Y1
006B  85  0A                STA YD
006D  A5  07                LDA Y2+1
006F  E5  03                SBC Y1+1
0071  85  0B                STA YD+1
```

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Listing 3—continued

```
                        ;CALCULATE NEAREST DIAGONAL
0073  A9  01    S110    LDA #1
0075  85  14            STA A0
0077  85  15    S120    STA A1
0079  A5  0B    S130    LDA YD+1
007B  10  04            BPL S140
007D  A9  FF            LDA #-1
007F  85  14            STA A0
0081  A5  09    S140    LDA XD+1
0083  10  04            BPL S160
0085  A9  FF            LDA #-1
0087  85  15            STA A1
                        ;NEAREST HORIZ/VERT
0089  A5  09    S160    LDA XD+1
008B  10  14            BPL S160A
008D  A5  08            LDA XD
008F  49  FF            EOR #$FF
0091  18                CLC
0092  69  01            ADC #1
0094  85  0C            STA XE
0096  A5  09            LDA XD+1
0098  49  FF            EOR #$FF
009A  69  00            ADC #0
009C  85  0D            STA XE+1
009E  4C  A9 00         JMP S170
00A1  A5  08    S160A   LDA XD
00A3  85  0C            STA XE
00A5  A5  09            LDA XD+1
00A7  85  0D            STA XE+1
00A9  A5  0B    S170    LDA YD+1
00AB  10  14            BPL S170A
00AD  A5  0A            LDA YD
00AF  49  FF            EOR #$FF
00B1  18                CLC
00B2  69  01            ADC #1
00B4  85  0E            STA YE
00B6  A5  0B            LDA YD+1
00B8  49  FF            EOR #$FF
00BA  69  00            ADC #0
00BC  85  0F            STA YE+1
00BE  4C  C9 00         JMP S180
00C1  A5  0A    S170A   LDA YD
00C3  85  0E            STA YE
00C5  A5  0B            LDA YD+1
00C7  85  0F            STA YE+1
00C9  A5  0C    S180    LDA XE
00CB  38                SEC
00CC  E5  0E            SBC YE
00CE  85  10            STA D1
00D0  A5  0D            LDA XE+1
00D2  E5  0F            SBC YE+1
00D4  85  11            STA D1+1
00D6  10  46    S190    BPL S240
      142N.B. BRANCH FROM PAGE        0 TO PAGE
00D8  A9  FF    S200    LDA #-1
00DA  85  12            STA S0
00DC  A9  00    S210    LDA #0
00DE  85  13            STA S1
00E0  4C  00 01         JMP S215
00E3                    *=$100
0100  A5  0E    S215    LDA YE
0102  85  18            STA LG
0104  A5  0F            LDA YE+1
0106  85  19            STA LG+1
0108  A5  0C    S216    LDA XE
010A  85  1A            STA SH
010C  A5  0D            LDA XE+1
010E  85  1B            STA SH+1
0110  A5  0B    S220    LDA YD+1
0112  10  03            BPL S220A
0114  4C  1E 01         JMP S230
0117  A9  01    S220A   LDA #1
0119  85  12            STA S0
011B  4C  41 01  S230    JMP S310
011E  A9  00    S240    LDA #0
0120  85  12            STA S0
0122  A9  FF    S250    LDA #$-1
0124  85  13            STA S1
0126  A5  0C    S255    LDA XE
0128  85  18            STA LG
012A  A5  0D            LDA XE+1
012C  85  19            STA LG+1
012E  A5  0E    S256    LDA YE
0130  85  1A            STA SH
0132  A5  0F            LDA YE+1
0134  85  1B            STA SH+1
0136  A5  09    S260    LDA XD+1
0138  10  03            BPL S260A
013A  4C  41 01         JMP S310
013D  A9  01    S260A   LDA #1
013F  85  13            STA S1
                        ;SET UP COUNTERS
0141  A5  18    S310    LDA LG
0143  85  1C            STA TT
0145  A5  19            LDA LG+1
0147  85  1D            STA TT+1
0149  A5  1A    S320    LDA SH
014B  85  22            STA TS
014D  A5  1B            LDA SH+1
014F  85  23            STA TS+1
0151  A5  18    S330    LDA LG
0153  38                SEC
0154  E5  1A            SBC SH
0156  85  1E            STA UD
0158  A5  19            LDA LG+1
015A  E5  1B            SBC SH+1
015C  85  1F            STA UD+1
015E  46  19    S340    LSR LG+1  LG=LG/2
0160  66  18            ROR LG
0162  A5  1A            LDA SH    CT=SH-LG
0164  38                SEC
0165  E5  18            SBC LG
0167  85  20            STA CT
0169  A5  1B            LDA SH+1
016B  E5  19            SBC LG+1
016D  85  21            STA CT+1
```

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Listing 3—continued

```
                        ;WHILE MORE POINTS DO
016F  A5 1C     S355    LDA TT
0171  D0 07             BNE S360
0173  A5 1D             LDA TT+1
0175  D0 03             BNE S360
0177  4C 37 00          JMP S60
017A  A5 21     S360    LDA CT+1
017C  10 1B             BPL S390
017E  A5 20     S370    LDA CT
0180  18                CLC
0181  65 22             ADC TS
0183  85 20             STA CT
0185  A5 21             LDA CT+1
0187  65 23             ADC TS+1
0189  85 21             STA CT+1
018B  A5 13     S375    LDA S1
018D  85 17             STA Z1
018F  A5 12             LDA S0
0191  85 16             STA Z0
0193  20 00 02          JSR S3000
0196  4C B1 01  S380    JMP S410
0199  A5 15     S390    LDA A1
019B  85 17             STA Z1
019D  A5 14             LDA A0
019F  85 16             STA Z0
01A1  20 00 02          JSR S3000
01A4  A5 20     S400    LDA CT
01A6  38                SEC
01A7  E5 1E             SBC DD
01A9  85 20             STA CT
01AB  A5 21             LDA CT+1
01AD  E5 1F             SBC DD+1
01AF  85 21             STA CT+1
01B1  A5 1C     S410    LDA TT
01B3  38                SEC
01B4  E9 01             SBC #1
01B6  85 1C             STA TT
01B8  A5 1D             LDA TT+1
01BA  E9 00             SBC #0
01BC  85 1D             STA TT+1
01BE  4C 6F 01  S430    JMP S355
                        ;END OF PLOT PROGRAM
01C1                    *=$200
                        ;
                        ;SUBROUTINE TO STEP MOTORS
                        ;Z0 FOR Y AND Z1 FOR X
                        ;IF ZX = 0 THEN NO STEP
                        ;ELSE ZX = 1 THEN STEP ON
                        ;ELSE ZX = -1 THEN STEP BACK
0200  A5 17     S3000   LDA Z1
0202  F0 0B             BEQ DOY
0204  10 06             BPL FORWX
0206  20 36 02          JSR XMINUS
0209  4C 0F 02          JMP DOY
020C  20 22 02  FORWX   JSR XPLUS
020F  A5 16     DOY     LDA Z0
0211  F0 0B             BEQ DEL
0213  10 06             BPL FORWY
0215  20 5C 02          JSR YMINUS
0218  4C 1E 02          JMP DEL
021B  20 45 02  FORWY   JSR YPLUS
021E  20 68 02  DEL     JSR DELAY
0221  60                RTS
                        ;STEP X MOTOR 1 POLE ON
0222  38       XPLUS   SEC
0223  66 24             ROR STEPX
0225  B0 04             BCS XP1
0227  A9 F7             LDA #$F7
0229  85 24             STA STEPX
022B  AD 00 17  XP1     LDA DA
022E  09 0F             ORA #$0F
0230  25 24             AND STEPX
0232  8D 00 17          STA DA
0235  60                RTS
                        ;SET X MOTOR 1 POLE BACK
0236  38        XMINUS  SEC
0237  A5 24             LDA STEPX
0239  2A                ROL A
023A  24 26             BIT TESTX
023C  D0 02             BNE XM1
023E  A9 FE             LDA #$FE
0240  85 24     XM1     STA STEPX
0242  4C 2B 02          JMP XP1
                        ;SET Y MOTOR 1 POLE ON
0245  38        YPLUS   SEC
0246  A5 25             LDA STEPY
0248  6A                ROR A
0249  24 27             BIT TESTY
024B  D0 02             BNE YP1
024D  A9 7F             LDA #$7F
024F  85 25     YP1     STA STEPY
0251  AD 00 17  YP2     LDA DA
0254  09 F0             ORA #$F0
0256  25 25             AND STEPY
0258  8D 00 17          STA DA
025B  60                RTS
                        ;STEP Y MOTOR 1 POLE BACK
025C  38        YMINUS  SEC
025D  26 25             ROL STEPY
025F  B0 04             BCS YM1
0261  A9 EF             LDA #$EF
0263  85 25             STA STEPY
0265  4C 51 02  YM1     JMP YP2
                        ;DELAY SUBROUTINE
0268  A0 0A     DELAY   LDY #10
026A  A9 3C     DELAY1  LDA #60
026C  8D 06 17          STA C64D
026F  2C 07 17  AND     BIT SA
0272  10 FB             BPL AND
0274  88                DEY
0275  C0 00             CPY #0
0277  D0 F1             BNE DELAY1
0279  60                RTS
                        ;SUBROUTINE TO INITIALISE PORTS
027A  A9 FF     INIT    LDA #$FF
```

(continued on next page)

(continued from previous page)

Listing 3—continued

```
027C  8D  01 17          STA DDA
027F  8D  03 17          STA DDB
0282  A9  EE             LDA #%11101110
0284  8D  00 17          STA DA
0287  A9  00             LDA #0
0289  8D  02 17          STA DB
028C  60                 RTS
                    ;HALT CONDITION - TIGHT LOOP
                    ;HAVING FIRST SET PB0 HIGH
028D  A9  01        HALT LDA #1
028F  8D  02 17          STA DB
0292  4C  92 02     HI   JMP HI
                    ;COORDINATE TABLE
0295      00 00     COORDS .WORD 0,0
0297      00 00
0299      C8 00            .WORD 200,200
029B      C8 00
029D      64 00            .WORD 100,400
029F      90 01
02A1      64 00            .WORD 100,600
02A3      58 02
02A5      C8 00            .WORD 200,600
02A7      20 03
02A9      90 01            .WORD 400,900
02AB      84 03
02AD      58 02            .WORD 600,900
02AF      84 03
02B1      20 03            .WORD 800,800
02B3      20 03
02B5      84 03            .WORD 900,600
02B7      58 02
02B9      84 03            .WORD 900,400
02BB      90 01
02BD      20 03            .WORD 800,200
02BF      C8 00
02C1      58 02            .WORD 600,100
02C3      64 00
02C5      90 01            .WORD 400,100
02C7      64 00
02C9      C8 00            .WORD 200,200
02CB      C8 00
02CD      FF FF            .WORD $FFFF,$FFFF
02CF      FF FF
02D1
SECOND PASS FINISHED O.K.
SYMBOL TABLE
      96
DA       1700   DDA      1701
DB       1702   DDB      1703   C64D     1706
SR       1707   KIMMON   1C00   X1       0000
Y1       0002   X2       0004   Y2       0006
XD       0008   YD       000A   XE       000C
YE       000E   D1       0010   S0       0012
S1       0013   A0       0014   A1       0015
Z0       0016   Z1       0017   LG       0018
SH       001A   TT       001C   UD       001E
CT       0020   TS       0022   STEPX    0024
STEPY    0025   TESTX    0026   TESTY    0027
START    0028   START1   002A   GO       002C
S60      0037   S60A     003B   S80      0059
S90      0066   S110     0073   S120     0077
S130     0079   S140     0081   S160     0089
S160A    00A1   S170     00A9   S170A    00C1
S180     00C9   S190     00D6   S200     00D8
S210     00DC   S215     0100   S216     0108
S220     0110   S220A    0117   S230     011B
S240     011E   S250     0122   S255     0126
S256     012E   S260     0136   S260A    013D
S310     0141   S320     0149   S330     0151
S340     015E   S355     016F   S360     017A
S370     017E   S375     018B   S380     0196
S390     0199   S400     01A4   S410     01B1
S430     01BE   S3000    0200   FORXX    020C
DOY      020F   FORYY    021B   DEL      021E
XPLUS    0222   XP1      022B   XMINUS   0236
XM1      0240   YPLUS    0245   YP1      024F
YP2      0251   YMINUS   025C   YM1      0265
DELAY    0268   DELAY1   026A   RND      026F
INIT     027A   HALT     028D   HI       0292
COORDS   0295
END OF ASSEMBLY

14.02.48-
```

Speeding SWT CT64

AN unedited version of this appears in the Cape Computer Club newsletter C3PO. If you have SWTP's economical display terminal, and if you are tired of filling the screen at a maximum of 50 characters per second, you will probably read it with an eye on fast interactive games and graphics. Be warned, however, that these modifications will be beyond the scope of the rank beginner.

Step 1

THIS involves the CTS board only. Take a wire from IC 9 pin 8 out of the CT64 and connect it to a status input on the serial interface in your computer.

If your computer uses an ACIA, this wire can go to pin 24 of the CTS input. When the signal on this line goes high, the ACIA is inhibited from sending data. Similarly, if you are using an I8251 serial interface chip in your computer, connect this wire to pin 17—it is functionally equivalent to pin 24 on the ACIA.

If you have neither of these chips, this wire should go to some input where your computer can test its status before sending data to the CT64.

(continued on next page)

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At this stage you can run a quick test by outputting data on your terminal. You will probably notice an immediate increase in speed—particularly on Line 1 of the display.

You can now also run the CT64 at any baud rate you like—up to 1,200 baud from the internal clocks in the CT64, or from external clocks up to 500 Khz, the upper limit of common UARTs. This is possible because of the handshaking you have just added, but though you are now using a higher baud rate, data will still be taken only as and when the CT64 can accept it.

- Cut track from J3 pin 13 to IC31 pin 4; cut this underneath the PCB near J3.
- Cut track between IC17 pins 13 and 12 on PCB upper side.
- Cut track between IC3 pins 14 and 13 on PCB upper side.

Now add the circuitry in Figure 1. Diode 1 should preferably be a germanium type. This wiring can all be executed on the upper side of the PCB.

If you have not socketed your ICs, now is the time to remove ICs 40, 41 and 42 on the main PCB. Do this carefully; you will need them in a later step. Install IC sockets in these positions.

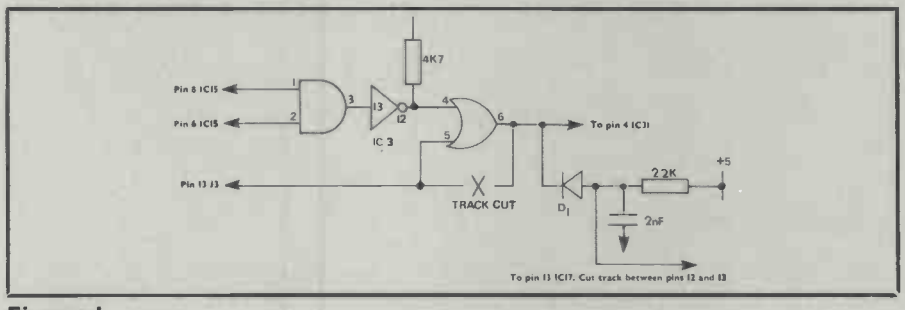


Figure 1

Note also that you will run into trouble when the CT64 has to perform an erase to end of line, or end of frame.

Step 2

Remove the main PCB from the CT64. You will now have to make three track cuts on the top and bottom of this PCB.

- Cut tracks to IC29 pins 1 and 2, so as to isolate each one—they are on top of the PCB adjacent to the IC and serve only to short these pins to ground. The output pin (3) is not connected.

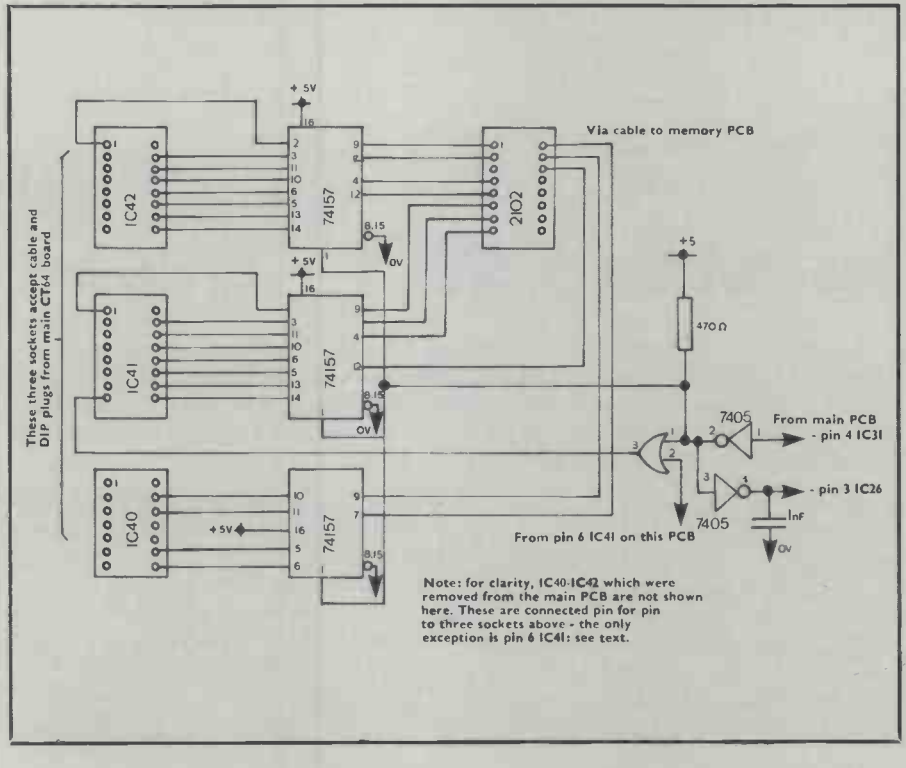
Step 3

This is where the hard work begins. You will require some Veroboard. The best mounting position is where the 'screen read' PCB normally resides. If you decide to do this, isolate some of the screen read board pins on the main PCB and connect them to IC45 pin 6 and IC26 pin 3, and make a note of them.

You will then need to make up four cables, preferably with 3M flat cable and DIP header plugs. Three of them will have 16-pin DIP plugs on either end, one with 14-pin plugs.

Figure 2

(*continued on next page*)



(*continued from previous page*)

One end of each of these cables will plug into the sockets vacated by ICs 40–42; the fourth goes into one of the sockets on the CT64 memory PCB occupied normally by the second page of memory.

Then take the ICs you removed and mount them on your piece of Veroboard. Wire the pin-for-pin to the 16-pin sockets intended to accept the spare ends of DIP cables and plugs from the main PCB.

In effect, all you have done is to remove ICs 40–42 from the main PCB and put them on your new PCB. At this stage all functions are unaltered, so then is a good time to plug everything together and test that all is still working correctly.

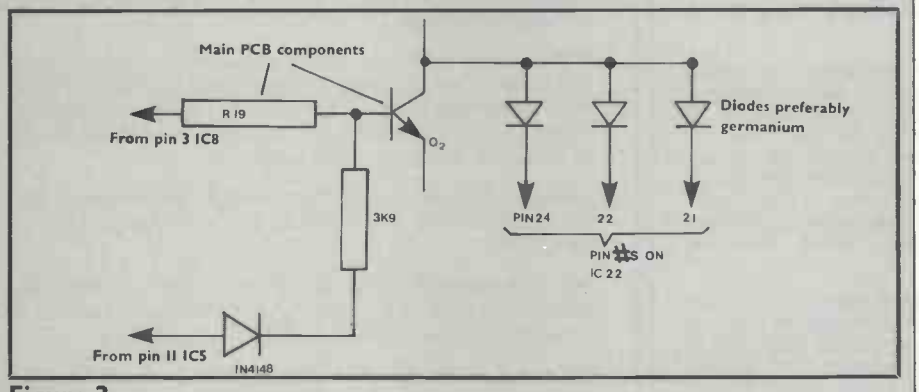


Figure 3

Step 4

Isolate all 10 memory address lines to the memory PCB. It can be done by cutting the relevant tracks on the memory board, or preferably by placing heat-shrink tubing over pins 1 to 9 and 13 on J7. Before going further, check with an ohm meter that the lines really are isolated.

Then locate IC41 on your PCB and isolate pin 6. Build the circuit of figure 2 on your Veroboard, noting that pin 6 of IC41 goes to a 7432 IC of figure 2. Then wire the remaining ICs of figure 2. Note that the sockets labelled IC40–42 and 2102 are the ones intended to receive the free ends of the flat cable header plugs.

That completes the modification and all that remains is testing. On powering-up the cursor, erase to end of line/frame functions should all work correctly and it will be possible to enter data at speeds up to the limits of your ACIAs and UARTs. If required, you can upgrade your CT64 UART to an Intersil IM6102 which can accept clock rates up to 4MHz.

The prototype of this modification was run at a clock rate of 450KHz, giving a baud rate of about 2,800. It was possible to load 2,500 characters per second both in page and scrolling mode. This was almost the upper limit of the UART on the CTS board so a higher clock rate was not tried.

Note that capacitors C1 and C2 should be disc ceramic types. Although it is bad practice to use caps to slow up TTL, it was considered worthwhile as this reduces chip count and complexity.

Finally, an additional three modifications are included. They do not improve speed but they improve the aesthetic appearance and operation. Figure 3 shows the circuit for changing the cursor from a reverse video box to an underscore; the modification requires only four diodes and one resistor.

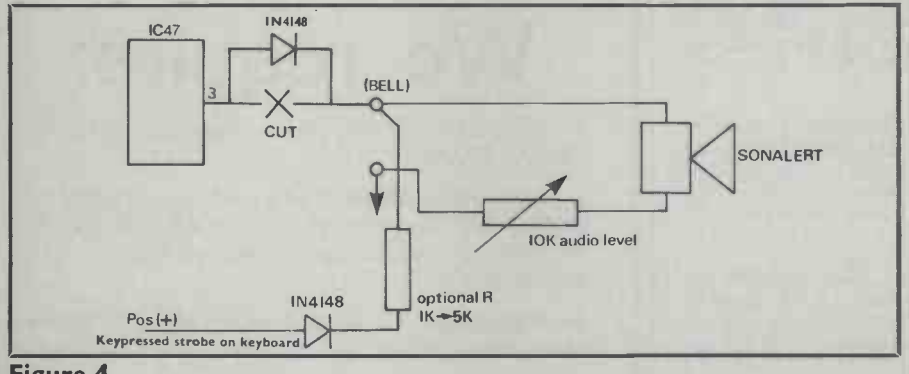


Figure 4

Figure 4 adds a keypressed monitor. It makes keyboard entry that much easier, as there is no longer a need to look to check that a character has been entered. Only one track cut is required, on the output of the NE555 driving the Sonalert, plus the addition of one diode between pin 3 of the IC and the bell pad. A small pot has also been included to lower the Sonalert Audio Level.

The final modification involves stopping the the bell signal which appears after every 16 lines, since it becomes irritating when loading data at high speeds. For this it is necessary to isolate only pin 1 of IC39. µ

May

●1 **Introduction to computer systems** is intended to fulfill the basic requirements of computer knowledge in technical and operational aspects. It is a five-day course and will be running almost constantly from May 1. The courses will be held in the Isle of Wight. The cost of each course is £100, exclusive of accommodation. Contact: ASMAP Environmental Products, Unit 1, Donor Industrial Estate, Newport, Isle of Wight. Tel: Newport (0983) 524393.

●1 **The microprocessor industry—the past year and the year to come** are two one-day seminars for the experienced microprocessor user and will discuss recent developments and probable trends. The cost is £75·60. Venue: London.

●4 **A beginner's seminar on microprocessors** is a one-day event designed to give delegates an understanding of what microprocessors are and a perspective of the industry. It will be conducted by Dr Adam Osborne and is sponsored by *Electronic Engineering*. It will cost £64·80, including lunch and refreshments, as as well documentation. The seminar at the Grand Hotel, Manchester. More information from Conference Communications, Monks Hill, Tilford, Farnham, Surrey. Tel: (025 18) 3111.

●4-6 **Southern Microcomputer Industry Show.** Venue: Expo Hall, Exposition Park, Orlando, Florida. If you have always fancied a trip to sunny Florida, this could be your ideal opportunity to mix business with pleasure. All the latest U.S. technology will be on display. Contact: Bud Felsburg, Felsburg Associates, Inc, PO Box 735, Bowie, MD 20715.

●8-10 **Compec Europe Exhibition,** Brussels. Similar type of exhibition to Compec but with a European flavour. Contact: Iliffe Promotions Ltd, Dorset House, Stamford Street, London SE1.

●12 **Personal Computer World.** Venue: West Centre Hotel, 47 Lillie Road, London SW6. Seminar/Mini Exhibition. More information from POW Exhibitions, 62A Westbourne Grove, London W1.

●15-17 **Seminex '79.** This popular seminar/exhibition is to be repeated for the first time in Scotland this year, at the George Hotel, Edinburgh. A selection of programmes first heard at a London seminar will be given. Seminex Ltd., 79 High Street, Tunbridge Wells, Kent. Tel: (0892) 39664.

●15-17 **Micro/Expo 79.** Venue: Paris. Promises to be one of the leading microcomputer and personal computing exhibitions in Europe. The themes will be personal computing, new products and industrial applications. Organiser: Sybex Europe, 313 Rue Lecourbe, 75015 Paris, France. Tel: (1) 828 2502.

●21-23 **Microcomputers in management—their potential and challenge.** Venue: Oxford. This seminar is directed at senior managers and will look at the threats and opportunities presented to companies by the rapid development of microcomputers. Fee for the three days is £250, including residence. Further details from Mrs S Beaven, seminar administrator, Oxford Centre for Management Studies, Kennington Road, Kennington, Oxford. Tel: (0865) 735422.

June

●4-8 **Applications Software for Operational Research.** Venue: National Liberal Club, Whitehall Place, London, SW1. Run by Oxford Systems Associates, this course is aimed at those involved in software development. The fee is £300, including course materials and lunches. More information from Judith Wagstrom, Oxford Systems Associates Ltd., BCM OSALTD, London, WC1V 6XX.

●11-15 **Trouble-shooting microprocessor-based systems** is a five-day course covering all you need to know about micros, from basic concepts and terminology to designing and testing. The cost is £540 plus VAT. Documentation relating to the course will be available at £115. More information from Integrated Computer Systems. Tel: (01) 283 3974.

● *If you have an event you would like us to include in our diary columns, write to Practical Computing, 2 Duncan Terrace, London N.1.*

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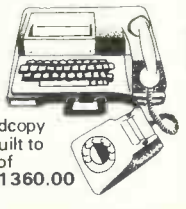

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THE BUYERS' GUIDE is a summary of low-cost computers available in this country. It appears each month; weadd new computers and amend existing information as required to keep up-to-date. The cut-off point is taken as £5,000. Computer systems costing more than that for a minimum configuration cannot be summarised adequately in a brief table, while probably they fall outside the scope of the magazine.

Systems are listed by manufacturer. We believe this is probably the easiest way to identify particular microcomputers, because the manufacturer's name is likely to be better-known than even that of a sole U.K. distributor. Some entries, of course, relate to British-made micros available only from the manufacturer, so there will be no difficulty there.

Most of the small computers available here are from the States, though, and are listed under the States-side name.

Note, however, that for many of them the U.K. distributors provide their own software packages, and in some cases they also offer their own hardware add-ons.

If you have a small computer which could be included in the Guide, please let us have details.

SUPPLIER	HARDWARE/SOFTWARE & APPLICATIONS/AVAILABILITY	PRICE
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APPLE COMPUTERS	**Apple II.** Min size: 16K memory; 8K ROM; keyboard; monitors; mini assembler; colour graphics; Pal card; RF modulator; games; paddles and speakers; 4 demo cassettes. Max size: Expandable to 48K memory; floppy discs and printers are now available. Two versions of Basic, PASCAL; Assembler; games; business packages. An American system regarded as suitable for any kind of applications. Maintenance contracts offered. Personal Computers Ltd (01-283 3391) is the sole U.K. agent but has a distributor network of 20 dealers.	Around £1,000
ATTACHE	**Attache.** Min size: system with 10 slots, S100 bus, 8080 processor and 16KB housed in desk-top case with built-in keyboard. Max size: 64KB, parallel printer interface, two single- or double-density 8in. floppies, video screen. Disc Basic; business applications produced by Moncoland, the sole U.K. agent. Distributors include Keen, GBH, Alba, and Lion.	From £1,737 without video or external storage. Full business system with screen, discs and printer about £5,000
BRUTECH ELECTRONICS	**BEM-CPU1:** single-board processor with 6502 and no RAM. No applications software. Available from Data Precision Equipment (04862 67420)	From £116
COMART	**Microbox.** Chassis with three to six PCB sockets for S100 boards, plus fan. Several S100 boards available. Aimed mainly at OEM industrial users and perhaps the serious hobbyist. It will take Cromemco, North Star and other processors. Available from Comart (0480 215005).	£255 for full package plus case.
COMMODORE SYSTEMS DIVISION	**Pet.** Single unit containing screen, tape cassette and keyboard. Floppy disc, printer and full-size keyboard are options, as are external cassettes. Basic; games; business packages. The British subsidiary of Commodore Systems of the U.S. sells Pet for home, educational and small business applications. About 80 distributors.	£460–£795 exc VAT
	Kim 1, processor (6502 chip); small calculator-type keyboard; LED six-digit display; built-in interfaces for audio-cassette and Teletype; 1K RAM; 2K ROM (can add up to 64K). No software available. but it has three good manuals. An American import which gives Pet-type capabilities with a maximum configuration. For the hobbyist but used mainly as an evaluation board for the 6502 chip. Twelve to 15 dealers.	£99·95
COMPELEC ELECTRONICS	**Series I.** Z-80 processor 512MB floppy, 32KB, Centronics printer, VDU. Up to 4MB disc and 64KB. CP/M, Basic, Cobol, PASCAL, Fortran IV, Assembler. Business and word processing packages available. From Compelec (01-580 6296), which is also sole supplier of Altair systems.	Less than £5,000 for basic system.
COMPUCOLOR	**Compucolor II.** Packaged system including 13in. eight-colour display with alphanumerics and graphics, 72-key detachable keyboard, 8KB, and built-in mini-floppy. Max size: 32KB. Extended disc Basic In ROM, graphics programs and games. The system now ranks fourth behind Pet, TRS-80 and Apple in personal computer sales. Abacus (01-580 8841) is sole U.K. agent and is arranging distributors, including the Byte Shop and Transam.	From £1,390
COMPUCORP	**610:** desk-top unit using Z-80 and incorporating screen, 150KB floppy, 48KB. Up to 60KB memory, four floppies, printers. Basic, Assembler, DOS, text editor, file manager; business packages. Nine dealers.	From £3,890
COMPUTER CENTRE	**Mini kit:** Z-80 CPU, CTC, USART, serial and parallel I/O. 16 bytes memory, Western Digital disc controller, SA400 5in. drive plus CP/M, cables and connectors.	Mini klt: £786.
	Maxi kit: As above but with DRI 7100 8in. drive instead of 5in. drive. All (33) volumes of CP/M user group library available for cost of media. Library includes utilities, games, Basic compilers/interpreters and Algol compiler. Microsoft Basic, Cobol, Fortran also available. Computer Centre (02514 29607).	Maxi kit: £886.
COMPUTER WORKSHOP	**System 1.** Typical size: 40K memory; dual 8in. floppy discs, total storage capacity 1·2MB; Ricoh daisywheel printer. **System 2.** Typical size: 24K memory; dual minifloppy discs of 80K bytes each; Centronics 779 dot matrix printer; VDU.	System 1, £5,000 plus. System 2, around £3,000.
	System 3. 12K memory, cassette interface; 40-column dot matrix printer. Editors, Assemblers, Basic, games, information retrieval package. The systems were designed and built in Peterborough and are suitable for educational and small business users and perhaps the more serious hobbyist. Twenty-five dealers.	System3, from £1,350.

(*continued on page 107*)

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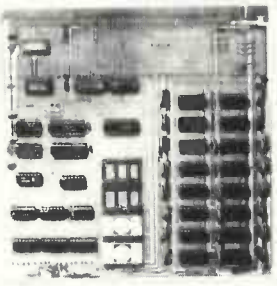
The great RAM sale



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16K £140.00
32K £200.00

Boards will also accommodate up to four EPROMS of type 2708 at £10.50 plus VAT each. And if you wish to upgrade 16K to 32K it will only cost you an additional £70.

Memory boards plug straight into a NASBUS and an edge connector is included for this. All boards must be used in conjunction with the buffer board which, like the memory boards, is available in kit form ex-stock from approved Nascom distributors.

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(*continued from page 105*)

SUPPLIER	HARDWARE/SOFTWARE & APPLICATIONS/AVAILABILITY	PRICE
CROMEMCO	**Single-card computer.** 4MHz Z-80 CPU, S100 bus, 1KB RAM, sockets for 8K ROM. 20mA/RS232 serial interface and parallel bi-directional interface. Basic in ROM and Z-80 monitor. For OEM and industrial users; used with backplane for "full computer capability". Comart is the sole agent and has 12 distributors.	£247–£281.
	Z-2. Min size: chassis, 30A power supply, motherboard, Z-80 processor, 16KB memory. Max size: 512KB, 21 sockets, three minifloppies or four 8in. floppies. Basic, Fortran, Cobol, assemblers. For serious hobbyists, OEMs, educational applications, and industrial/scientific users.	£372 (in kit form) to more than £4,000.
	System Two. Min size: factory-assembled system with 32KB, dual 90K minifloppies, dual printer interface, serial interface. Max size: two additional floppies, 512KB, up to seven terminals. CP/M-compatible operating system (CDOS), Fortran, Cobol, Basic, assemblers, word processing, database manager. Multi-user system for software development, or scientific/industrial/business users.	£2,294 upwards.
	System Three. Min size: 32KB, dual 256KB floppies, dual printer interface, 20mA/RS232 serial interface, Z-80 processor. Max size: two additional discs, 12KB, seven terminals, multi-channel A/D and D/A interface, PROM programmer. Software as for System Two. Described as appropriate for small to medium business, scientific and industrial users—"rivals minicomputers at more than twice the price".	£3,444 to more than £10,000.
EQUINOX	**Equinox 300.** Min size: 48K memory; dual floppy discs giving 600K bytes of storage; 16-bit Western Digital m.p.u. Max size: up to 256K memory; up to four 10MB hard discs. Basic, Lisp, PASCAL, Macro Assembler, Text Processor. All software bundled. The system is a multi-user, multi-tasking, time-sharing system for two to 12 users. Application software available for general commercial users. Sole distributor Equinox Computers Ltd (01-253 5181).	£5,000–£40,000 plus.
EXIDY	**Sorcerer:** based on Z-80. 16K and 32K; cartridge and cassette interfaces; 79-key keyboard; 256-character set (128 graphics symbols); 12 in video monitor; expandable with Micropolis floppy discs. Basic, Assembler and Editor; games, word processor. Other pre-packaged programs plus EPROM pack for your own programs on cartridges. There is no sole importer for U.K.; sold through various importers and dealers.	£760 for 16K, £859 for 32K (excludes video monitor); £1,200 with floppy discs.
IMSAI	**VDP 40:** 32K or 64K RAM memory 9in. display screen, standard keyboard. Two 5¼in. floppy disc drives; serial I/O. No software support, but packages for the larger VDP-80 could be converted for smaller system. This would be from about £700 per package. Computer Mart, Norwich (0603 615089), is the main U.K. supplier but there are other distributors.	£4,507 for 32K model.
ITT	**2020.** Identical to Apple II. Min size: 4K memory; 8K ROM; keyboard, monitor, colour graphics, mini assembler; Powell card; RF modulator, games, paddles and speaker; Max size: 48K with floppy discs and printers. Basic, Assembler, games, business packages. Generally suited to any type of application. Fifteen wholesalers, including Fairhurst Instruments.	From £965 for 4K and cassette, to £2,014 for 32K plus floppy and printer. £3,003 for 48K version, two floppies and serial printer.
MICRONICS	**Micros.** Typical size: 1K monitor; 47-key solid state keyboard; interfaces for video, cassette, printer and UHF TV; serial I/O, dual parallel I/O ports; 2K RAM; power supply. 2K Basic; British-designed and manufactured system. Claimed to be the cheapest data terminal—a system with an acoustic coupler and VDU for £1,020. Prospective applications for small businesses, process controllers and hobbyists. Manufacturer is sole distributor (01-892 7044).	From £400, assembled.
MICRO V	**Microstar.** Single box with twin 8in. floppy discs, 64K RAM, three RS232 serial inputs, STARDOS operating system enables system to have three VDUs, plus a fourth job running simultaneously. Word processing software available. Packages being developed include invoicing system, payroll, accountancy type system. Price includes a reporter generator language. Imported by a Data Efficiency subsidiary, Microsense Computers. Microsolve is London agent; other distributors being arranged.	£4,950 or machine and software.
MIDWEST SCIENTIFIC INSTRUMENTS	**MSI 6800.** Min size: 16K memory, Act 1 terminal; cassette interface. Max size: three disc systems—minifloppy system with triple drives of 80 bytes each and 32K memory, large floppy system with up to four 312K-byte discs and 56K of memory mounted in a pedestal desk, or hard disc system with 10MB and 56K. Basic interpreter and compiler; editor; assembler; text processor on small disc system. American-designed system being manufactured increasingly in the U.K. Sole U.K. agent is Strumech (SEED) (05433 4321) but a distributor network is being established.	Basic system: £1,100 (£815 as kit); Minidisc, £2,500; Large floppy disc £3,200, plus £1,400 for quad system; hard disc, £8,000–£12,000.
NASCOM MICROCOMPUTERS	**Nascom 1.** Min size: CPU; 2K memory; parallel I/O; serial data interface; 1K monitor in EPROM. Max size: CPU; 64K memory; up to 16 parallel I/O ports. Mostly games, but also a dedicated text editor system written by ICL Dataskil. Nascom is working on large versions of Basic, and 8K Microsoft Basic should be available soon. Eleven distributors in U.K. Nascom is negotiating to increase the number.	£165 exc. VAT.
NEWBEAR	**7768.** CPU board, 4K memory, cassette and VDU interfaces. Range of Basics and games, British-manufactured system for hobbyists. Expandable to 64K memory, available only in kit form. From Newbear; also from Bearbag dealers, Microdigital, Microbits.	From £45
NORTH STAR	**Horizon.** Min size: 16K memory; Z-80A processor, single minifloppy disc drive (180KB). Max size: 56K memory, four minifloppy disc drives (180KB), any acceptable S100 peripheral boards. Basic (includes random and sequential access), disc operating system and monitor. Options: Basic Compiler, Fortran, Cobol, Pilot, PASCAL and ISAM. The system is suitable for commercial, education and scientific applications. Application software for general commercial users. Twenty distributors.	£995 to £2,500.

(*continued on page 109*)

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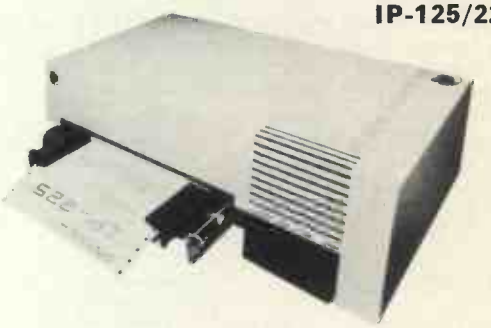

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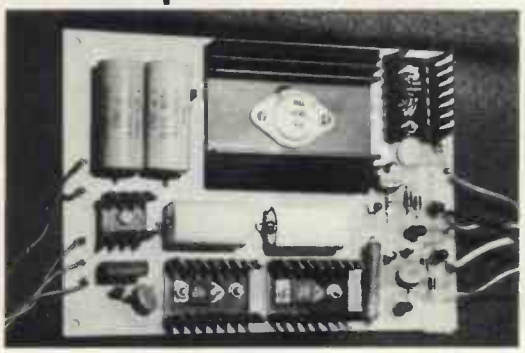
Computer standard



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(*continued from page 107*)

SUPPLIER	HARDWARE/SOFTWARE & APPLICATIONS/AVAILABILITY	PRICE
OHIO SCIENTIFIC	**Ohio Superboard II:** Min size: 6502 processor. 8K Basic in ROM; 2K monitor in ROM; 4K RAM; Cassette I/F; full keyboard; 32 × 32 video I/F. 8K Basic in ROM; Assembler/Editor; American single-board system with in-board keyboard. Aimed at hobbyist/small business. Ohio makes games, personal maths tutors, and business programs. This and other Ohio products have six U.K. distributors.	From £298.
	Challenger C24P: similar to Superboard but with a 32 × 64 character set. Supplied as two separate boards with open slots for expansion. The 'professional portable'; similar to Superboard but packaged and ready to use. Aimed at small business, education, research.	£620 to £1,595.
	Challenger C28P: similar to 4P but expandable to include two 8in. floppies, allowing use of Ohio software. Personal computer for larger business/commercial programs. Aimed at small business, education and research.	£825–£2,670.
	Challenger C3. Min size: 32K RAM, dual 8in. floppies, triple processor architecture (6502A, Z-80, 6800). Max size: 768K RAM, 74MB hard disc, multiple terminals, printers. Can run virtually all 6502, 6800, 8080 and Z-80 code. Runs Basic, Cobol and Fortran under OS CP/M. Full business software packages available, including word processing and database management. Multi-programming available.	£3,425–£13,000.
PERTEC	**System 1300.** Min size: 32K memory; dual minifloppy discs 71 bytes each, formatted; serial interfaces. Max size: 64K memory; four serial ports. Basic (single and multi-user), Fortran, Cobol. The hardware for Compelec Altair systems is from Pertec but the software is Anglo-Dutch. Sole distributor Compelec (01-580 6296).	£3,000–£5,500.
PROCESSOR TECHNOLOGY	**Sol.** 808-based S100 microcomputer packaged with cassette and video interfaces (including graphics), keyboard with numeric pad, and 16KB RAM. Basics, assembler, word processors. Floppy disc systems available. Several distributors including Comart (0480 215005), which can offer nationwide maintenance contracts.	From £1,750 (excluding monitor and cassette). Complete floppy disc systems with word processing about £5,000.
RAIR	**Black Box.** Min size: 32K memory dual minifloppy discs, 80K bytes each; two programmable serial I/O interfaces. Max size: 64K memory; eight serial interfaces; 1MB disc storage (or 10MB hard disc); range of peripherals. Basic, Fortran IV; Cobol. Hardware distributors are being signed and agreements made with software houses to add software. A warranty and U.K.-wide on-site maintenance is given. From manufacturer (01-836 4663) and systems houses.	From £2,300.
RESEARCH MACHINES LTD	**380-Z.** Min size: 4K memory; 380-Z processor, keyboard. Max size: 56K memory. Options: cassette, single or dual minifloppy discs, dual 8in. double-sided discs (1MB); serial interfaces; parallel interfaces; analogue interface; printer available. Basic Interpreter, Z-80 Assembler; interactive text editor: terminal mode software; data logging routines; CP/M, DOS, text processor, C Basic, Fortran, Algol, Pilot, Cobol, CP/M users' club library. Sold principally to higher and secondary education, and for scientific research, data processing and data logging. Available from Sintel and the manufacturer.	From £830–£3,500.
	280-Z. Board version of 380-Z system. 4K or 32K (identical in performance to the 380-Z). Interfaces, software as for 380-Z.	4KB version at £398; 32KB for £722.
RCA	**Elf II:** RCA 1802 micro with hex keypad and output to TV screen. Assembler and machine code programming; options include Tiny Basic. Available by mail order from HL Audio (01-739 1582).	From £99·85 in kit form; £164·10 including postage and VAT.
ROCKWELL	**Aim-65:** Kim-compatible with full keyboard and on-board printer. 1K or 4K RAM. The 4K version is described as a development system rather than a personal computer. Assembler, editor, Basic. Available from Pelco and Microdigital.	1K—£249·50. 4K—£315.
SCIENCE OF CAMBRIDGE	**MK14:** SC/MP processor, 256 bytes user memory; 512-byte PROM with monitor program; hex keyboard and eight-digit, seven-segment display; interface circuitry; 5V regulator on board. To this can be added: ¼K RAM (£3·60); 16 I/O chip (£7·80); cassette interface kit (£5·95); cassette interface and replacement monitor (£7·95); PROM programmer (£9·95). No software provided but a 100-page manual includes a number which will fit into 256 bytes covering monitors, maths, electronics systems, music and miscellaneous. Based on American National Semiconductor chips. Science will soon have a VDU interface and large manual on user programming. Mail order from manufacturer (0223 312919) and by selected dealers.	£39·95 basic.
SDS	**SDS 100.** Single unit containing 32K memory (expandable to 64K); up to 8K PROM; twin double-sided floppy disc drives of 500 bytes each, serial and parallel RS232 interfacing; keyboard; 12in. video display; power supplies; SD monitor program; line printer available. CP/M, 8080 assembler, E Basic, Editor supplied with system; M Basic, Fortran, Cobol available for business use, industrial process monitoring and control (with additional hardware). All CP/M games and business packages. Sole supplier Airamco (0294 65530).	From £3,750 (basic machine) plus £890 (printer); £4,500 combined.
SYNERTEK	**Sym 1:** 6502 chip and keypad with memory available in 4K blocks to 64K. Any Kim software. American, meant to be the foundation system for very small business and hobbyist users. Available from Newbear (0635 49223).	From £200.
TANDY	**TRS-80:** Min size: Level 1 4K memory; video monitor; cassette; power supply. Max size: Level 2 16K memory; line printer, floppy disc system. Basic; some business packages. American system from the Tandy consumer electronics chain—the Level 1 is aimed at the hobbyist and education market, Level 2 more at small business applications. Floppy disc and printer available. Tandy has 161 retail shops.	Level 1— £499 Level 2—£807 for basic CPU with no extras.
TRANSAM COMPONENTS	**Triton:** British-made kit computer. Up to 65KB. Full graphics capability, 64 characters. Power supply: cabinet. Communications interfaces. Tiny Basic or 2K Basic, 1KB monitor plus new option 4K firmware on board. Available from manufacturer. (01-402 8137.)	£286 kit with 5KB.
VECTOR GRAPHIC	**48KB RAM, Z-80 micro:** 63K bytes, mini-discs are standard, Options: graphics. Monitor, MDOS, Basic: business packages from dealers. Several distributors.	£2,300

A PRACTICAL GLOSSARY

Continuing the terminological gamut from H to I

Hash

Pre-digested version of dead Argentine cows, much beloved by Boy Scouts. It's also a sign—# the hash mark—which Americans use a good deal as shorthand for 'number' (just as we use No.). That connection means that the hash mark appears frequently on U.S. derived keyboards and internal computer codes; the hash is printable, of course ,and the code relating to the hash frequently has an inescapably important internal meaning.

HDLC

High-Level Data Control. In sophisticated computer networks, many different computers talk to each other and use each other's facilities. A communications *protocol* is a format to which inter-system messages must conform if all participants in the network are to understand them. HDLC is an example of a protocol. It is utilised by several computer manufacturers as their standard protocol. Its principal competitors are SDLC (from IBM) and DDCMP (from Digital Equipment). This is all a little esoteric, but wait for an entry on *PCNET*.

HDX

Abbreviation for *half-duplex*.

Head crash

Bad news. It's what happens when the read/write head in a disc drive hits the surface of the disc. Disc drive technology is such that a minute particle of dust might cause the head to bump on to the disc; at the very least you are likely to get duff data from the event, and the impact might damage the surface permanently.

Hertz

Hertz is a measure of frequency and means 'cycles per second'. Electricity supply has frequency. Things which run from the electricity supply have to reflect its frequency, its Hertz rate; and in Europe the supply is at 50 Hertz, while in the States it is 60.

This is important, because it means that something designed to run off a U.S. power supply won't work here. Converting from 60 to 50 Hertz isn't too tricky, but this is the reason why you can't run an unmodified U.S. microcomputer in Britain.

Heuristic

Means that you rely on trial and error to get your result, learning by experience. It sounds trivial, but it isn't. There is a methodology called heuristic programming and it is a trifle esoteric. The classic textbook on the subject is Slagle's 1974 opus *Artificial Intelligence—the heuristic programming approach*. Slagle describes " a heuristic" as " a rule of thumb, strategy method, or trick used to improve the efficiency of a system which tries to discover the solutions of complex problems".

Hewlett-Packard

HP has a running battle with Data General for No. 2 spot in the minicomputer business—Digital Equipment is unassailably top dog, of course. DG ships more minis than HP, but HP minis are worth more, so HP makes more money. In fact, they are in different (albeit related) markets. The bulk of HP mini sales tend to be commercial systems accoutered with terminals, database managers, high-level languages and the like. DG does such systems, but most of its shipments are of cheaper and less fully-specified minis.

DG also sells a 16-bit micro, the microNOVA. HP makes its own micros, using SOS—sillcon-on-sapphire—technology rather than the MOS—metal-oxide-silicon—which everyone else has. But HP micros are embedded in HP products, notably a line printer and the HP small business system. You can't buy HP micros like you can the LSI-11 or microNOVA.

There are other important strings to HP's bow, of course, It is one of the leading manufacturers of programmable calculators, and its product lines in thls area extend up to the cost and complexity ofits minis. HP is also big in instrumentation for hospitals and laboratories.

Hex

Abbreviation of hexadecimal. Since we shall not repeat it, read on. Hex is a number system to the root 16, just as decimal Is to the base 10, binary to the base 2, and octal to the base 8.

Hex uses number 0 to 9 and letters A (for 10) to F (for 15). In this way a byte can be represented as only two digits, one for the first four bits and one for the second four. Hex is thus a neat way of relating numbers to internal computer operations.

A practlcal example: the decimal number 183 can be represented in binary as 10110111 (which is a precise equivalent to what's going on inside, but it is a bit clumsy). In hex it is B7, B because the first four binary digits represent '13', if you like, and 7 because that's the hex notation for 0111 (which is also 7 in decimal).

High-level language

Optimistic name for a group of programming languages which try hard to be independent of any computer. A 'low-level language' is one specific to a particular computer. The lowness of the level refers to how closely the programming language matches the computer's internal machine code; a high-level language needs a good deal of translation and conversion before it can be expressed in machine code. A high-level language tends to use single powerful commands which initiate many machine code operations.

Machine-independence is something of a chimera, of course. Languages like Cobol, Fortran, APL and Basic are largely machine-independent, but the programmer who knows Basic on one computer will have to learn some new wrinkles before writing (or running) a program on another.

Highway

Alternative name for *bus*.

HLL

Abbreviation for high-level language.

Hobby computer

A computer not used for profit, though many companies with conventional computers would be hard put to identify any profit from them. Computing as a hobby implies that you get your buzz from computing itself, rather than from applying the results of computing.

Hobbyist

One who practices a hobby, of course. It's an ugly word, but try and produce a better alternative. Anyhow, it's one of those words which if you repeat for long enough takes on a life of its own.

Hollerith

The man who effectively specified the punched *card* as we know and detest it; at the time (1889) it was a great idea, though. Herman H was involved in statistical analysis of the U.S. census and immigrant information and evolved the idea of putting all the information on to cards with holes punched in appropriate places to denote specific information. He then unveiled a machine called a tabulator which detected whether ot not a hole or a series of holes occurred in particular positions; if that was the case it added one to a counter.

So if you had a series of columns on a card which denote respectively age groups, sex and marital status, you could detect which of the alternatives in each column a particular card represented, and you could also sort particular combinations of age, sex and marital status.

Hollerith died rich and the particular code used by him, called the Hollerith code, is still the standard for punched cards.

Home computer

You're not going to believe this, but a home computer is a computer which can be used in the home. It sounds like a silly name, but there is a distinction between home computers and office computers. An office computer presupposes hard-copy output, for instance, and it tends to be bulkier and more robust than something you can load into the boot of your car or move around from room to room. Home computer isn't exactly a technical definition though.

Honeywell

One of the big American companies in mainframe computers. Honeywell also has a process control division which, among many other things, makes intelligent thermostats for domestic central heating.

In the early 1970s Honeywell had the chance to become a major force in the mini business but it chose to concentrate instead on its big computers. With the Level 6 mini line launched two years ago, it is once again looking strong at the small end of things.

Honeywell doesn't seem very interested in micros and really small computer systems. It is well into the use of micros for process control, though.

House-keeping

This is a good analogous term. House-keeping in a computer system covers all those internal activities which don't relate to solving problems or executing user programs but which contribute to the system's general capability for solving problems and executing programs. It's a bit like dusting and sweeping-up at home; these operations don't have much specifically to do with what your house is for but they contribute to the 'operation' of the home.

There probably isn't an exact definition of what constitutes a housekeeping routine, but we would include such activities as checking files for unused space and compacting everything if possible. For instance, you may have a name and address file with space for you to list 50 friends. If you only have two friends at the moment, you might as well cut down the file size and give yourself some more space on the disc

(*continued on next page*)

(*continued from previous page*)
or cassette. You can also forget that football fixtures program you've been writing.

HPIB

Hewlett-Packard Interface Bus. Essentially a plug-and-socket connection defining one way in which peripherals (typically laboratory instruments, in this case) communicate with a computer.

RS-232 is popular as a standard interface connection but the HPIB was adopted more or less wholesale when the independent American Institution of Electrical and Electronic Engineers produced its own standard interface. That one is known as IEEE-488.

Among other places, it's used by Pet; the standard peripheral connector at the back of Pet is an IEEE-488 interface. Many people were irritated by this, because many standard peripherals (especially printers) have an RS232 interface but not IEEE-488.

Hybrid

There are three uses of this adjective or noun you might meet and all are rare. A *hybrid computer* combines analogue and digital processing and is used only in esoteric technical application. A *hybrid circuit* is an IC package which incorporates separate chips inside. And a *hybrid disc* is a unit with a fixed disc and a removable cartridge disc. The two are usually the same capacity—2·5 or 5 megabytes seem to be the norm—and the idea that new data or programs can be taken to the computer on the cartridge and loaded into memory and/or the fixed disc. The fast-access fixed disc is then used for most of the processing work and at the end of the day the cartridge takes a back-up copy for security purposes. This set-up is sometimes called a FEDS (fixed-plus-exchangable disc store).

Not many people use hybrid computers, not many need to know about hybrid circuits, and not many would recognise the term 'hybrid disc'.

Hz

Abbreviation for Hertz.

IBM

International Business Machines Corp is one of the big names. This means it can astound people with the amount of money it makes but it also means that IBM can pay for some of the best R&D in computers and telecomms business.

It dates from 1911, when it was the much less exciting Computing-Tabulating-Recording Corp and its interests lay principally in punched card machines deriving from Hollerith (qv) and his ideas. Big dates in its history include 1914, which was when a brilliant ex-NCR salesman, Thomas J. Watson, became president; 1935, when IBM produced the first commercially-successful electric typewriter; 1958, with the first real IBM computer; 1959, with the arrival of a pioneering smallish business computer, the 1401; 1964, when it launched the stunningly successful 360; and 1970, when the 360 was updated to become the 370.

IBM has elected to stay out of the very small computer business. The unkind view is that the company is geared to making money from service, support and software, and micros do not need much of that. More likely, IBM is reluctant to lay itself open to still more charges of attempting to monopolise the market.

It makes its own microprocessors by the ton and builds them into the Series/1 minicomputer—a non-LSI device rather like the non-LSI PDP-11s; the 5110 'portable' computer—built-in various 'intelligent' terminals.

IBM is big enough to set *de facto* standards. It was responsible for Fortran, PL/1, and APL among languages: it invented the golf-ball typewriter and many of the basic functions in word processing. One of the standard communications protocols, binary synchronous, is from IBM. In big computers, IBM is king.

IC

Integrated circuit (qv).

ICL

The British answer to IBM was something of a shotgun marriage in the late 1960s, welding the most active of the indigenous computer suppliers then, with plenty of Government encouragement. ICL tends to make big computers and sell them in the public sector. The closest it gets to small systems is the 1500, a £10,000-plus computer it inherited when it bought the Singer computer operations two years ago.

Idle time

The time when a computer is switched-on and ready to go but is not doing anything; typically it is waiting for something else to happen.

IEE

Institution of Electrical Engineers, which has a micro group among its members, and a home near London's Savoy Hotel.

IEEE

Institute of Electronic and Electrical Engineers. A U.S. body whose significant activities include the propagation of standards—like IEEE-488, which is the same as HPIB (qv).

IF

A conditional statement in Basic. You always need a THEN (IF some condition is satisfied THEN something) and some versions of the language allow you an ELSE as well.

IIL

Isoplanar Injection Logic, also wittily referred to by some as I^2L. It's a way of making expensive high-performance ICs.

Immediate

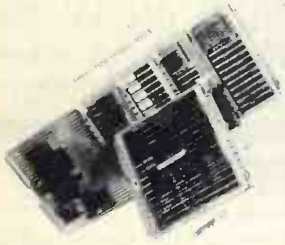
An address (qv) mode in which the memory address to be referenced is contained explicitly in the instruction. This is why it is also called explicit addressing.

Impact printer

A printer with a mechanism which hits something to create a character. Typically a metal-type element bangs against an ink-coated ribbon on to paper. Examples are typewriters, Teletypes, daisy-wheel printers, and most conventional matrix and line printers, though these days some high-speed line printers use non-impact techniques like xerography and lasers.

Advertisement Index

HOW TO BUY AND USE A MICROCOMPUTER



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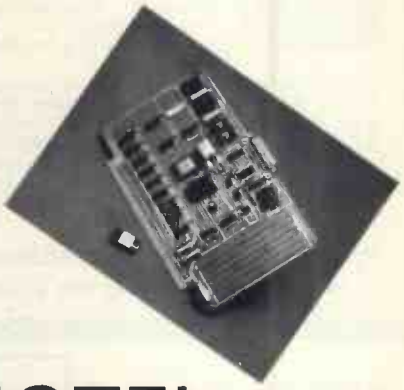

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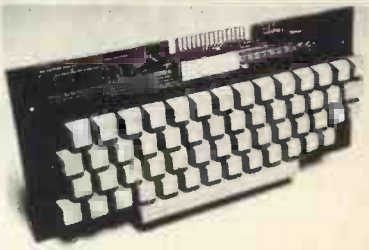

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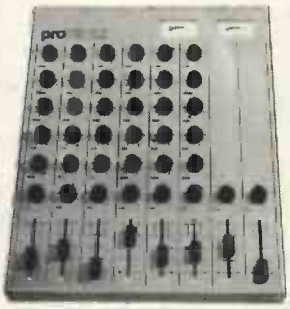

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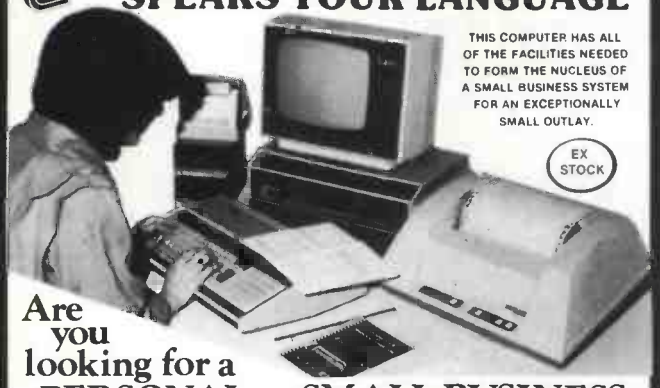

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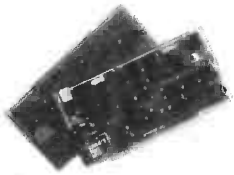

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