Practical Computing

50p

August 1979

An ECC Publication Volume 2 Issue 8

We review new Pet II

Plus Kim— the £100 computer

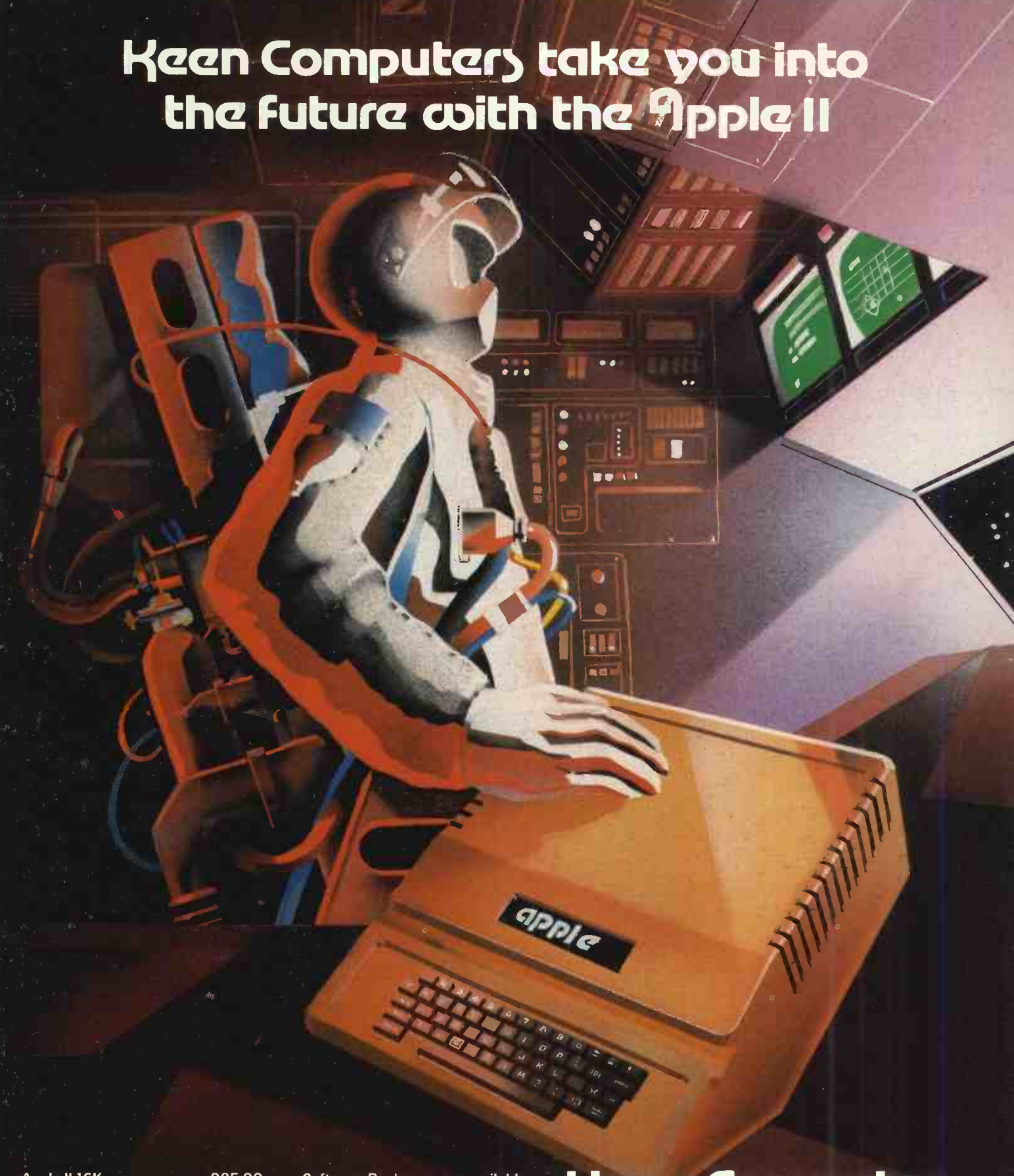
Microcomputer user groups

School re-runs Russian Revolution

Life— the complete game

Scene in California

Keen Computers take you into the future with the Apple II



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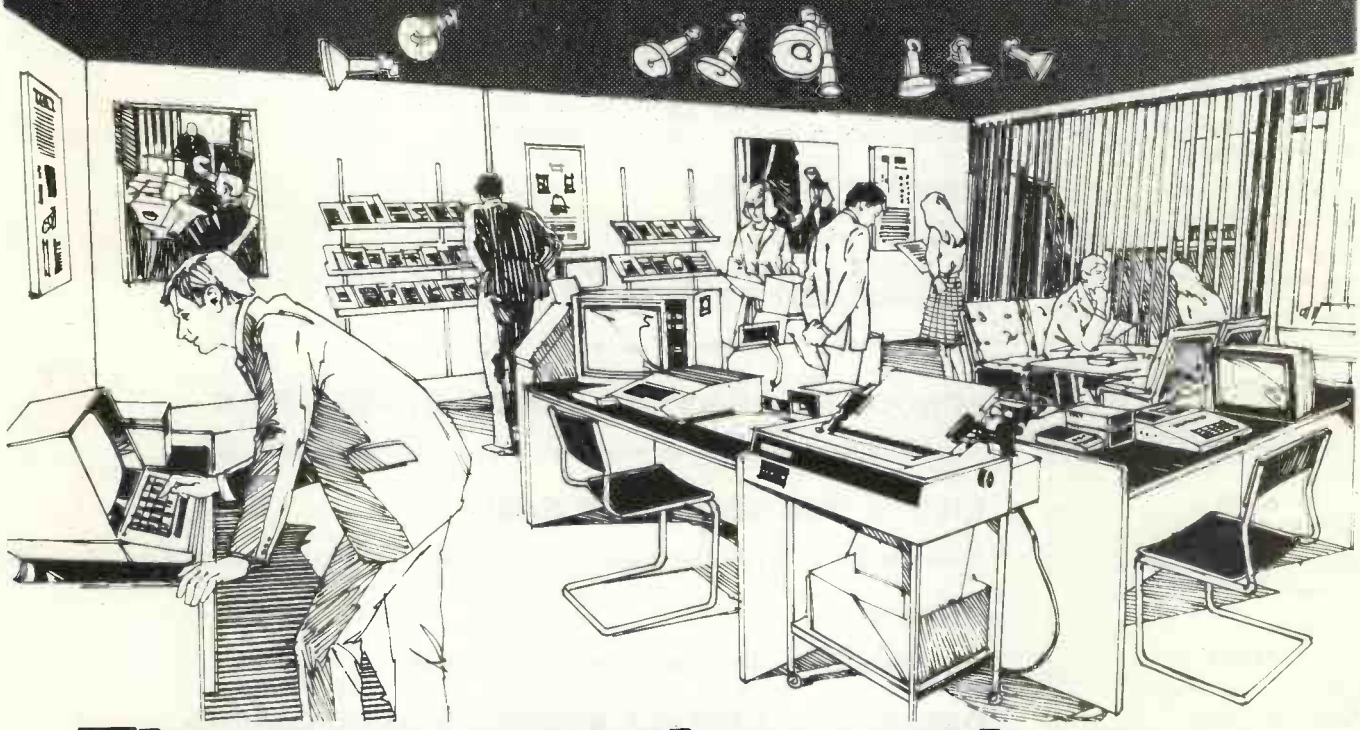
SEPTEMBER ISSUE ON SALE AUGUST 15

Thinking Computers?



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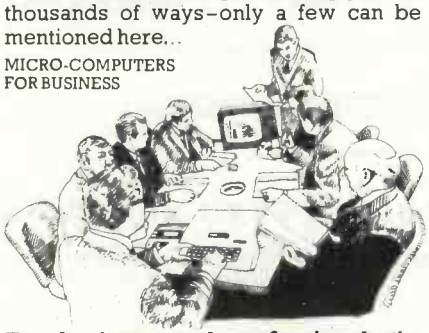

For business and professional, the versatility of compact micro-computers means that all the benefits of big computers are made available to **all** at low cost. The businessman can now computerise his accountancy, his stock control, his records and much more–cutting his overheads and improving his efficiency.

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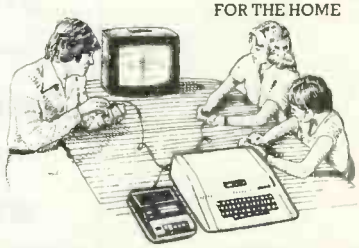

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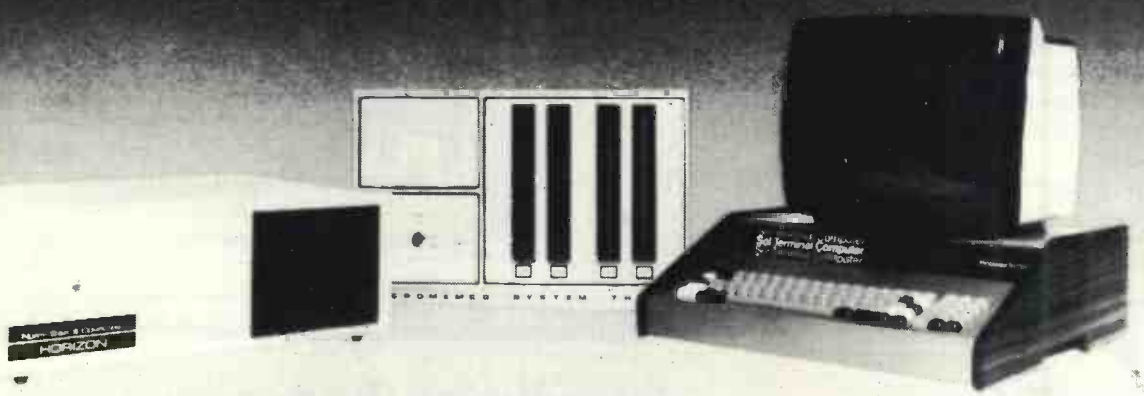

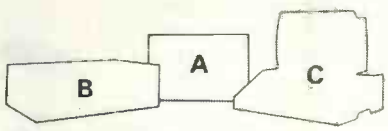

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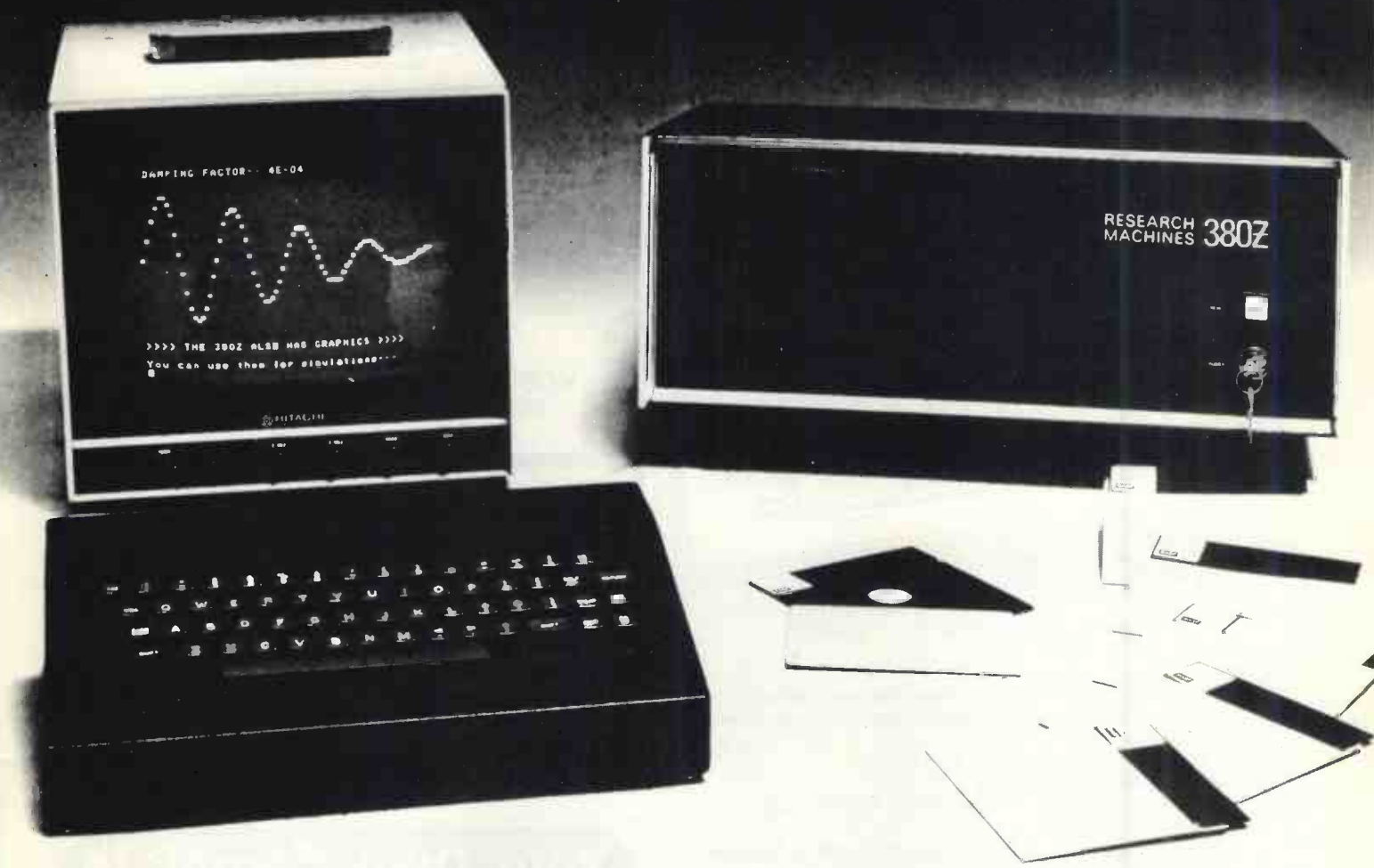

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The RESEARCH MACHINES 380Z is an excellent microcomputer for on-line data logging and control. In university departments in general, it is also a very attractive alternative to a central mainframe. Having your own 380Z means an end to fighting the central operating system, immediate feedback of program bugs, no more queueing and a virtually unlimited computing budget. You can program in interactive BASIC or run very large programs using our unique Text Editor with a 380Z FORTRAN Compiler. If you already have a minicomputer, you can use your 380Z with a floppy disk system for data capture.

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WHAT OTHER FEATURES SET THE 380Z APART?

The 380Z with its professional keyboard is robust, hardwearing equipment that will endure continual handling for years. It has an integral VDU interface—just plug a black and white television into the system in order to provide a display unit—you do not need to buy a separate terminal. The integral VDU interface gives you upper *and* lower case characters and low resolution graphics. Text and graphics can be mixed *anywhere* on the screen. The 380Z also has an integral cassette interface, software and hardware, which uses *named* cassette files for both program and data storage. This means that it is easy to store more than one program per cassette.

Owners of a 380Z microcomputer can upgrade their system to include floppy (standard or mini) disk storage and take full advantage of a unique occurrence in the history of computing—the CP/M™* industry standard disk operating system. The 380Z uses an 8080 family microprocessor—the Z80—and this has enabled us to use CP/M. This means that the 380Z user has access to a growing body of CP/M base-software, supplied from many independent sources.

380Z mini floppy disk systems are available with the drives mounted in the computer case itself, presenting a compact and tidy installation. The FDS-2 standard floppy disk system uses double-sided disk drives, providing 1 Megabyte of on-line storage.

Versions of BASIC are available with the 380Z which automatically provide controlled cassette data files, allow programs to be loaded from paper tape, mark sense card readers or from a mainframe. A disk BASIC is also available with serial and random access to disk files. Most BASICs are available in erasable ROM which will allow for periodic updating.

If you already have a teletype, the 380Z can use this for hard copy or for paper tape input. Alternatively, you can purchase a low cost 380Z compatible printer for under £300, or choose from a range of higher performance printers.

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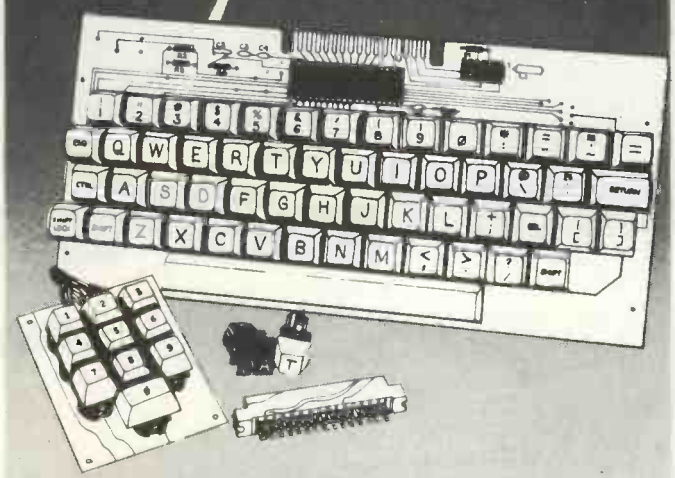
Professional ASCII Keyboards



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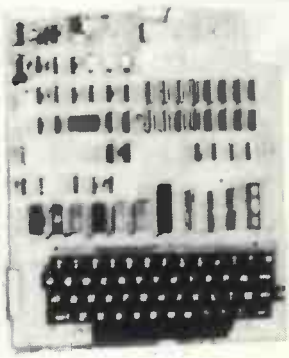

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7403	.15	7486	.25	75491	.50	74LS08	.35
7404	.10	7489	1.05	75492	.50	74LS09	.35
7405	.25	7490	.45	74H00	.15	74LS10	.35
7406	.25	7491	.70	74H01	.20	74LS11	.35
7407	.55	7492	.45	74H04	.20	74LS20	.30
7408	.15	7493	.35	74H05	.20	74LS21	.35
7409	.15	7494	.75	74H08	.35	74LS22	.35
7410	.15	7495	.60	74H10	.35	74LS32	.35
7411	.25	7496	.80	74H11	.25	74LS37	.35
7412	.25	74100	1.15	74H15	.45	74LS38	.45
7413	.25	74107	.25	74H20	.25	74LS40	.40
7414	.75	74121	.35	74H21	.25	74LS42	.75
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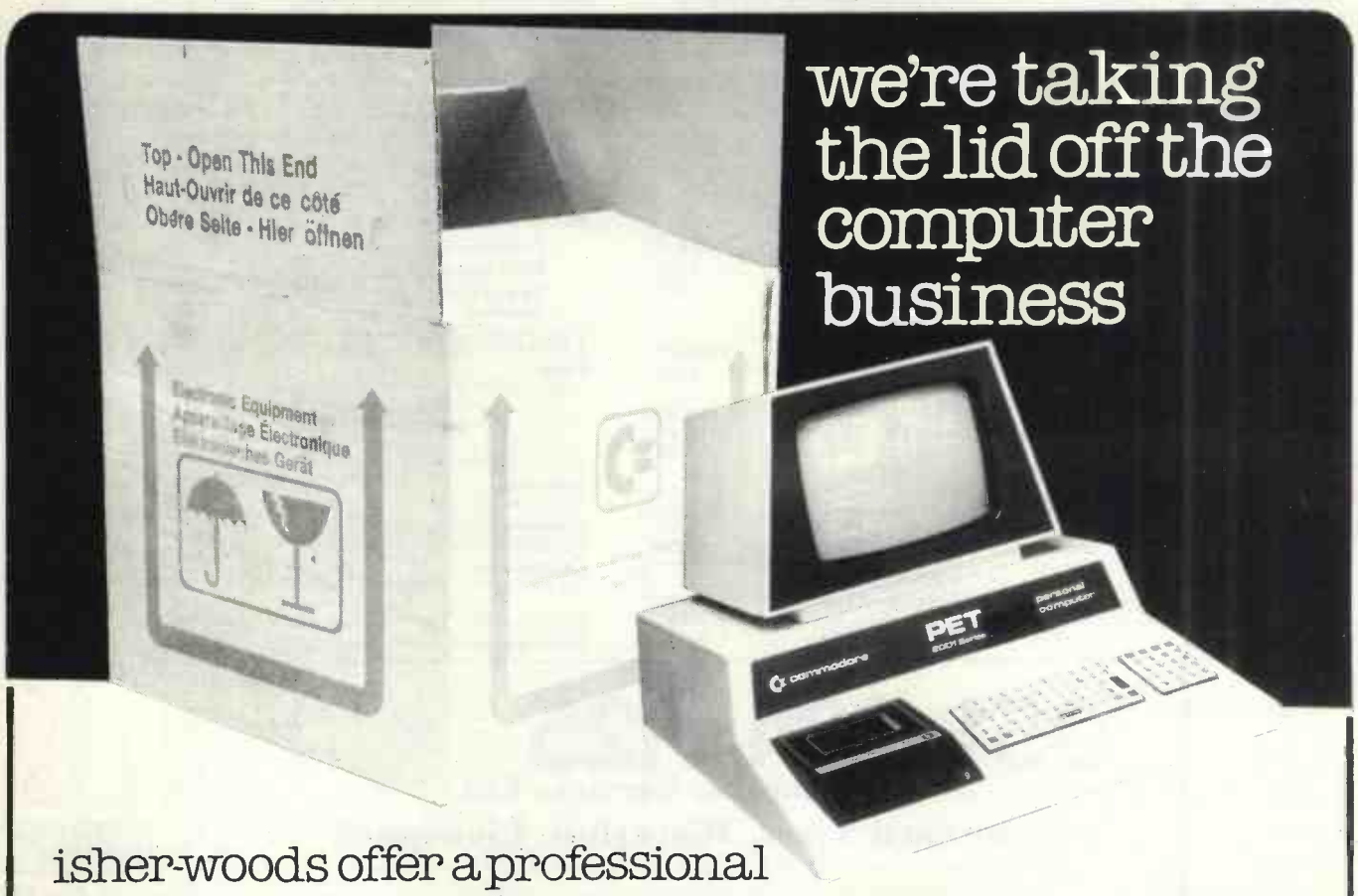

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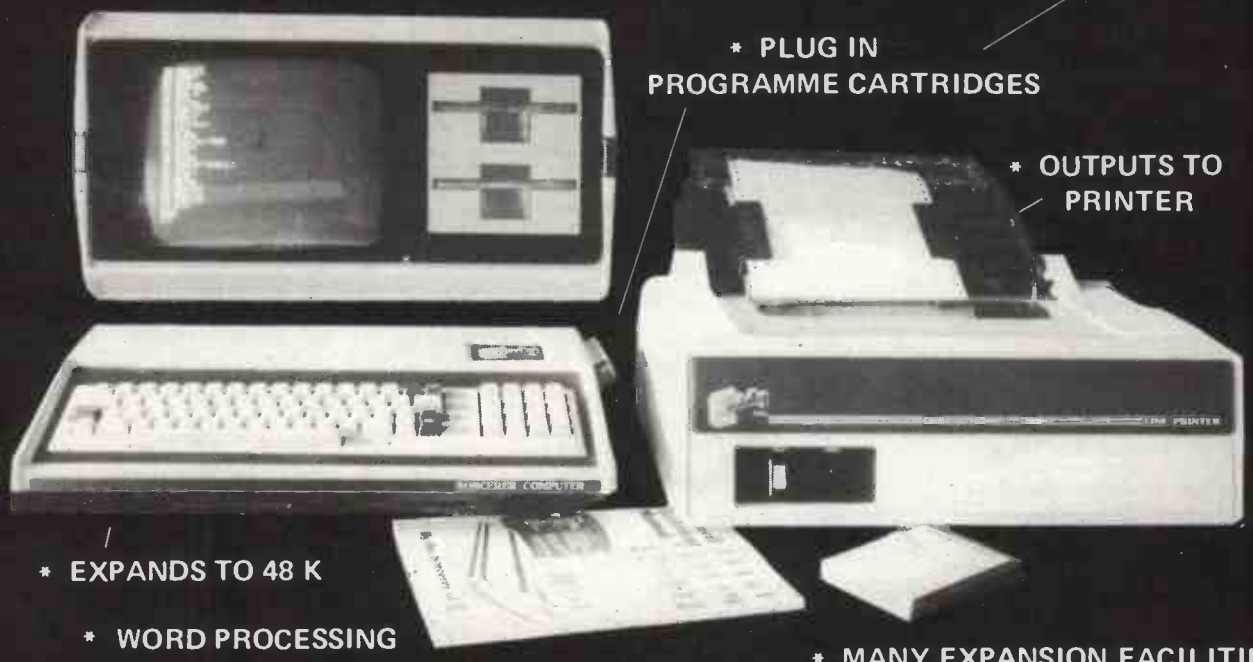

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The Hobbyist

HOBBYIST. There is no way round it — that's an embarrassing word to write. It describes your editor, most of the people who work on this magazine and its sister, WHICH COMPUTER? and, I'm sure, the vast majority of the people who read it. Accurate as it is, it is not the word you would choose. Yet try to think of a better. It's difficult.

Why is it such a bad word? Because it has the air of fumbling inefficiency, or self-indulgence in an occupation which is essentially closed, of interest to its performer and no-one else.

In a sense that is true. People who think about computers tend to live in a private world which is different from everybody else's. The things we fret about are often inexplicable to our nearest and dearest, and even when we manage to explain them it's often impossible to explain why it was interesting in the first place.

Yet there is a great difference between the preoccupations of the computer hobbyist and, say, those of the stamp collector.

It is not news that the world is being revolutionised by microelectronics. It is easy to say that, hard to visualise the vast and probably painful changes which will have to be made as industrial civilisation sloughs off the dead shells of obsolete industries.

What is new, and doesn't seem to be appreciated, is that the change is being made from beneath. For the first time it is not being imposed from the top.

Governments and huge companies have not issued diktats that the microprocessor shall henceforth alter everything. Just the reverse. They are carried along on a tide of invention which is bubbling-up round their feet, coming from the heads of thousands of "hobbyists" who are inventing new chips, new languages, new ways of using microcomputers because they are in love with it all. They — well, we — find it all so exciting we couldn't stop even if we wanted to do so.

Only the beginning

Sometimes things all seem to change so quickly you haven't even time to read the paper before the world is different. And I am sure we have seen only the beginning of it yet. The western world is like a ski jumper who has just pushed off at the top of the mountain.

He's crouching, beginning to gain speed. The wind starts to whip at his goggles, he fidgets to get his balance. Before him the great hill drops away in a sickening fall. People at the bottom are just dots.

The thing is he's never made the jump before. "He" is the state, the body politic, Hobbes' Leviathan. The minipeople riding on his shoulders are us — the hobbyists, the fanatics, the lovers of the emerging mind in the machine.

We are taking a huge responsibility on ourselves. Will the poor old body-politic make the jump? Will he get his skis tangled up in his bus? Will we, like over-ambitious fleas, crash with him? And when he reaches the bottom, what will be his reception? The people there may not be friendly. They may be Chinese. They may be throw-backs to a barbarian age. They may be silicon, having freed themselves from the tyranny of human mastery, in whose veins no milk of human kindness flows.

Enough of sci-fi country. To change the analogy, microelectronics is opening up a new Wild West. Huge, rich territories are there for the grasping. We, the hobbyists flooding into the new land, are so thin on the ground that we find ourselves doing whatever has to be done.

A 21-year-old sells his pocket calculator to finance a $100 million business (Apple). A telephone fitter becomes a director of a booming computer business (Research Machines). As a successful manufacturer said to me: "If you have talent and you are not too greedy, you have to succeed." The tide has not flowed so strongly for 150 years. The last time was the opening up of engineering. Then 20-year-olds found themselves driving railway lines through farms which had scarcely changed for 1,000 years, building bridges, ordering towns, designing vast ships — the people stood open-mouthed around them, amazed by the audacity of their youngsters who had taken a new technology and made it their own.

We, the hobbyists, are the settlers in this new land. We have amazing opportunities, we have a thing to do we love, which we would do even if there were no rewards.

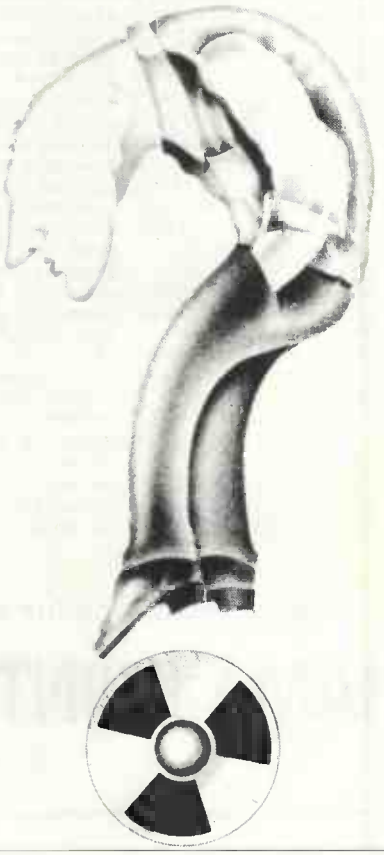
Great responsibilities

But we also have great responsibilities. We make decisions freely today because the land is open and uncrowded but we are laying the foundations of the world of the 21st century. Just as in the West great cities grew up around ranch-houses as cattle bosses founded dynasties which today control huge banking, oil, manufacturing empires; so we are now starting things, setting standards which will spread like cystallisation across the world. We have to think very carefully what we are doing.

The DoI said recently that the rejuvenation of Britain's industry through microelectronics was likely to be severely crippled by the lack of engineers trained in using these new devices. It was estimated that there were only 4,000 to 5,000 engineers in the country who really understood the microprocessor.

There must be easily as many people again who read this magazine, who perhaps think of themselves as being only hobbyists but understand the micro very well. You, gentle reader, may be a nationally-important intellectual resource. Think of that.

In fact, we thought about that, and concluded that we didn't know nearly enough about the reader, gentle or otherwise. So, to discover more, there is a questionnaire in this issue. Please fill it in and return it. It will, we hope, produce information of great value to everyone interested in microcomputing.



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5=ENTER A/C PAYABLES
6=ENTER/UPDATE STOCKS REC'D
7=ENTER ORDERS REC'D
8=EXAMINE/UPDATE BANK BALANCE
9=EXAMINE SALES LEDGER
10=EXAMINE PURCHASE LEDGER
11=EXAMINE ORDER BOOK
12=EXAMINE PRODUCT SALES
WHICH ONE (ENTER 1 TO 24)

SELECT FUNCTION BY NUMBER

13=PRINT CUSTOMER STATEMENTS
14=PRINT SUPPLIER STATEMENTS
15=PRINT AGENTS STATEMENTS
16=PRINT VAT STATEMENTS
17=PRINT WEEK/MONTH SALES
18=PRINT WEEK/MONTH PURCHASES
19=PRINT YEAR AUDIT
20=PRINT PROFIT/LOSS ACCOUNT
21=UPDATE ENDMONTH FILES
22=PRINT CASHFLOW ANALYSIS
23=ENTER PAYROLL
24=RETURN TO BASIC

EACH PROGRAM GOES IN DEPTH TO FURTHER EXPRESS YOUR REQUIREMENTS.

FOR EXAMPLE (9) ALLOWS: a. list all sales; b. monitor sales by stock code; c. invoice search; d. amend ledger files; e. total all sales.

THINK OF THE POSSIBILITIES, AND ADD TO THOSE HERE IF YOU WISH

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LIST OF FUNCTIONS AND FILES IN THIS PACKAGE

Program	1 BUS	displays above options
Program	2 TRANSAC1	creates invoice file containing all sales information
Program	3 TRANSAC2	creates accounts received file
Program	4 TRANSAC3	prints sales invoices and credits
Program	5 TRANSAC4	enters invoice details to monthly ledger
Program	6 TRANSAC5	enters invoice details to 2nd ledger for payment
Program	7 TRANSAC6	links current invoice files to old file for third copy purposes
Program	8 TRANSAC7	updates payment ledger with monies received and rejects discrepancies
Program	9 TRANSAC8	prints final total outstanding and enters to liquidity
Program	10 PURCHAC1	enters purchases made and creates ledger file
Program	11 PURCHAC2	enters monies to be paid out, with a check against discrepancies
Program	12 PURCHAC3	updates purchase ledger file with new entries
Program	13 PURCHAC4	evaluates old creditors balances and updates to include purchases
Program	14 PURCHAC5	updates creditors balance to include payments made out
Program	15 PURCHAC6	evaluates and prints new ledger balances and gives final liquidity balance
Program	16 ADDRESS	examines, adds, amends, prints lists of address files (up to 999)
Program	17 STOCK	examines, adds, amends, prints lists, gives valuations of stocks on hand
Program	18 ORDER	examines, adds, amends, prints lists, valuations and confirmations to clients
Program	19 TRANSPRT	examines, adds, amends, prints lists of ledger entries and stocks sold
Program	20 PURCHPRT	examines, adds, amends, prints lists of ledger files
Program	21 VATPRT	lists ledgerfiles for three months and prints vatform entries
Program	22 CUSTPRT	prints customer statements with aged debtor analysis for 1 or all clients
Program	23 AGENTPRT	prints agent statements for 1 or all, with 4 commission rates presented
Program	24 SUPPRT	prints suppliers statements
Program	25 ENDMTH	updates all files for month end, to clear files to another disc
Program	26 BANK	examines, adds, amends, totals bank transactions
Program	27 AUDIT	(in work) prints years audit
Program	28 PROFIT	(in work) prints years profit/loss account
Program	29 CASHFLOW	(in work) prints years calendar of cashflow to include standing orders etc
Program	30 PAYROLL	(in work) evaluates weekly payroll and taxation applied to record files

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Copyright

IF I write a computer program containing a section whose general format, although not exact typography, resembles that published in a copyright book, am I free subsequently to sell or publish my entire program in my own copyright?

For example, the TIS Pet Workbooks contain a small program to generate a high-resolution bar histogram of a random number.

I am writing a program to analyse a set of data, and print-out some of its values in various formats, including a modified high-resolution bar histogram of some of the data values.

My bar histogram sub-section contains the same principles but is modified from the TIS format.

Dennis Lyons,
Nuneaton,
Warwickshire

● This is a difficult and vexed area of law. Strictly speaking anything anyone writes is automatically copyright in British law. In the States, you must put © with the date and your name to obtain protection. Protection extends to altered versions which are still fundamentally the same material. So, for instance, if you chose a play, altered the names of the characters, changed the locations of the action, and rewrote parts of the dialogue, you would still be infringing the author's copyright.

On the other hand, it would be unreasonable, for instance, to claim copyright for the phrase 'on the other hand' and to try to prevent anyone else using it.

Your case seems to fall between the two limits. The safest course is to seek the author's permission to use his material. If he cannot be traced, it would be sensible, and polite, to acknowledge what you have borrowed, so long as it forms only a small part of your work. Eventually the law of copyright, so far as it deals with computer programs, data and even hardware, may have to be reformed. The European Economic Community is concerning itself with questions of intellectual property; so far nothing useful has emerged.

Pet programs

WE HAVE typed-in and debugged two programs for the Pet from *Practical Computer*, and offer the following notes to other readers:

1. SLALOM (*Practical Computing*, volume 2, issue 5; May, 1979, page 88):

- The legend indicating the notation used for cursor control keys should be noted — although it is printed in small type.
- The notation [&] in line 640 means shifted & key.
- The lines involving reverse field (510, 525, 540) should contain the print statement PRINT "[RVS] [SPACE]; where [RVS] denotes the reverse field key and [SPACE] denotes the space key.
- The variable IO must be distinguished from the constant 10 on lines 700 and 1000. It would have been better to avoid names like IO.
- The moving character can be changed from an asterisk to a ball by changing line 1410 to replace 42 by 81.
- Each time the program is run, the first game must have a new course.

2. DRAWING PROGRAM (*Practical Computing*, volume 2, issue 5; May, 1979, page 57):

- The printout fails to distinguish cursor control keys, which are crucial. We use the following notation:

[UP]...cursor up — [RVS]...reverse field
[DOWN]...cursor down
[OFF]...reset reverse
[LEFT]...cursor left — [CLR]...clear screen
[RIGHT]...cursor right — [HOME]...home cursor
and with any of these — SPACE...space bar
[UP*5]...cursor up pressed 5 times.

```
 100 CD$ = "[OFF] [DOWN*24]"
 150 CA$ = "[OFF] [RIGHT*39]"
 200 PRINT "[CLR] [SPACE*10] [RVS] ARTIST'S
PROGRAM [OFF]"
 250 PRINT "[DOWN*2]...
 300 PRINT "[DOWN]...
 350 PRINT "[DOWN]...
 400 PRINT "[DOWN]...
 450 PRINT "[SPACE*6][RVS] MAKE SURE IT'S CON-
NECTED [off]"
 500 INPUT "[DOWN*2]...
 600 PRINT "[DOWN*2]...
1200 IF 1% = 50 THEN PRINT "[LEFT]"; C$(1) "[UP]
[LEFT] [RVS] [SPACE] [OFF]";:...
1250 IF 1% = 18 THEN PRINT "[LEFT]"; C$(1) "[DOWN]
[LEFT] [RVS] [SPACE] [OFF]";:...
1300 IF 1% = 41 THEN PRINT "[LEFT]"; C$(1) "[RVS]
[SPACE] [OFF]";:...
1350 IF 1% = 42 THEN PRINT "[LEFT]"; C$(1) "[LEFT*2]
[RVS] [SPACE] [OFF]";:...
```

- Beware on line 750 to distinguish letter O from zero 750 IF 5%<1 OR 5%>5 THEN 650
- For a Pet without the printer, omit — if you wish — lines 400, 450, 1400.

David, Katy, John and Ian Pyle,
York.

Kim motor control

THIS LETTER refers to the article '*Using Kim-1 to aid motor control*' in the April issue of *Practical Computing*.

The article is on a subject essential to anyone who wants a micro to do something, but where it falls down is in the electronics; not owning a Kim I cannot vouch for the program but assume it has been tested.

To start in figure 1, which shows a darlington transistor pair, this current cannot possibly switch a current amplifier which in the case of TI will have a gain of between 40 and 100 if R2 is a value which at the current of TI will have at least one volt across its emitter to collector; and T2, if used as a switch — it must be used in this way if it is not to get hot — must be used with a designed gain of 10. This gives a combined gain of 400 to 1,000.

With what current do you start? Well, a transistor which is turned on has an emitter-base voltage (Vbe) of 0.6 to 0.7 volts — and the output of the 7400 will not normally be above 3.5 volts under load, so using the 3.9K shown you will be starting with 0.56mA. So the most that circuit (as drawn) can switch is just over ½ amp but possibly as low as ¼ amp.

It can work at 2 amps if the 3.9K becomes 390Ω and R2 is 22 at 6V (+V) or 120 at 25V (+V). R2 must vary with +V for if the suggested 10 were used with the upper limit of 25 volts, then the TI current is not restricted (2.33A) and there will be more than enough V times I to fry.

The current gain of T2 is not a problem, as this affects only the maximum current limit. It is R2 which sets the safe operation of TI.

Figure 2 needs the outside pair of contacts (as drawn) joined to the top positive supply rail while the middle pair must have their connection to the positive rail removed.

In figure 5 the LED is shown upside down and 4011 second input must not be allowed to be left unconnected but should usually be tied to the first input.

I hope these comments help.

Walter Wallenborn,
6502 Users' Club,
21 Argyll Ave.,
Luton. Beds.

Big game

I AM a first-year student of electronics engineering at Queen's University, Belfast. As part of the first-year course, all engineering students are given a course in Fortran, and are set several exercises and a project to test their knowledge of the language. Usually those exercises are carried out on the university's main computer, an ICL 1906S, by submitting a program on a coding sheet, which is then punched on to cards and submitted as a batch to the computer.

Unfortunately, a few weeks before our exercises were due, the computer centre was bombed. No serious structural damage was caused but there was considerable smoke and water damage, and it was several weeks before the machine was operable again. A week after it returned to service, the staff went on strike.

The result was that all the engineering projects had to be typed into the engineering maths department computer, a CTL Modular 1 system, and this caused considerable chaos-200 people trying to use 15 VDUs is not funny.

Although many people gave up and decided to wait for the dispute to be settled, most of us persevered, and a group of electronics students, myself included, took the opportunity to learn more about the computer installation.

The main computer, the 1906S, is used primarily in batch mode, and cards may be submitted at various points throughout the university. Users are divided into groups by year and faculty, and each group is allocated a number of priority units.

Units are deducted according to the urgency of the job submitted — ranging from urgent to overnight. Direct on-line use of the 6S is possible, using an IMLAC graphics terminal, but this is charged at double-urgent rate and is not used often for ordinary jobs.

Linked to the 6S is an ICL 1904A. It is used almost exclusively on-line and will permit communication and file copying with the 6S. The 4A has an advanced command and editing system, which is very powerful, but can be awkward to use for the novice.

The third main system is entirely separate from the other two. It is a CTL Modular 1 and

(*continued on page* 35)

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.

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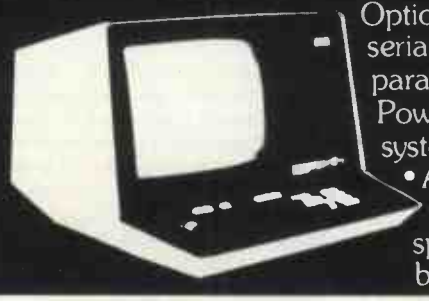

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● Circle No. 153

(*continued from page* 33)

is primarily a teaching system. It allows easy entry of programs in Fortran or Basic, and each user is allocated a certain amount of file-space, on which he can set passwords to prevent unauthorised use.

With the help of the more experienced students and the staff, who were happy to spend some time explaining the function of the various commands, we were able to run various programs.

Once we discovered how to operate the machine, we did the obvious, and began playing games. We wrote a few games programs ourselves and found many more in various files, including about six variations of *Star Trek*. We would have liked to try some of the games written for the Pet and Apple II, but while the big machines have the advantage of large amounts of file-store, they lack the Peek and Poke commands of the small micro's.

They also communicate with the VDUs at 110 baud, though a few 300 baud lines are available. This slow speed makes the drawing of boards or maps very slow, so most of the games rely on numerical output. If you or any of your readers would be interested we can supply copies of these games, provided we have the permission of the owners — if we can find them.

One game which we would, however, love to try is *Adventure*, mentioned in your magazine recently. I understand that it was written in Fortran for a PDP-10.

If this game would run on the 1906S, or 1904A, we would like to obtain a listing, on paper tape, and if you could suggest any possible source we would be grateful.

Any other ideas for games suitable for running on large machines would be very useful also, since most of the games published are designed for micros.

Stephen McKinty,
Bangor, Co. Down

Resistance

WHEN ARE you going to learn some basic electronics? In the May issue of your otherwise good magazine, I discovered two fundamental errors. Firstly, in the review on the MK14 you suggested that only two sockets were needed for this kit.

That is no example to set — sockets should be used for all integrated circuits on the MK14. If a fault occurs in, say, the microprocessor and it needs replacing, then removal is almost impossible, whereas with sockets it is a one-minute job.

The second mistake was in your article, Music Micro Please, where you show a digital-to-analogue converter. The resistors shown were 25KΩ, 50KΩ, 100KΩ, 200KΩ, 400KΩ, 800KΩ, 1.6MΩ, 8.2MΩ, and 8KΩ. Using the E24 series, only three of those resistors are available. For the others, resistors must be used in series.

I list a table of equivalents:

8KΩ=6.8KΩ+1.2KΩ
25KΩ=24KΩ+1KΩ
50KΩ=47KΩ+3KΩ
100KΩ=100KΩ
200KΩ=200KΩ
400KΩ=390KΩ+10KΩ
800KΩ=680KΩ+120KΩ
1.6MΩ=1.5MΩ+100KΩ
8.2MΩ=8.2MΩ

The second column represents those resistors which should be bought.

On a brighter note, however, in my area I know of three computer enthusiasts, including myself, who are interested in forming a computer/electronics club, and I am wondering if you could put me in touch with any other interested enthusiasts? (In the Sunbury-on-Thames/Ashford areas only please.)

S. N. Taylor
8 Priory Close
Sunbury-on-Thames
TW16 5AB

● **Your name is in the User Group Guide in this issue.**

Handbook search

I AM a regular reader of '*Practical Computing*' and find much to interest me. I noted with interest your review in the May 1979 edition concerning the *The BASIC Handbook* by David A. Lien.

You say in your conclusion that a UK distributor is being signed but despite many telephone calls I have not found one.

I have not yet bought a home computer but I have ordered a Compukit UK101. Reading your article on the Superboard, on which the UK101 is based, I am now thinking twice about it. I understand that the UK101 incorporates several improvements on the Superboard and I wondered if you were likely to be reviewing it at some time in the future.

I would also like to know: how to estimate how much memory a particular program will need; is there any rule of thumb? Why don't you always quote how much memory your published programs will need? Is a computer capable of storing several pages of written word — like pages of a book — on to tape and then retrieving them.

W. M. Dewdney,
Filton,
Bristol,

● **The distributor of *The Basic Handbook* is Rostronics — see the advertisement in this issue. We may review the UK101 but nothing is imminent.**

There is no rule of thumb which will allow one to estimate how much memory a particular program will need. We do not quote how much memory a program will need because different machines use different methods for turning high-level language into machine code and they vary in efficiency.

Finally, a computer is certainly capable of storing text and far more than a few pages. If you want to use your machine for this purpose you will need a considerably more sophisticated system than the UK101, and a word processor package to run on it. You might like to consider *Electric Pencil* running on a TRS 80 but there are many others.

Writing software

I AM a 16-year-old student at public school studying for four 'A' levels. I am very interested in computers and I hope to have an 'O' level in computer studies before long.

My interest at the moment, however, is focused mainly on the microcomputer and, more specifically, on the writing of software for them.

I have many ideas for new programs which are, to my knowledge at any rate, original and I would like to write them.

The problem essentially lies in the fact that I have very little opportunity to do so. We have a TRS-80 in the physics department and a Digital PDP-8/f Mini in the maths department, both of which leave much to be desired for the serious programming enthusiast. There is no opportunity for any program over 16K and, believe it or not, no possibility for hard copies for programes over 4K.

I would like some advice on how to get to use larger machines or join a club which would involve me more deeply in program writing.

David Brown,
Stanley House,
Wellington College,
Crowthorne, Berkshire.

● **We receive many letters from young people, who desperately want to get their hands on a computer. The best advice we can give is to look for a nearby user group in the guide in this issue.**

Sight unseen

I AM interested in buying an ASCII-encoded keyboard and, as a pensioner on a tight budget, your advertisements show three possible contenders:

Happy Memories, p. 20, April issue, £48.50 including VAT, 59 keys; Alphameric, p. 27, April, £83 including VAT, 60 keys; Comp Computer Components, p. 114, April, £53.89, including VAT.

No 1 seems the best buy but having some experience of the Pet atrocity which passes as a keyboard, I am loathe to purchase without seeing. Unfortunately, living here means about £20-£30 to reach anyone with such an item in stock which fits my budget.

Does any member of your staff have knowledge of the tactile feel of these boards? If not, perhaps it could be aired in your pages for readers' views on the matter. There must be others in similar circumstances who would also like users' comments on these items.

C. E. Williams
Cockermouth, Cumbria

● **Can anyone help with advice? What we know best is the tactile feel of typewriters. To advise on such a personal question is somewhat difficult.**

Check digits

MANY THANKS for a superb magazine, which I find fascinating and informative.

May I refer to your book review in May of Rodnay Zaks' *Check Digits*?

Recently I read Zaks' *Introduction to Personal and Business Computing* as a result of a previous mention of it by you. Like your reviewer in May, I found the same irritating errors, in particular the one about check digits and I reached the same conclusion as you did.

I have assumed that Zaks means first digit from the right times one, second × N, 3rd × N^2, 4th × N^3, 5th × N^4 and 6th × N^5. I then assumed a value for N of 6 and found that for 881921 did produce a check digit of 5.

So I wrote a small program to test the theory for a number of transpositions of 881921, with the following results:

881921 — 5
889121 — 5
881912 — 4
881291 — 5
818921 — 5

This seems to show that I have made one or two errors; we have misunderstood and/or wrongly assumed something from Zaks' error-strewn text; Zaks has made a deliberate error for some reason; or he has it wrong.

Can you help please?

D. E. Mack
Old Harlow
Essex.

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BECAUSE

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Chertsey Road,
Woking,
Surrey.
Tel. Woking 20727/23637

● **Circle No. 154**

Agency appointments for Sord range

THE SORD range has been included in the *Practical Computing* Buyers' Guide for several months, but for those who haven't yet seen the machines, our picture gives some idea of what they look like.

The Sord is a desk-top computer in two ranges, the M100 and the M200 series. The former units are the entry-level machines and can cost less than £1,000 for a complete small business system. The M200 series, aimed at the end user, costs around £4,000.

The M223 Mark II is the top of the range and, like the other machines, is Z-80 based. It has a built-in 350KB minifloppy diskette system, expandable to a maximum of 1·4MB, using double-density double tracks.

The unit has a large-screen CRT and optional controller, full ASCII keyboard with 10 keypad special-purpose keys and RS232 communications ports.

Software includes Cobol, Extended Basic, Fortran, a high-level operating system and several application packages, including sales and purchase ledger, communications and all CAP Microproducts packages.

A full range of peripherals is available for the system, including colour monitor, printers, XY plotters and card and paper tape readers. Three S100 slots are available for expansion.

Applications include a management system for a taxi business, an on-line system for studying animal behaviour, automatic data measurement and selection for crystal oscillators, a data analysis system for studies of the effects of vibration on the human body and video tape compiling.

Sord Computer Systems has representatives all over the world, and the U.K. distributor is Dectrade of Nottingham (0602) 861774. Two agents have already been appointed — Midas Computer Services and Computer Broking Services.

Sord is the first Japanese microcomputer firm to enter the U.S. and is one of the few who have taken an interest in Europe.

The Sord M100.

Rockwell source

PORTABLE MICROSYSTEMS of Brackley, Northamptonshire, has the Rockwell AIM-65 microcomputer we tested in the July issue in three versions.

AIM-65, the popular bare board version, is the one we reviewed. It is aimed at the hobbyist, student or systems manufacturer who wants to develop AIM-65 into a higher level system. Prices start at £249·50.

AIM 650 includes case, power supply, 4K RAM and 8K ROM Basic, from £485.

PDS 65 is a portable development system, suited to programmers or hardware designers who need to modify and debug systems. The good documentation of this product enables the user to home-in on the target system and allows any necessary changes to be carried-out immediately.

More information from Portable Microsystems, (0280) 702017.

Price cuts of items in Elf II series

HL AUDIO has cut the price of most items in the Elf II range "as a result of continuing demand".

The machine is a self-contained personal computer imported by HL Audio from Newtronics in the U.S. It is based on the little-known and little-used RCA Cosmac 1802 processor.

The heart of the system is the ELF II board. With video interface it costs £79·99 plus VAT. That includes 256 bytes of RAM (expandable to 64K) and a hex keyboard. The price quoted is in kit form but you can have it fully-wired and tested.

Each kit has simple and complete instructions for assembly and testing, as well as a good *Short Course in Programming* written specifically for the ELF II.

The full range of hardware includes the Giant Board at £37·80 in kit form. It has a system monitor/editor, cassette I/O routine, two 8-bit parallel I/O ports and a serial I/O interface; 4KB expansion memory costs £75·60. A full ASCII keyboard costs £54·63 in kit form and a video graphics board will be available.

Software includes Tiny Basic on cassette for £14·58.

Useful power module

SERIES 7100 power line module from Potter can accommodate input voltages and frequencies of electronic equipment anywhere in the world.

This means that it will be very simple to use U.S. equipment here for equipment importers, the 7100 eliminates multiple input power designs, a variety of chassis cut-outs, expanded inventories and costly retrofit programs.

The 7100 combines an AC power receptacle, a fuse holder/ejector and a line selector. A single push-in circuit board provides positive, rapid and repeatable selection of any six voltages — 100, 115/120, 220 and 230/240 VAC.

The module is housed in a durable, fireproof, shock-resistant plastic body and has built-in safety features. Its power cord must be disconnected before the fuse or voltage selector can be changed.

The power line module is in three styles. An unfiltered version, model 0001, for general applications, costs £4·56; and there are two filtered versions. The 0002 is for data processing requirements (£8·52) and Type 0003 for medical and dental applications.

All are available from Tekdata Electronics, Burslem. Tel: (0782) 813631.

Anadex agreement

AN AGREEMENT between Anadex and Kode Services provides full servicing facilities in U.K. and Ireland for the Anadex DP-8000 80-column printer. The Kode Services contract gives two scheduled calls per year, plus any emergency cover at a total annual cost of £84.

Kode runs a nationwide team of more than 100 engineers but recognising that many customers for the printer will be personal computer users, for whom vists by service engineers are not practicable, Kode Services will also be offering a workshop repair service — units may be returned by the customer for a full service.

New single board offering from Texas

TEXAS INSTRUMENTS has announced its new single-board computer, the TM990/189M. It has been designed as a learning aid for hands-on experience plus instruction in microcomputer fundamentals and Texas expects it to find its market mainly in that field.

It is based on the TM9900 16-bit microprocessor and has a comprehensive users' guide which takes you through really elementary steps and then on to difficult applications.

The textbook is a self-contained learning guide which can be used by colleges or universities as a primary course book for a 16-bit microcomputer class. The board is punched for insertion into a three-ring binder.

The board is self-contained with 1K of RAM expandable on board to 2K; and 4K ROM, expandable to 6K. The 4K ROM contains the monitor unibug and symbolic assembler. There is a cassette interface for mass storage which can be used with any cassette recorder.

The device has a built-in 45-key alphanumeric keyboard, identical to the top of a TI-58 or 59 programmable calculator. It produces a 10-digit, seven-segment display which has a 32-character buffer. There is provision on the board to add an external standard EIA terminal or TTY interface.

The TM990/189M features a series of addressable LEDs, coupled with a piezo-electric speaker for audio signals. When the computer is powered-up, a group of four LEDs flash, the speaker beeps and the display signals "CPU READY". The character display is not all it could be but you get used to it quickly and learn to recognise the letters.

In quantities of one to nine, Texas is selling the microcomputer for £256, including the textbook. A suitable power supply is available as an option.

The machine is already widely-available and can be obtained from most Texas Instruments suppliers.

Another Plessey memory

PLESSEY MICROSYSTEMS has introduced another memory device for the Pet, an add-in memory called INPET to provide an extra 32K.

It is a single board which attached to the Pet processor board and connects to the memory expansion port. No modification is needed to the Pet and it takes only a few minutes to fit. It has a built-in power supply and all connectors for £319.

Plessey has also reduced the price of the 32K PETITE add-on memory by 30 percent, to £369. This stand-alone mains-operated memory unit plugs directly into the Pet memory expansion port and can be used as a portable peripheral.

Software Cottage

TRIDATA Micros, the Midlands-based software "cottage" has opened new premises at Smithfield House, Digbeth, Birmingham. Tel: 021-622 1754.

The company deals with microcomputer software, including packages such as payroll, sales and purchase ledger, estate agents' packages and industrial control. It has installed systems for art galleries and dentists, among its many customers, and will soon be featured in depth in *Practical Computing*.

polyFORTH package reduces development time

FORTH of California has introduced a new package which cuts software development time for mini and microcomputers.

Called polyFORTH, it is based on the established mini- and microFORTH packages, but combines all their best features.

It is a fully-interactive operating system and multi-level language and Forth claims it will cut software development time by 50-90 percent, and reduce memory requirements by 30-80 percent.

The package "offers a faster dictionary search algorithm, all 16-bit arithmetic, more secure multiprogrammer, simplified vocabulary handling, a new simpler target compiler and an improved text editor", says Stephen Hicks, vice-president of marketing.

A complete single-user system can be configured using 6K of memory — 4K to run the software and an extra 2K for the assembler and text editor. The economy of memory is made possible by the structure of the system.

To the nucleus of essential operations can be added outer-level functions such as the compiler and terminal handler and a buffer handler which supports RAM as mass storage.

Options for the basic package include database management and applications software, as well as delivery of the 6K system in PROM.

The language is available for TI9900, 8080 and Intel 8086 microcomputers. It will soon be available for the 8086, LSI 11, PDP 11, Series 1 and Honeywell Level 6 minicomputers.

RCA is one of the main distributors in the U.K. Write or telephone Sunbury-on-Thames, Middlesex (or your local RCA distributor) on 093 27 85511.

Add-on graphics for Nascom-1

AN ADD-ON graphics facility for the Nascom-1 is supplied by Bits and PCs of Wakefield. It has six integrated circuits, including the alphanumeric character generator removed from the Nascom main board and a pre-programmed 2708 EPROM supplied in the kit, which costs £32·75.

The graphics board connects to the Nascom board via a 24-way ribbon cable and DIP plug; it fits into the socket vacated by the character generator IC. You also need one wire to the −5V supply.

Three wire straps have been provided on the Nascom board to utilise the eighth bit of the video RAM. It is also usually necessary to do the modification to IC 18 monostable mentioned in the Nascom Club's first newsletter, details of which can be found in the instruction booklet with the board.

Sixty-four new graphics characters are produced, with a further 64 corresponding (black on white) reverse-field characters available. The standard alphahumeric characters retain their hexadecimal values of 00 to 7F, the new characters taking values of 80 to FF hex.

The kit needs no RAM space and may be used on a Nascom with or without expansion. Two application programs are included as examples of the many ways the graphics can be used.

We hope to review the board in a future issue. Meanwhile, you can contact Bits and PCs at 8 Church View, Crigglestone, Wakefield. Tel: (0924) 251007.

'Comprehensive business system' re-launch of Pet

COMMODORE is to re-launch the Pet as a "comprehensive business computer system". It has also introduced an endorsement scheme for peripherals and software, and "mainframe quality" business software has just come to the market from Applied Computer Techniques, called PETACT.

The re-launch, as Pet 2, is due to the latest modifications of the system — bigger keyboard, more memory, disc and printer. The "complete business system", which sells for less than £2,500, comprises a 32K CPU with integral VDU, floppy disc unit and printer. Commodore is trying to depart from the image of the "toy computer" which was generated by the old-style 8K model.

To ensure that the user has a guide to the suitability of the numerous third party peripherals and software, Commodore has begun an official endorsement scheme, whereby it will issue an "officially approved by Commodore" sticker to dealers and products which it believes will enhance the system.

An official catalogue of all the approved products will be issued soon but Commodore will not be involved directly in marketing any of them.

The new range of business software from ACT has been developed in conjunction with Petsoft, now a division of ACT.

The first two suites are sales accounting and purchase accounting — each package handles 200 accounts and 800 transactions in RAM simultaneously.

Sales accounting provides facilities for maintenance of the sales ledger, preparation of a list of outstanding balances and printing of statements. Purchase accounting packages handle purchase ledger, preparation of a list of outstanding balances and printing of remittance advices.

Both packages run on the 32K version only, with a printer, and they are in cassette version or on disc. The cassette version is £225, with the disc version at £350. Together, the packages will cost £325.

Soon to be released will be invoicing, payroll, stock control, nominal ledger and management information suites. They average around £500 each; the most expensive will be approximately £800.

The software will be available widely throughout the country, and the price includes documentation and an automatic one-day training course for anyone who buys it.

PRIZES to the winners of the *Practical Computing* Christmas competition have been presented to the winners of the education and domestic categories.

Top picture shows Janet Hill, far left, receiving the Nascom-1 from Kerr Borland, right, on behalf of Stratford-upon-Avon Grammar School. The pupils, under the guidance of Mrs. Hill, won the competition with a proposal to computerise a survey of local facilities for the disabled they had undertaken voluntarily.

The second picture shows Mike O'Reagan, left, of Research Machines presenting the keys and manual of a 380-Z to John Ward, head of computer studies at Sweyne School, and Richard Ennals, right, who instigated the competition entry. Peter Laurie, our new editor, is seen in the centre.

Sampling the delights of Silicon Valley

Petsoft founder Julian Allason spent a week among the wonders of West Coast computing. Here is his diary.

Monday

AFTER a morning frying beside the swimming pool on the roof of the Beverly Wilshire hotel — "Paging Mr Travolta: Mr Travolta to the telephone please" — I decide it is time for work. In this case work meant lunch with the *Daily Express* man on the West Coast. Waiting for him in the Polo Lounge of the Beverly Hills Hotel — Gregory Peck and Bianca Jagger at neighbouring tables — we are astonished to be greeted by an exotic young man with bouffant blonde hair and silk shirt slit to the waist to reveal equal amounts of golden torso and jewellery. After some moments of confusion, it emerges that this is my hard-bitten Fleet Street friend. Apparently prolonged exposure to the Californian sun invariably produces this effect.

Things are moving fast in Silicon Valley. The *Express* man reports extensive cross-fertilisation between the disciplines of microcomputer and video. Microprocessors are being used to generate digital television, while the new range of video discs is seen as a useful medium for mass data storage.

The discs closely resemble ordinary LP records, most using a laser instead of a stylus to scan the grooves. An initial problem was that the discs were, in effect, read-only memory. Work is under way at RCA and Philips to overcome this, the news-hound claims.

He departs for an urgent assignment to which he is summoned on his $2,500 pocket telephone.

Tuesday

MICRO SOFTWARE companies on both sides of the Atlantic seem to appear and vanish with alarming rapidity. In the last few months an outfit called Programma has established a name for itself. I decide to pay it a call.

After a hair-raising journey down Wilshire Boulevard, I find my way to the basement of a large hotel. It is a cavernous place, crammed with micros of every description. While waiting, I amuse myself with a Sphere, the first complete micro to be marketed nationally in the U.S., and also the first to go bust.

Mel Norrell, Programma founding father, introduces himself before a guided tour of his premises and software. The latter proves considerably more impressive than the former.

Programma has managed to develop a version of the FORTH language for Pet and Apple. That is an achievement in itself but the language is marvellous, since it is user-defined and very fast. In effect you use FORTH to write your very own language.

Norrell reckons Micro-FORTH at least halves software development time compared to assembly language programming. I am so impressed that a hard bargaining session ensues, the result of which is that 6502 FORTH is now available from leading U.K. computer stores or direct from Petsoft. The price is £30, including VAT.

Programma also has an impressive new text editor, Apple Pie, which is different from the usual line-based editors, designed originally for Teletypes. There is a Pet version, too, called Petpie. U.K. price is £25.

While Norrell isn't looking, I sneak into the development office, and what are they working on but Pascal?

Wednesday

TO THE HOME of Michael Richter, inventor of the Metagames. This proves less easy than I had imagined since, although Los Angeles is laid out on a grid system, once on the freeway network, it is difficult to get off again. There are up to six lanes in each direction, with overtaking allowed on any of them.

Eventually, we arrive to meet Richter, a gentle giant who works on a secret project programming anti-anti-missile missiles — I think.

The arrival of micros has generated tremendous interest among the millions of American science fiction freaks. Many buy micros to explore the increasingly complex fantasy simulations of Middle Earth or King Arthur's Court.

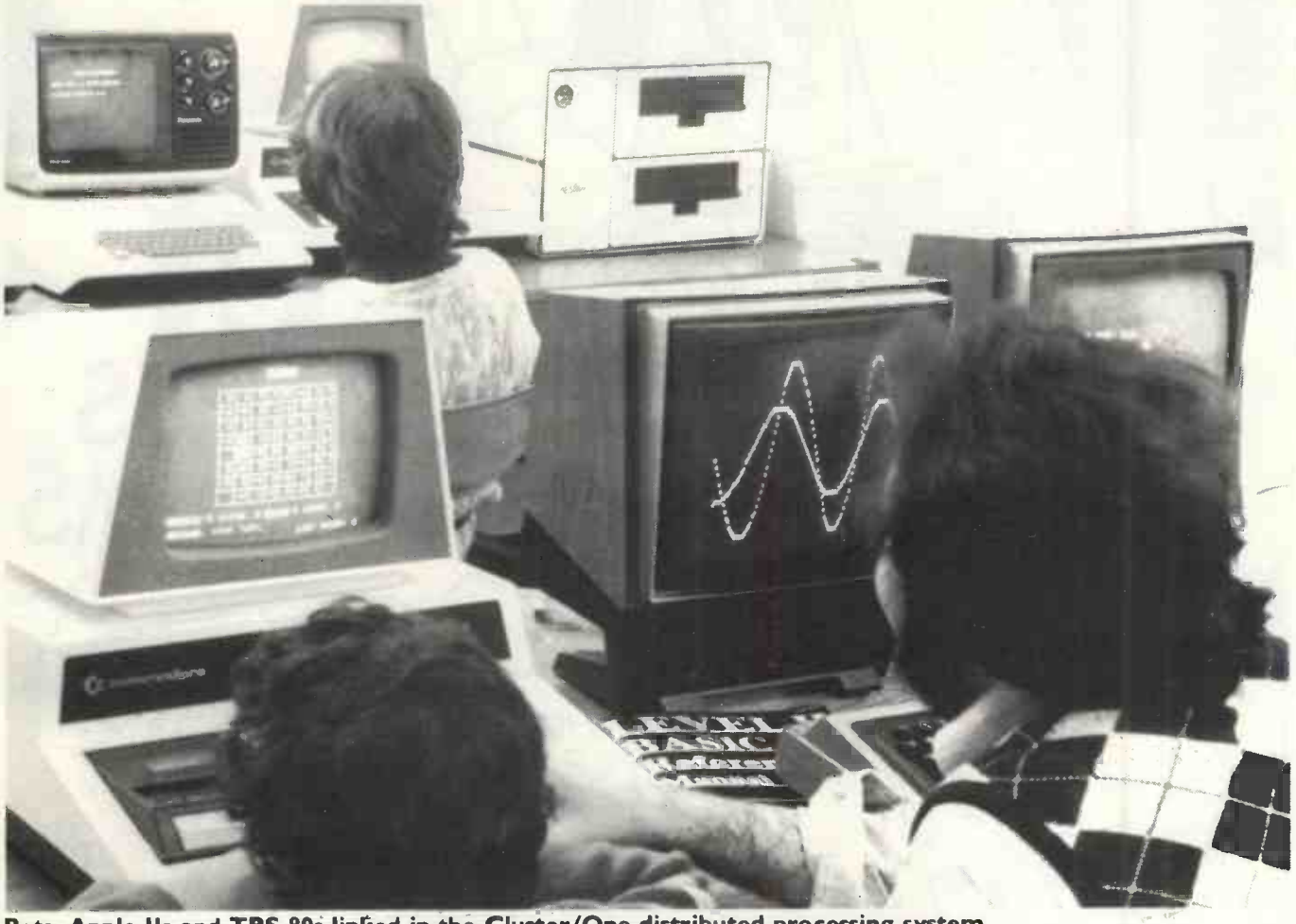
The turning-point was Richter's description of the Hunt game in the May issue of Recreational Computing. In Hunt, you define the game. Richter said that he had set out originally to investigate the possibility of developing a computer game which had no conventional analogue. The result of many months' work was Hunt, the underlying concept of which is a table-driven game.

As he put it: "At the simplest level, the game is played with a set of data tables in a style not dissimilar from a variety of board and computer games. On the next level, that of a meta-game — as in metaphysics or metamathematics — there is no conventional equivalent. The player is defining the rules of the game as well as playing it.

"The context is that of a search for a defined object, typically Atlantis, a lost planet, or the Holy Grail. The objective, the names and natures of the searchers, their antagonists and the properties of the space in which the hunt is conducted, are all defined in the table."

This offers an almost infinite variety of

Petsoft founder Julian Allason outside the new solar-powered Commodore factory in Santa Clara.



Pets, Apple IIs and TRS 80s linked in the Cluster/One distributed processing system.

games of varying degrees of complexity, yet which demand no knowledge of any computer language.

Richter showed us one of the early Hunt games, Firstworld, which included elements from Quest, Middle Earth and Oz. Being relatively simple, it took about half an hour to play without a map. With knowledge of the terrain, five or 10 minutes would be sufficient.

Development of a third level of play is nearing completion. It would make possible a meta-game for War. With luck it should be available soon.

Thursday

THE Californians like an early start. When I called Ron Jefferies, publisher of *Cursor*, he invited himself to breakfast at the Santa Barbara Biltmore, where I was staying.

Jefferies told me how it had started. "Since it was to be about computer programs for the Pet, I thought, let us make the magazine itself a program, or rather, several programs."

Cursor arrives by post each month in the form of a C-30 cassette containing five excellent programs and a printed set of *Cursor Notes* which provide instructions for using the routines; new product announcements; book reviews; and suggestions on how to use Pet more effectively.

One of the most pleasant features of *Cursor* is its front cover program with a different animated display each month. You press a key and the table of contents is displayed.

Since its inception, *Cursor* has sparked a number of imitators. With the exception of Ralph McElroy's CLOAD magazine for TRS-80 users, which slightly pre-dates *Cursor*, none of those I saw appeared to be to the same standard.

Cursor is available in the U.K. at £35 for a year's subscription, from 5 Vicarage Road, Edgbaston, Birmingham B15 3ES.

Friday

WALKING down a quiet tree-lined street in Palo Alto, part of sunny Silicon Valley, three girls in bikinis roller-skate past as I turn into the windowless headquarters of Nestar Systems.

I am shown into the office of the president, Dr Harry Saal. You can tell it is a working office; there is barely room to move among the piles of continuous stationery and gutted peripherals.

"So you have come to see my baby", says Saal, a genial bearded figure. Baby is Cluster/One, a distributed computer system based on personal microcomputers. Distributed processing is the new buzzword among large computer users, so I am intrigued to see its application to micros.

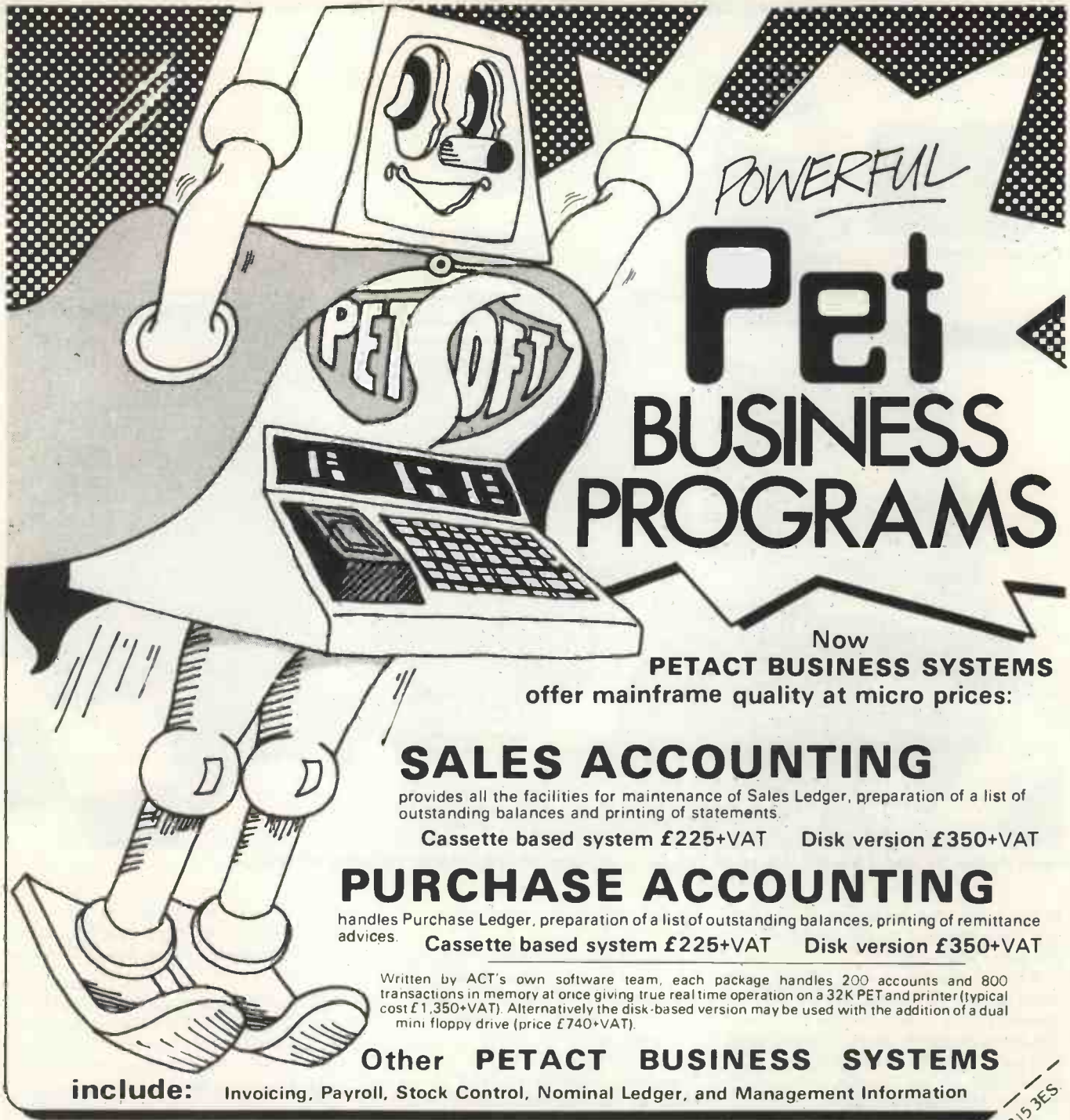
Cluster/One represents a significant breakthrough, Saal explains, since it provides many of the features of large time-sharing systems, but with the important advantage that the "terminals" are personal computer systems, each with its own CPU and memory.

Saal leads me into the showroom where four Pets, an Apple and a Tandy TRS-80 are daisy-chained to the central disc storage unit by ribbon cable. Up to 30 microcomputers can be linked in this way, he says.

In a time-sharing system, each user has only a portion of the central computer available for executing his program, so delays are likely if several users are running programs simultaneously. With Cluster/One, each user has the full resources of his individual computer available all the time.

The connection scheme makes it possible for any station to use, modify and maintain hundreds of Basic programs on the central disc system. The dual 8in. flexible diskette drives use the IBM 3740

(continued on page 43)



POWERFUL

Pet BUSINESS PROGRAMS

Now
PETACT BUSINESS SYSTEMS
offer mainframe quality at micro prices:

SALES ACCOUNTING

provides all the facilities for maintenance of Sales Ledger, preparation of a list of outstanding balances and printing of statements.

Cassette based system £225+VAT **Disk version £350+VAT**

PURCHASE ACCOUNTING

handles Purchase Ledger, preparation of a list of outstanding balances, printing of remittance advices.

Cassette based system £225+VAT **Disk version £350+VAT**

Written by ACT's own software team, each package handles 200 accounts and 800 transactions in memory at once giving true real time operation on a 32K PET and printer (typical cost £1,350+VAT). Alternatively the disk-based version may be used with the addition of a dual mini floppy drive (price £740+VAT).

Other PETACT BUSINESS SYSTEMS include: Invoicing, Payroll, Stock Control, Nominal Ledger, and Management Information

Send for a free copy of our new 16-page catalogue. It contains details over 150 programs from £3 to £375, covering Business Packages, Programming Aids to help you make the most of your PET and some super Games to play with it. Here are just a few examples:

TRY THESE PROGRAMS AT YOUR NEAREST PET DEALER *Prices include VAT*

Addressbook £6	Hotel Finder £5	Program Merger £8
6502 Assembler Editor £25	Linear Programming £8	Sales Analysis £10
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Bridge Challenger £10	Mailing List £15	Super Startrek £8
Civil War £7.50	Micro Chess £14	Tax £8
Data File Handler £12	Music £10	VAT Pack £17.50
Discounted Cashflow £8	Payroll £25	Word Processor £25
Estate Agents Pack £25	Percentage Costing £49.50	76 Common Basic Programs £15
Graphics Package £12	Pet Basic Tutorial £12	

For full details of these and the other cassette and disk programs in our free catalogue, complete the coupon or ring us today. We also accept credit card orders over the telephone.

Recommended by Commodore

Petsoft Specialists in personal computer programs,

5-6 Vicarage Road, Edgbaston, Birmingham B15 3ES.
Tel: 021-454 5348 Telex: 339396.

Petsoft A member of the ACT Computer Group.

PET is the trade mark of Commodore

To Petsoft 5-6 Vicarage Rd., Edgbaston, Birmingham B15 3ES.
MY PET NEEDS FEEDING. Please rush me a copy of your free 16 page catalogue of PET programs without obligation.

My name is

My PET lives at:

● Circle No. 225

(continued from page 41)

format, soft-sectored with 256 bytes per sector. The system I saw had a total formatted capacity of 630Kbytes and cost $4,500 plus the cost of the individual microcomputers, and approximately $100 per micro for firmware cards and ribbon connectors.

For an extra $500 one could have the dual double-sided version which gave a total formatted capacity of 1,261,568 bytes. Enough, I calculated, for the entire Petsoft library of 150 programs without changing discs.

As a test, I typed-in instructions to load two different 8K programs on to the Apple and the TRS-80. The central system whirred and clicked — no flashing lights, alas — and in less than 11 seconds both programs had loaded and been verified. Test dumping took about one and a half times as long.

Simplicity

Addressing was simplicity itself: eg @LOAD "KINDGOM", @SAVE "MATHSRUN", 2 etc. In addition, there are LOSE and DIR commands. The latter can display all the programs on a diskette or a particular subset. Housekeeping ensures that only programs in the correct Basic subset are loaded into the microcomputer calling them. On the system I used, there were Startrek programs written in Pet, Apple and TRS-80 Basics.

Access to a large central program library or database and large mass storage usable by each station makes such a system ideal for business use. Most of the installations, however, have been to schools and colleges who find it an ideal way of teaching on different micro systems. Subsequently, I met two dealers who were using Cluster/One for showroom demonstration.

I gather there are plans for European distribution soon. I have some further information if anyone would like to write to me at PO Box 9, Newbury, Berkshire.

Allason then covered the West Coast Computer Faire.

Boffins galore

THE West Coast Faire is not the biggest computer show but it may well be the best. For one thing, the San Francisco venue is no distance from Silicon Valley. At one point there seemed to be more boffins than buyers. Crowds of micro men milled about, engaged in gossip and discreet industrial espionage. Hair-tearing and garment-rending were the order of the day for harassed production managers. Last year it was the memory famine. This time there was a shortage of disc drives.

Star of the show was Atair, launching two new microcomputers. Non-stop lectures from an extraordinary Punch and Judy stage kept the crowds thronging round. The colour graphics looked good although several potential customers voiced the opinion that 50 dollars was a high price for a game of Life or Breakout (on ROM cartridge).

"By September, Atari will have the $550 computer in every store which carries its video games and that could hurt us," one established manufacturer told me.

No Ataris are destined for the U.K. before Autumn, 1980, software chief Peter Rosenthal says. Difficulty converting to Britain's PAL TV system is the reason given; production problems seem a more likely explanation.

New offerings

The cause of considerable embarrassment was a jumble sale run by the Tandy Computer Centre Division. The company has ceased selling other manufacturers' micros in its specialist computer stores — service problems were hinted — and will be concentrating on its own Radio Shack line.

On the main Tandy stand, the new $219 printer was busily demonstrating itself to admiring crowds. Unfortunately, no-one was prepared to divulge the cost of the aluminium-coated paper it was spewing forth and no technical information was available.

Compu/Think launched its new double-density disc drive for the Pet — available in the U.K. now — but received sidelong glances from Commodore, demonstrating its double-density disc on a neighbouring stand.

Meanwhile, staff in the Apple booth maintained a resolutely low profile, claiming to have no new product announcements. This must be an industry record.

One of the bonuses of the West Coast Faire is that the cost of exhibiting is relatively low. That guarantees the presence of a range of very small companies and publications. One which caught my eye was Automated Simulations, a one-man software house offering a single program, a good fantasy simulation in versions for Pet and Apple II.

For some inexplicable reason the president and vice-presidents of Spinterm printer distributors, Input/Output, attended wearing top hat and tails, thereby causing confusion and distress to the Mad Hatters of Mad Hatter Software.

Sargon, the new rival to Peter Jennings' best-selling Microchess, put in its first appearance on cassette. Sargon thrashed all comers in the San Jose Microcomputers Chess Tournament, including Microchess versions 1 and 1.5, but has apparently not played the current 2.0 version in competition yet.

Music everywhere

Music was everywhere. After two days of Greensleeves performed non-stop by an Apple, David Gordon, president of Programma, finally took wirecutters to the next-door stand.

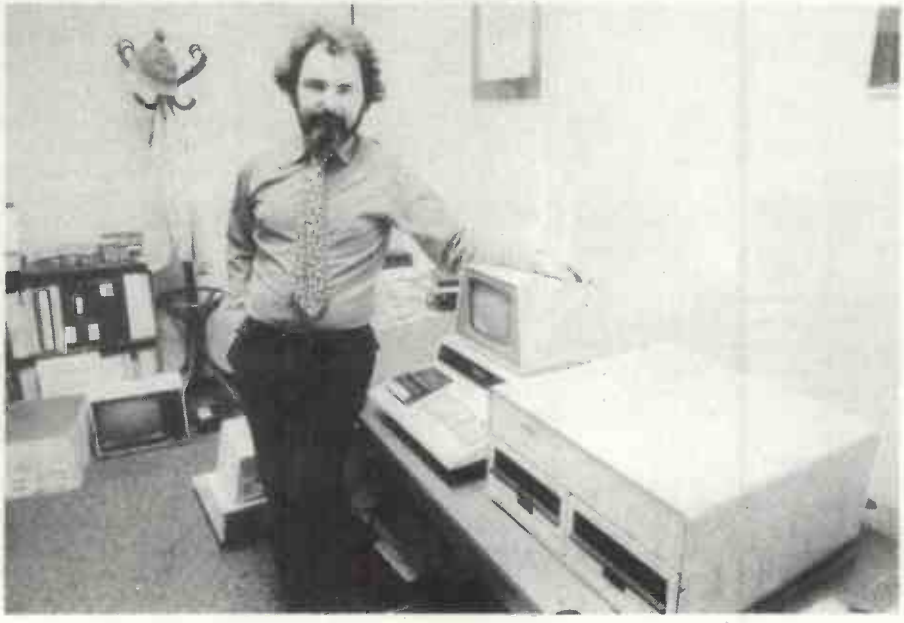
Meanwhile, Adam Osborne, rapidly becoming the grand old man of micros, gave his statutory lecture on Whither Computing? while Vince Coen of LP Enterprises added a few more magazines to his British distribution list.

Most interesting new development on the hard-copy front was the 225 cps Comprint, a quiet, compact electrostatic printer which uses a 9 × 12 matrix; that is three times better than the usual 7 × 5 character format. Best of all, it retails for $560 in the U.S., inclusive of parallel interface.

Then there was the man with a badge with the legend IBM Personal Computers. Sadly, I never did talk to him. ■

* *A condensed version of this report appeared in sister publication, Computer Report.*

Dr Henry Saal, president of Nestar Systems, with the central processor of his Cluster/One distributed processor.



Involving the student

In a previous article, I described the ideas behind the use of the computer in historical simulation games at Sweyne School, Rayleigh. I described the range of games and outlined the ways in which the computer could help. This article gives more details of the way the computer works.

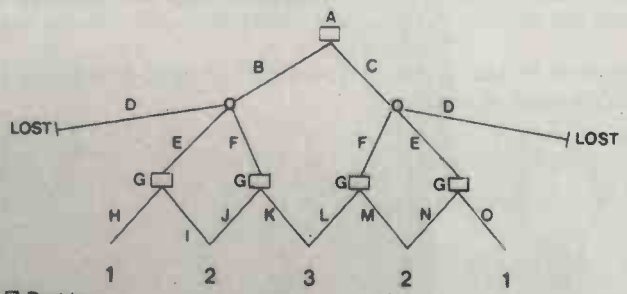
EXISTING history games for the computer rely on the interaction between the individual and the computer but the games at Sweyne School are designed to involve a whole class of mixed-ability students, and so have to use somewhat different techniques. They are not designed solely for older and/or abler students, so they cannot depend on an advanced knowledge of computers.

Applications of the computer for secondary school history teaching have been described in a recent Historical Association pamphlet edited by Joseph Hunt and commissioned by the National Development Programme in Computer Assisted Learning — *Computers in Secondary School History Teaching*. In the suggestions for simulations they have still been restricted in their range. The authors say they cannot involve the student emotionally through the use of the computer but adhere to intellectual involvement in a game played with a computer keyboard.

Our aim is to involve the student both emotionally and intellectually by using the computer to provide a simulation based on members of the class playing different historical roles.

FLOWCHART FOR RUSSIAN REVOLUTION DECISION THEORY PROGRAM

The program is designed for interactive use and works as a tree diagram. The tree diagram is terminated by the awarding of points depending on the position of the player on the tree.



□ Decision
o Random choice
I Terminator

A How do you intend to gain power?
B By legal means.
C By illegal means.
D Complete failure to gain support.
E Moderate success in early campaign.
F Great popular success in early campaign.
G How do you intend to continue your campaign for power?
H Rely on the will of the people in elections.
I Improved use of legal means.
J Continued use of legal means.
K Seek support from other groups.
L Direct appeal for public support.
M Seek support from other groups.
N Continue organising popular campaign.
O Rely on spontaneous popular support.

by Richard Ennals

Our approach relies partly on theoretical and partly on technical innovation. The theoretical innovation is the application of basic decision theory to historical situations, such as the Russian Revolution, enacted in the classroom. The decisions facing key individuals are analysed, separated chronologically, and simplified into an overall structure — a tree diagram or critical path analysis corresponding to the choices made and outcomes of actions taken.

A parallel critical path analysis follows the progress of the overall simulation by stages. If this is done appropriately, the same critical path model may serve as a guide. Or, translations may be added, perhaps as PRINT statements, to a common core of logical symbols.

The computer is not being used to make decisions in the simulation. It is there to increase the ability of the players to decide, make decisions, or perhaps to comprehend or explain decisions of historical characters. A problem in historical teaching is to give the student enough information to enable him or her to make decisions. Normally, this is difficult but the computer can be used to call-up further information when required by the participants which is available only at certain stages of the simulation and once certain alternative courses of action have been followed.

Incidentally, the determining of what alternatives are followed can be done retrospectively by an observer or as laid down from a choice of alternatives provided by the computer. This can be

printed; or, more suitably, it can be displayed for class use on a large-view screen.

So far, this is all theory on paper but the provision of a Research Machines 380-Z through the competition in *Practical Computing* gives us the chance to put theory into practice far more than was possible when we relied solely on a time-sharing terminal. Our new microcomputer is connected to a large black and white television screen and a small monitor, and it is about to be interfaced to the tape and printout facilities of our terminal.

We are working on the use of the television screen for the class. In our General Election simulation on May 3, once the computer had processed the results of the school it displayed the national consequences which would follow if the voting tendencies at Sweyne were repeated throughout the country.

In our simulation on June 7 of the election for the European Parliament, the results of the school-wide vote were processed and the screen provided briefing information to the (School) Members of the European Parliament when called to speak in their debate, information which enabled the participants to reach decisions on the admission of Spain and Portugal to the EEC.

One of the first games to be given computer assistance will be the Norman Conquest Game used by first-year classes. Using the principles described above, the computer will display further information as and when required by the players, to enable them to make up their minds on the basis of sufficient information.

The computer is also being used for more straightforward assistance to young historians. In the Explorers Game, for second-year students, a program simplifies the complex process of trading in different commodities. Each participant inputs what is being bought or sold and what price is being offered; they can also read a display of prices offered elsewhere.

In the Wedgwood Game for third-year students, straightforward mathematical routines help the young managers to calculate wages and prices and assist in their determination of policy.

Participants in historical simulations can carry-out decisions of a greater complexity and subtlety than normally would be possible. An individual version of the Russian Revolution game has been devised following the decision theory model outlined. It points quickly to the historical consequences of different courses of action.

The same model can be adapted using historical translations for the rise of Hitler, and it could be developed into a game of several rounds for the individual power-seeker.

I am more interested in developing the approach for use by a group. We are trying to develop the consequences of the interaction of two or more participants using the decision models outlined, with different outcomes for the matrix of their decisions. These are early days.

TCHEIDZE, Social Democrat, right-wing president of the Workers and Social Council until suspended by Trotsky, May 12, 1917 (above).

RED Guards shooting from an armoured car in Petrograd (below).

GENERAL disorder when Leninists besieged Duma in July, 1917 and a group of Georgian officers intervened (previous page).

On kits, soldering irons — and Sludgeware

by Nick Laurie

ASSEMBLED, £250; kit, £180. The difference is enough to buy a handful of books, manuals and add-ons and the temptation to keep a few hard-earned pounds in the pocket has probably lured a number of would-be computer owners into over-reaching themselves.

My own first experience of computer kits dates from a Heathkit Analogue machine, assembled in the 60s and full of — wait for it — valves. Heathkit is well-known for the quality of its documentation and I wasn't surprised to find my clicking monster performing complex operations reliably and accurately from the first switch-on.

Then followed the single-board computers. I chose a Nascom and in spite of the fact that I haven't wielded a soldering iron with any serious intent for five or six years, I chose a kit.

As a kind of warm-up, I Veroboarded a crystal set which worked first time; more, I think, because of the advent of the modern sealed diode than to my soldering ability. My first crystal set used a lump from an old lead soldier and a kind of wooden gallows arrangement with dangling wires to do the job, so neatly performed now by a glass capsule less than a quarter of an inch long.

Anyway, confident that I still had some knack at sticking components together, I sailed off to the big city to spend my £200 and returned home with a box full of assorted chips, boards, sockets and what have you; and a manual.

I read through the book of words — twice, in fact — and very quickly found myself longing for one of those beautiful Heathkit booklets which take you step by step through every operation from unpacking the components to wiring the mains plug.

Nevertheless, the PCB was very clearly overprinted with the component positions, the manual contained all the information needed, and I felt fairly sure that, apart from the 1,300 potential dry solder joints, I couldn't really go far wrong.

The job took a weekend and I limited myself religiously to 250 joints per session, with an hour's digging in the garden between sessions. By Sunday night — very late — I had a computer and a very tidy garden.

Shuttle service

Five o'clock on Monday; a cup of tea and the last few joints were made. In went the ICs and on went the power. Nothing. A quick check discovered one or two simple faults and by half-past five I had a television screen full of something. It wasn't what I had expected; my new baby had a strange tendency to amend programs to suit itself and I began to shudder at the thought of finding one or two dry joints among the 1,300. I re-read the manuals, checked the positioning of the components again, and finally resigned myself to re-soldering the entire board.

That, incidentally, is often much simpler than trying to track down a single duff joint and needn't take long really. A couple of evenings later the job was done; I powered up and found myself staring at a screen full of the most incredible garbage which simply wouldn't go away.

So the next morning I telephoned Nascom and had a word with the very helpful and very concerned informant who suggested a couple of tests and alterations. They were duly carried out, without any improvement. Mr. J. again. "Send it back", he said. So I did.

I packed the two main boards carefully and sent them away and waited the requisite three weeks.

Back it came. Power on, and to my amazement it seemed to work — for five minutes. Then we were back to garbage which steadily deteriorated until there was nothing there of any use at all. Back to Mr. J. who assured me that it was working perfectly when he despatched it and had I checked the power supply. Yes, I had, with a meter.

"Try using a 'scope on it", said Mr. J, so I did, and there for all the world to see was my problem. Shooting up the −5 volt line were the most amazing positive spikes, 100 of them every second and each one driving into the heart of the monitor's EPROM to garble a few bits here and there.

The only surprising thing was that the machine had lasted five minutes before packing up. Yet another call to Mr. J. and the problem was isolated. Tuppence worth of capacitor on the power line had failed and replacing it put my Nascom into perfect working order, where it has remained ever since.

The fault was minor but, and herein lies the point of my tale; I couldn't fix it without half a dozen calls, the cost of postage, a long wait and a good deal of time.

As it happened, the fault was cured easily and I ended with what I wanted. I learned a good deal about the inside of a computer and had plenty of time to read all the manuals very thoroughly.

While all this was happening, I took the opportunity to quiz half a dozen other kit builders and was scarcely surprised to find that only one of them had had instant success. Two had minor faults cured easily with the aid of a 'scope; two had to return kits for re-building; one is still waiting for spare parts to arrive from the States.

What, I asked them, did they consider to be the heart of their problems, and with one voice they replied "Sludgeware".

Coined by builders

Sludgeware, for those unfamiliar with the term, is a word coined by dissatisfied kit builders to describe badly-thought-out, badly-written and badly-printed (is it "O" or "Ø" or "B" or "8") documentation.

Sludgeware is typified by hand-drawn circuit diagrams, non-existent cross-references, assumptions that the constructor receives Heavenly guidance at all crucial stages of construction, and a total lack of fault-finding procedures.

My sample of six kit builders built, between them, four makes of computer, made some 20 phone calls — long distance — sent off 23lb. of parcels by first-class letter post, wrote 18 letters and travelled from Somerset to London no fewer than five times.

That lot, divided among the unsuccessful builders and added to repair fees varying from £5 to £35, would be enough to have enabled most of them to buy a fully-assembled model in the first place.

Add to that a longish delay between buying and using, and the whole idea of a kit becomes rather less attractive.

I know that building a kit isn't always for economic reasons; some people like building but that is no reason why it should cost them money. The cure, you see, is very simple, and as a first shot in a war I intend to carry on from time to time I cry: "*Ban the Sludgeware*".

If every kit builder who finds manuals inadequate, incomplete or illiterate, wrote to the manufacturer concerned to make that point clear, in no time at all we would see something happening — wouldn't we?

Think before yo into system c

Stop and think before you rush into an ill-conceived system that you might have for several years — that is the message in the third and final part of Mike Collier's introduction to systems analysis.

AT FIRST glance it would seem obvious — a product file will contain data relevant to each product, a customer file data relevant to each customer, and so on. That is exactly right, but it must be remembered that once the file content has been decided, it may be very difficult to change it.

All the programs using that file will need to be altered and the file of data will have to be converted to the new layout. So it is important to think ahead and make certain that all the necessary information has been catered for. It is this thought process which is the heart of the systems analysis work and it can save hours of labour if the right decisions are made at the beginning.

Consider a customer file. The types of information to be stored against each customer are probably:

- The customer's name.
- The address and postal code.

That may be sufficient for a simple system but other data could be stored to provide more information, such as:

- Sales this year so far.
- Sales last year.

That will provide valuable management information, answering such questions as "How much did Joe Bloggs buy from us last year?" For even more detailed analysis, you may want to keep these figures for each type of product sold.

- Customer category.
- Trade terms.
- Credit rating.

The next group of items would allow customers to be categorised — e.g., trade, retail and for the particular trade terms to be held on file, possibly using a convenient code to refer to a file of the different trade terms available. The credit rating could indicate those customers who are good risks and those who are not, or it could hold the limit of credit allowed to the particular customer:

- Customer telephone number.
- Name of contact.

These two items will help in contacts with the customer; without them no doubt the information would be kept elsewhere, thus forming the basis of an alternative file. One of the most common problems of any computer system is that the data files are not maintained sufficiently diligently. The best way to avoid this is to make sure that the computer file is the only file and therefore has to be relied upon.

Having settled the various items of data to be held on the file, the number of characters allowed for each must be determined. For any particular field the length must always be the same, so that when re-reading the record the program will be able to dissect it into the different fields. The following is an example of a very simple product file.

character positions	field description
1-6	product code
7-31	description
32-37	quantity in stock
38-43	quantity on order
44-51	selling price
52-59	purchase price
60-79	suppliers name
80-83	stock location

name	no. of chars.
PC$	6
DE$	25
QS$	6
QO$	6
SP$	8 (2 dec. pl.)
PP$	8 (2 dec. pl.)
SU$	20
SL$	4
	83

An important point to notice is that even the numeric data fields are stored as string variables. This is because numeric variables in Basic are not of any fixed length; but by converting the numeric value into a string, using the STR$ function, it can then be padded-out with blanks to the required size, assembled with the other data fields into the record, and then written on to the file.

On reading back, the record can be separated into the individual fields and the numeric ones converted using VAL.

Since each data field will need to be padded-out with blanks, where necessary, to the required size, it will be helpful to write a subroutine to do this. For example, to pad A$ to L characters long:

```
1000 ER=0
1010 A=LEN (A$)
1020 IF A>L THEN ER=1: RETURN
1030 IF A=L THEN RETURN
1040 FOR I=A TO L-1
1050 A$=A$+" "
1060 NEXT I
1070 RETURN
```

This routine returns with ER=1 if A$ is too long, otherwise A$ will be returned with the required length.

Having decided the length of each field, the total record length can then be examined. Most disc drives have fixed sectors, often of 256 characters, and do not allow records to cross over sector boundaries. In the foregoing example, three records of 83 characters can be stored in each sector, with only seven characters wasted in each 256.

If one more field with three characters — e.g. VAT rates (VRS) — were added to each record, then only two could be stored in each sector, taking 172 characters and leaving 84 characters wasted in every 256, almost one-third of the file.

Minimising loss

If it is essential to have the record of such a length that much of the file would be wasted, there are ways of minimising the loss. There is no rule to say that each record has to contain the same data fields — only that the record length must be the same.

The record could be broken into two parts, record type 1 and record type 2. By including the record type as a separate field, records of 44 characters can be made and stored five to a sector, thus wasting only 36 characters in 256.

The approach of having different record types can be used to store different kinds of data in the same file. There is no reason why both customer records and product records should not be stored on the same file, so long as they are of equal lengths — dummy fields of blanks can always be used to pad the shorter record to the same length as the longer.

To run a small business system successfully, it is important that care is taken to choose hardware with the right capabilities to cater both for the system under consideration and any possible future expansion.

The first major decision is whether a single terminal will be sufficient to cope with the volume of data. If it is, the way is open to a really low-cost system. If not, the choice is limited to only a few machines available to handle multiple terminals.

With the single terminal machines there is a wider choice but care must be taken, since not all the available alternatives can offer practical business systems.

The minimum necessary configuration would be a 32K computer capable of handling a printer and some form of disc storage. Any printer would be suitable for a general purpose business application; a matrix type would be reasonably fast and would cost £600 to £1,200.

If the application calls for high-quality print the choice is more limited, and the price much higher — around £2,000. It is surely about time print manufacturers began to produce a fully-formed charac-

u rush
noice

ter printer for a price more in keeping with the cost of small computers.

The printer will attach to the computer via a serial port, the standard being RS232 interface, so that should be one of the facilities on the checklist.

Disc drives are in many forms, the most popular being the floppy disc variety in either 8 in. or 5¼ in. sizes. Both sizes are satisfactory but note should be taken of the storage capacity. Most 5¼ in. discs will hold 90,000 characters, which may be too small for other than the smallest operations.

For example, a stock file with records 128 characters long will allow only 700 records on a 90K diskette. There are 5¼ in. disc drives which store more data — the Micropolis stores 315,000 characters on each disc.

The larger size of floppy disc is also in various capacities from 256,000 to more than one million characters but they tend to cost considerably more than the smaller size.

Maximum flexibility

For maximum flexibility it is best to choose a computer which can accept S-100 standard peripherals, since disc drives and controllers of all types, up to several million characters, are available to the S-100 standard.

On the software side there may be less choice, as most disc drives are supplied with software to operate them. This should include as a minimum a disc operating system and an extended Basic with file-handling statements. There are some commonly-available disc operating systems of which the best is probably CP/M. It allows many facilities and under CP/M all kinds of language compilers can be run — C-Basic, APL and the like. The Basic programming language can operate either as an interpreter or a compiler. The interpreter stores the program only in the source form and when the program is run it is compiled simultaneously into machine code.

The compiler has the ability to perform a conversion from source to object form (machine code) as a separate step, so that the compiled object form can be stored and executed without the need for re-compiling each time it is run.

There are advantages to both types; interpreters are best for program development but compiled programs run faster in everyday use. Ideally you need both.

You should look for a certain amount of software already available — for example, a word processing system would be useful to most businesses.

In writing programs for business applications there are a few points that should be borne in mind. Here are a few hints:

● Never use INPUT N, since a mis-keying of a non-numeric value will cause the program to collapse with an error message. Instead use INPUT NS
N=VAL(NS)
which will avoid the problem.

● Most data keyed-in will need to be converted to a string of the same length as the field allocated on the file. A sub-routine can be written to do this:

```
1000 REM CONVERT AS TO L CHARS LONG
1010 ER=0
1020 AL=LEN(AS)
1030 IF AL>L THEN ER=1: RETURN
1040 IF AL=L THEN RETURN
1050 FOR I=1 TO AL-1
1060 AS=AS+" "
1070 NEXT I
1080 RETURN
```

On return from this routine, ER will be equal to zero unless the string was already longer than L characters when ER will be returned with a value of 1. The calling program should test the value of ER returned and take appropriate action — i.e., displaying an error message — if an error occurred. Numeric values can also be converted to fixed length strings using similar techniques.

Amenable

Many applications are amenable to the 'menu' approach, where a list of options is displayed and the user chooses which option he requires. Depending on the choice made, the program will then branch to the appropriate sub-program or sub-routine.

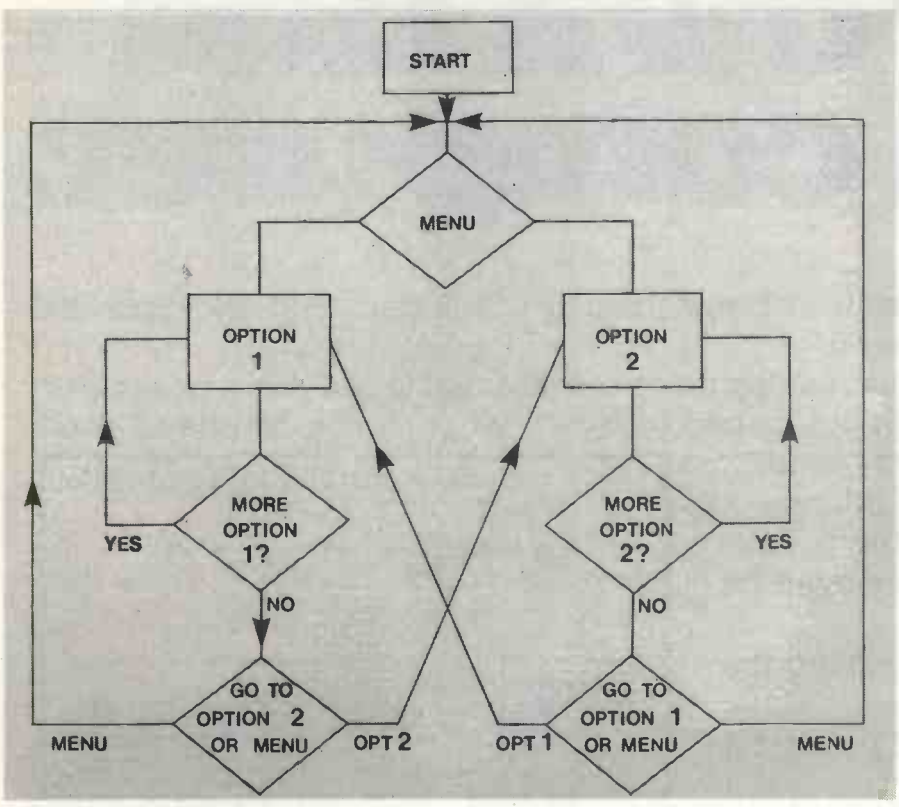
In such systems it can be annoying to have the program return to the menu automatically after each transaction if there are similar transactions to process. The approach I use is to return automatically to beginning of the current menu option, e.g. in a stock recording system. After entering details of an issue from stores, the program will then ask for the part number relating to the next item to be issued. This means that a batch of similar transactions can be entered quickly and easily.

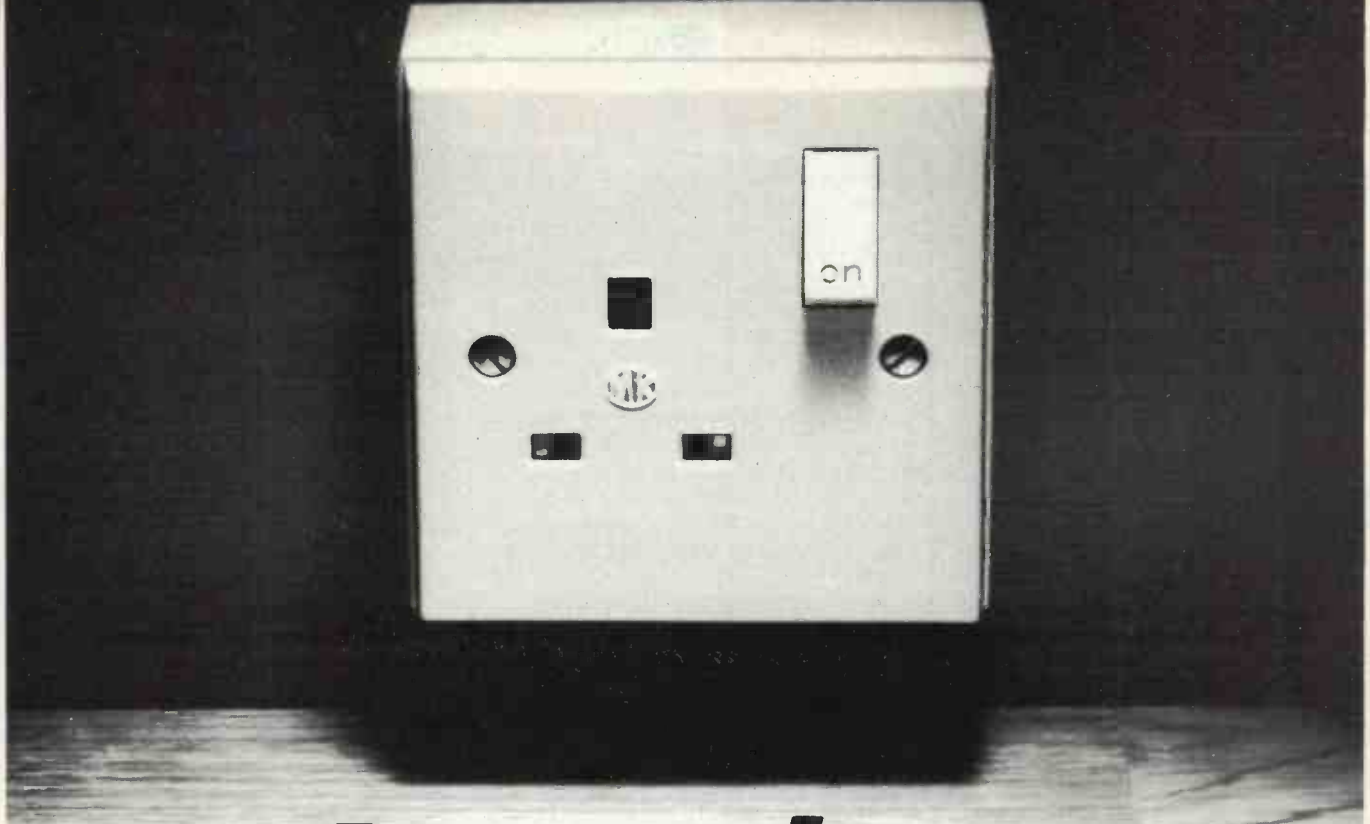
At the end of the batch when there are no more part numbers to enter the user presses RETURN without any part number and the program asks for the next transaction type.

On disc systems it is possible for one program to chain to another. The program chained to then has to be loaded from disc and run. This process obviously takes a time, so it should be avoided where possible.

One place where it can and should be avoided is when returning to the menu. It seems sensible to have a separate program to write the menu list and to chain to that program after each batch of transactions, but it would be much more efficient to repeat the section of program which puts the menu in each of the transaction programs.

The process can be simplified further by not displaying the menu but asking for the option number required. The user will learn very quickly which option number relates to which transaction, and the program could be written so that pressing RETURN without entering an option number will then display the menu. The illustration shows the program flow.





If you've got one of these, you can install your own IBM small computer.

The IBM 5110 computer is no larger than an office desk and asks no more than a 13-amp socket to power it.

Once programmed, it isn't much more complicated to use than a typewriter.

Yet at the touch of a button or two, you can, for example, handle all your accounts, business forecasts–even advanced mathematical modelling.

Even more remarkable is its price: around £11,000. We may even be able to help you finance it.

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IBM United Kingdom Limited,
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Surrey TW9 1DW.
Telephone 01-940 9545.

IBM

● Circle No. 157

Pet II has an improved keyboard and better documentation

THE PET has already proved itself a reliable and popular machine. Around 5,500 systems have been sold in this country, with a figure of 80,000 reported worldwide. There are now more than 120 dealers for the pet, from Glasgow to the Channel Islands. So why is there a need for a new Pet when the company already has a marketable product?

Fortunately, Commodore did not take that attitude. The new Pet seems to have been produced for two distinct reasons. First, notice has been taken of criticisms made of the Pet; second, the company is now trying to capture more of the small business market.

When the Pet was introduced originally more than half its applications were for education, with fewer than 20 percent of users wanting business applications. Now the balance has changed somewhat, with about 40 percent in each category. The Pet II has been designed with the needs of the businessman in mind, while retaining the features of the old Pet.

The most obvious change is the new keyboard. By removing the cassette deck from the case, the Pet II has a full-size typewriter keyboard. No longer will you have to pay typists claiming for damaged fingernails.

> **"No longer will you have to pay typists claiming for damaged fingernails."**

The graphics characters have been demoted to the front of the keys, which makes the lay-out far less cluttered. The other extra feature is the addition of a shift lock. The letters are held in normal QWERTY sequence, with all the edit characters reachable without the use of the shift key. The numerics are located on a separate pad to the right of the main keyboard.

Although this lay-out is different from a normal typewriter, becoming accustomed to it does not take too long. The one criticism is the lack of a repeat key.

The other changes are internal. The most significant is that of the characters set within the ROM. Originally, when poked into lower-case, to obtain lower-case characters the shift key had to be depressed. Now, the shift key has to be depressed for upper-case characters, making it possible for the Pet to act as a normal typewriter.

Note also that the standard Pet as supplied had 16K or 32K of RAM rather than 4K and 8K.

One other minor change is that it is not now possible to turn the screen on and off. This was possible previously by using the following commands:

POKE 59409,52 to turn the screen off.
POKE 59409,60 to turn the screen on.

(continued on next page)

The new Pet II in action. The good news is that the keyboard is much improved. The bad news is that the cassette is now separate from the computer.

(continued from previous page)

We had one game program which turned off the screen while it drew the board, then turned it on again. On the new Pet it disabled input from the keyboard.

Although most software will transfer on to the new Pet, some will not. We had problems with a word processor designed for the old Pet, as well as one or two games. Commodore has assured us that most software is compatible and any of its own which is not will be shortly.

With the new keyboard it is possible for the Pet to act as a normal typewriter.

Most of the changes needed are minor and we have not found one we have not been able to debug ourselves. Also, most of the changes have meant shortening the program concerned.

An example of this is in the CmC Word Processor, sold by Commodore. By deleting the following lines:

```
6130 IF CU=0 THEN CS$=CHR$ (ASC(C$) OR 128)
6140 IF CU=128 THEN CS$=CHR$ (ASC(CS$) AND 127)
```

and by changing the various graphics into lower-case, the program works perfectly.

As far as software is concerned the Pet has much to offer. As well as Commodore, there are several other companies selling software, including Petsoft and Gemsoft. There is also the *Pet Users' Club Newsletter* which has developed from a few stapled sheets into a printed booklet with a set format.

It gives not only a list of new software but also includes book reviews, update on old software and users' letters, as well as forthcoming hardware releases for the Pet. A year's subscription costs £10 (£15 overseas).

The documentation received with the Pet is also surprisingly good. Most manual writers seem to assume that everybody knows everything about Basic and that their machines are self-explanatory. The Pet documentation does neither of those things.

It is in the form of two manuals. The first, *An introduction to your Pet* serves as just that. It does not try to teach Basic but talks you through setting up your Pet, how to write some simple programs, how the editing facilities work, and how to save and load your programs.

The manual is very readable and contains a good deal about computers in general.

Several appendices include a list of error messages, a clear and concise summary of the Basic statements available, instructions on how to clean the Pet and the cassette, and a set of useful references on the cassette interfaces, memory expansion and an easy-to-read memory map.

The second manual is much larger and looked formidable at first. We found, however, that it is very readable and contains a good deal about computers in general. The section on Basic goes into detail about the use and syntax of each command.

The Pet has appeal for the first-time user. There are no wires to put in the wrong places — unless you don't know how to wire a mains plus properly.

The manual also has a section on machine code and a listing for a monitor.

The one major fault in the manual is the instructions for using the cassette. You may have difficulty finding them. Chapter 7 is entitled *Pet interfaces and lines*. Buried in the middle of it are the various commands for accessing data files and peripherals. Don't despair if you can't find them immediately — they are there somewhere.

This highlights the one other possible criticism which can be made about most

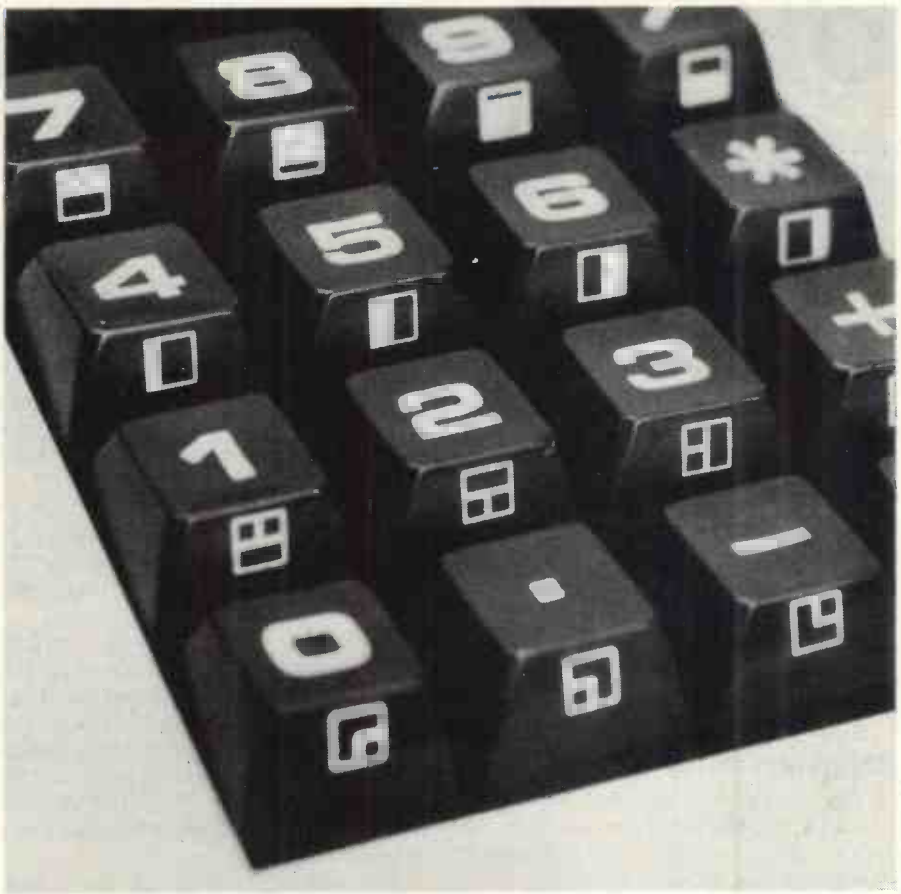
manufacturers' manuals. What about an index?

The Pet has appeal for a first-time user. There are no wires to put in the wrong places — unless you don't know how to wire a mains plug properly — although Commodore has made it slightly more difficult — you now have to plug the cassette interface into the back of the Pet. If you can fit a DIN plug into your record player you can do this.

Also the sheer volume of Pets sold and the number of Pet dealers around the country means that support for your system should be simple and readily available. Perhaps the most important feature is that, of all the machines around, the Pet represents very good value for money.

Conclusions

- **a much better keyboard.**
- **Great improvements in the documentation, although another revision would not be a waste of time.**
- **A viable proposition for a small business system, especially when the new disc system is available more readily.**
- **Very good and fast Basic.**
- **Good display and graphics, with a more sensibly-arranged character set.**
- **Wide range of software, most of it of good quality.**
- **The prospect of good support. At least if you have problems you don't have to travel hundreds of miles to complain.**



A section of the keyboard, designed for human fingers. The placing of the graphics legends on the front of the keys is clever and looks as if it will be an advantage.

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						
Sockets for chips	Y					
Numeric, calculator-type pad on keyboard	Y					
Large amount of removable memory, randomly accessible	Y					
Cassette tape recorder capability: Own	N					
Built-in recorder	Y					
Floppy disc capability	Y					
Communications capability (can talk to other computers)	Y					
Speed of instruction cycle	1MHz					
Ease of expansion				●		
Low power consumption					●	

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

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

Old war-horse proves a trifle limited

Bob Marshall looks at one of the old war-horses of hobby computing, the Kim, and finds it well turned out, somewhat pricey and a trifle limited.

THE Kim-1 is a ready-assembled microcomputer module based on the popular 6502 processor — as used in the Pet and Apple II.

As supplied, it includes 1K of RAM, a hex keyboard and LED display, 2K of monitor in ROM, and facilities for connecting an audio cassette and a 20-mA loop serial device, such as a printer. Expansion is made easy by the provision of locations for connections to the fully-decoded address/data bus (for memory expansion) and 16 programmable I/O lines (for user applications and peripherals).

The price of the basic system, excluding a power supply, is £108 including VAT.

Monitor

The monitor on the Kim — which stands for Keyboard Input Monitor — is a neat piece of software with a number of useful routines. Its main job is, of course, to enable the use of the integral keyboard and display but it also contains routines for interfacing a cassette recorder and a serial keyboard/printer; this is clever, as it adjusts to the bit-rate of the device automatically.

The monitor also maintains a copy of the registers of the 6502 in RAM page Zero, thereby easing considerably the task of modifying registers during debugging.

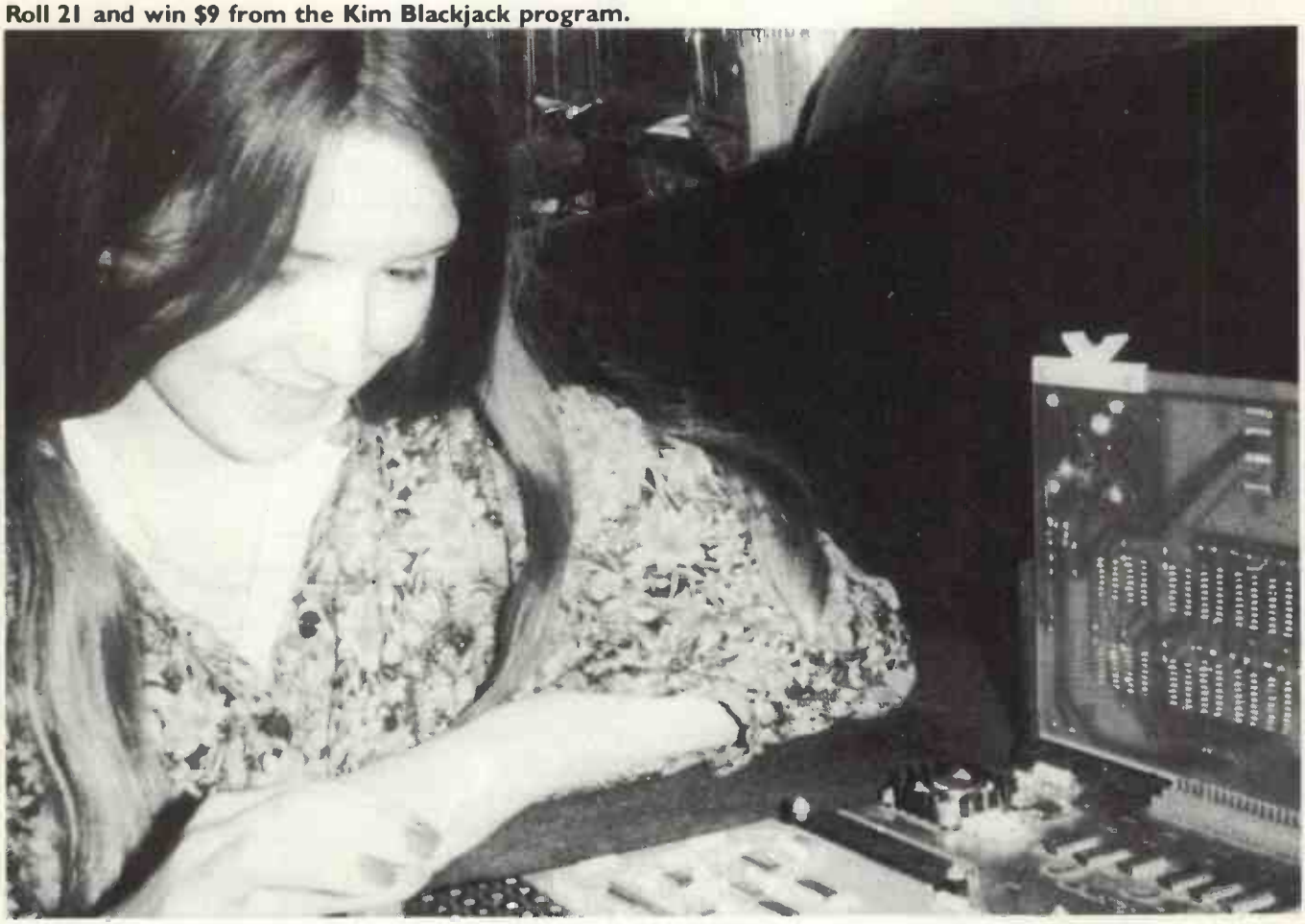
Contained in each of the two 1K ROMs is a counter-timer. One of them is used by the monitor for various purposes, including the I/O routines to the tape and printer, but the other can be programmed by the user for a variety of purposes; for example, the *First Book of Kim* contains programs for a clock, a chess-clock and a stopwatch/timer.

The output consists of six seven-segment, calculator-type, numerical displays. The four left-hand ones normally show a memory address; the right-hand pair show the data held there in hexadecimal. The display, however, is capable of producing limited alphabetical messages such as SAVEd or 'dEAd' — the combination of upper- and lower-case is confusing for a time, and 'b' is easy to mistake for '6'.

The keyboard has 16 hex keys, plus the following seven special keys:

GO	— begin program execution.
ST	— stop current program and return to monitor.
RS	— re-set system.
AD	— set address-entry mode.
DA	— set data-entry mode.
+	— increment displayed address by one.
DC	— display the contents of the program counter.

Roll 21 and win $9 from the Kim Blackjack program.



'All he does is enter machine code'. Thoughtful moments with Kim.

There is also a useful switch to permit single-stepping through a program under test, though ours worked in the reverse sense to that specified in the manual.

Adding a tape recorder is simple. You connect the "mic" and "ear" sockets of the recorder to three pins on the applications connector and use the routines in the monitor to do all the work. The data-transfer rate is only 130 bits/sec, but I have seen this increased to nearer 400 bits/sec under the control of a software routine — again from *The First Book of Kim* — Hypertape.

If you want to connect up a Teletype or similar 20 mA loop-compatible device, again all the software necessary is there in ROM. Only four wires are needed between the application port and the Teletype to get it up and running.

Prices

Kim 1: the basic computer with keyboard and display	£99.95
Kim 3B: each 8K memory expansion board	£129.95
Kim 4 motherboard (necessary for memory expansion)	£69.95

All excluding VAT.

The basic Kim provides room on-board for an additional 8K RAM and if the Kim-4 motherboard is purchased extra RAM boards (8K – KIM3B) can be plugged-in to expand to the full 64K.

The applications connector has 15 programmable I/O pins, to be used as the owner chooses. These TTL level lines can drive relays, lamps, A/D converters and sensors for a variety of applications.

Documentation

THE standard of documentation for Kim is worthy of high praise. Almost everything you could ever wish to know is contained in the three manuals supplied — *6502 Hardware, 6502 Software* and a *Users' Manual* — and most of the few remaining gaps are filled by the U.K. Kim Users' Hints, including a circuit to interface Kim to an RS232 serial data device. We also received a handy reference card and a large system schematic diagram.

Conclusions

● The Kim is a well-made, well-presented and well-documented system which could be very useful for building into some larger project or to introduce a beginner to computing.

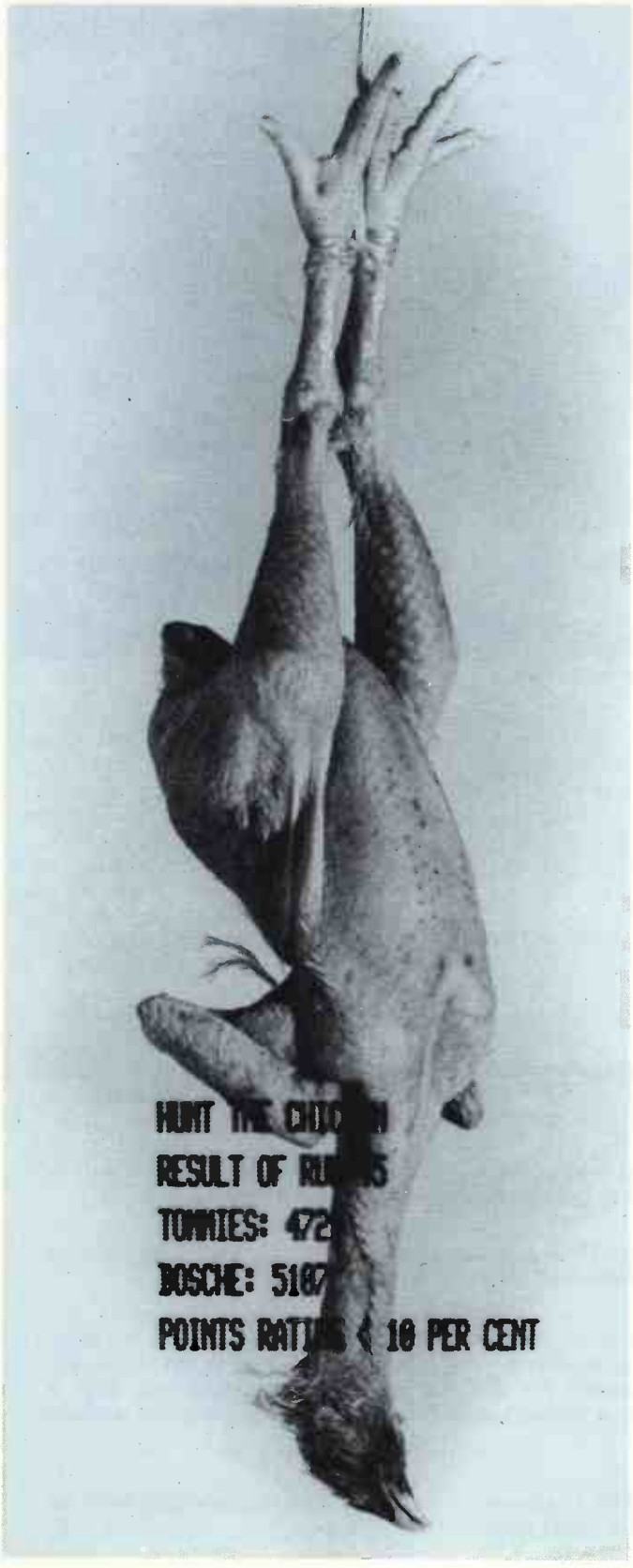
● The unwary should realise, however, that it can be programmed only in machine code, which is very difficult and time-consuming to write.

● There are some excellent programs in *The First Book of Kim* and it is amazing how communicative the six-digit display can be.

● Lunar Lander had us in spasms of fear; we sat for hours into the night trying to win dollars at blackjack — Kim is as hard to beat as the Mafia; but once you have exhausted the delights of pre-written programs, Kim is likely to interest only a dedicated enthusiast, or someone with a definite problem to solve.

● A minimum of £100 is plenty to spend on something which may be really useful for only a short time.

Bringing World War One to living reality



"The Ball no Question makes of Ayes and Noes,
But Right or Left as strikes the Player goes;
And He that toss'd Thee down into the Field,
He knows about it all – He knows – HE KNOWS!"

Omar Khayyam

WEST of Marville, the Somme runs through marshy ground, useless for trench warfare; so the front line followed a tributary, the Aurignon, and crossed what had once been the D'Arbles estate. The Bosche, having taken the high ground to the north of the wide, landscaped lake, had burrowed deeply beneath the cellars of the ruined mansion. The Tommies were south of the lake in the devastated vineyards.

Long artillery duels and ineffective attacks had rendered the once lush landscape a blood-soaked, fertile desert, where not a single wall or tree was intact. The exception was an unravaged island in the centre of the lake, some six feet high, 100 yards long, and of no strategic importance.

Thick bushes and untouched birch trees made it a magnet for eyes on both sides, and then there was the chicken. It was white and plump and seemed inured to the periodic whine and crump of shells, the bursts of machine-gun fire, and the plop and hiss of shrapnel into the water.

Every day it would appear and scratch around on the small mud and shingle beach. Salivary glands on both sides of the front, bruised by an unrelieved diet of bully beef, rock-hard biscuits and plum-and-apple jam, would ache at the sight, and snipers' fingers would quiver on triggers.

by John Abbatt

The night was calm as the boat slid quietly out of the reeds. Second Lieut. Reynolds sprawled in the stern with little to do except bail the leaking timbers with a tin hat. The lake was covered with a comforting bank of mist some three feet high, streaked with the ever-present smells of cordite and putrefaction. Overhead the clear, frosty stars were plainly visible.

To the east, the horizon flashed and fretted with a heavy barrage. Someone was getting it. On this front there was little activity beyond the occasional star-shell or burst of tracer. It was a time for housekeeping; the repair of barbed wire and minefields, the collection of groaning wounded from no-man's-land, the snatching of prisoners for interrogation.

Reynolds had survived for 10 days on a sector where the average life expectancy for his rank was eight. His battallion was due for relief in 20 days. He had no compunction about volunteering for the otherwise foolhardly attempt to get the chicken before the Germans did.

Three good men

Better to die in sight of the stars, he thought, than to be compressed in a clay dugout. In any case, his alloted hole had been made uninhabitable by the smell of a rotting corpse somewhere in one of the walls, and it had so far eluded or absorbed their patient probing.

He had three good men. Bombardiers Watson and Gordon worked the muffled oars. The rigid British class barriers which separated them from him had dissolved in the barrages and he admired and warmed to their stoicism and humour.

In the bows was Sergeant Gillespie, a 29-year-old Liverpudlian who was fast becoming a legend, having survived two previous spells in the front line; a man to stand near. He was steering a compass course for them and using the butt of his .303

to fend-off the bloated corpses of horses which dotted the surface of the water.

Reynolds glanced at his digital watch — 2330 hours.

"I've written to the compilers about the watch anachronism, Paul. They give 10 new pounds if you spot one."

They crunched softly on to the beach and Gillespie tied the painter to a birch. The men scrambled out and Reynolds passed their rifles to them.

"What now, sir?"

He considered. The normal rule on patrol was always to stay close together, but the chicken could scuttle past them. The sensible thing to do would be to spread out and beat the island. He decided to compromise.

"We'll split into pairs. You take Gordon; Gillespie and Watson can come with me. Zig-zag from shore to shore. Back here in half an hour and a low whistle if you get the bird first."

"Back to your winning option, Paul."

They picked up rifles and haversacks and melted into the bushes.

It was four hours before Reynolds returned to the boat. He had taken a bayonet thrust in the left calf muscle, which made him drag that leg. The teeth in his right lower jaw had been loosened and his face swollen by a glancing blow from a rifle butt.

The sergeant in the German patrol had strangled Watson before Reynolds had managed to shoot him with his revolver. The shot had produced bursts of fire from both sides of the lake.

Nightmare

It had been a nightmare as the two patrols stalked one another silently, afraid equally of friend and foe. Reynolds had stumbled over the body of Gordon *(850 points)* and two other Germans *(700 and 950 points)* and at the end had escaped by lowering himself into the water and pulling himself silently along to the beach. Every sound alerted his over-stretched nerves.

The boat was up to its gunwales in water — useless. It was doubtful if he could have rowed and bailed alone anyway.

Gillespie's body was sprawled across it and clutched in the lifeless hand was the body of the chicken. The man had been bayoneted in the back.

Reynolds grasped the chicken and realised with a start that it was still warm. Quickly he stuffed it into his pack. Then he shed his rifle and boots, picked up the two oars, eased himself back into the water and kicked out with his feet.

The mist had departed and the faint, pink glaze to the East outlined his head against the surface. The bushes parted and the German lieutenant raised his rifle and took careful aim.

The wargamers removed their headphones and rubbed their eyes as the score was printed. It had lasted two hours.

"Nobody got the chicken and the overall points ratings within 10 percent," said Roger, "so that makes it a draw."

"I can afford time to play a decider," Paul answered, "that is, if my nerves hold out. I need another can of beer."

Roger passed him one. "Your problem is that you identify too much with the characters and events in the game."

"I think that's inevitable when you are taking the British side. Anyway, they reckon that the best players achieve a symbiosis with the characters and much of me seems to be rubbing off into this Reynolds."

He worked the controls on the processor to create the start position. The machine guzzled the 64-megabyte program and data from its disc and then re-wound the four million video sequences. "Hunt the Chicken" appeared in bold lettering on the two video screens.

Lifelike

Paul was still thoughtful. "It's so lifelike the way the program feeds on the situations created by the background and characters and the options that we key-in that I begin to believe I am playing God to real people.

"Did you notice that Reynolds thought he had deja vu as they approached the island? He confused it with memories of punting on the Cam. I think what I'm trying to say is: Do the characters think they are real people in a real world?"

Roger liked this sort of conversation. "You have to start with a means of defining reality. How do you know that we are not fictional characters, and if so, how does our author know? . . ."

Paul cut him short. "Come on. This is getting too metaphysical." He put on the headphones and keyed in "Start".

The night was calm as the boat slid quietly out of the reeds. Second Lieut. Reynolds sprawled in the stern with little to do except bail the leaking timbers with a tin hat.

Diary

August

● **6** **The Real World of Microprocessors.** Venue: Holiday Inn, Chelsea, London. This one-day seminar is designed for industrial and commercial end-users and aims to give the "maximum amount of technical and market information" on microprocessors and microcomputers. The semmar is not very technical and emphasis is placed on examples of applications. Run by Control Data Institute, the seminar costs $120, which roughly translates to £65 plus VAT. More information on 01-637 2171.

● **8-10** **Introduction to Computers.** Venue: London. Organised by Keith London, this three-day course is useful if you want a generalised introduction to the world of computers. Price is £140, which includes refreshments.

● **23** **The use of small computers in business.** Venue: Kinver, near Stourbridge. One-day summary at a Worcestershire hotel run by a local software house; aimed at the non-technical. Organised by Video Software, the fee is £50.

September

● **6** **Choosing a Computer.** Venue: Glasgow. A practical summary of what is available for the small business; ostensibly for accountants but also for a more general audience. The course is organised by the Institute of Chartered Accountants of Scotland and the fee is £97 for the two days.

● **5-7** **Microcomputer Systems for Business and Administration.** Venue: London. This intensive three-day course is highly recommended for those who want to know how and where to use a microcomputer in an organisation. From the industry background on the first day, it proceeds through programming, intelligent terminals, terminology and applications. Organised by Learmonth and Burchett, it costs £190 and is non-residential. Contact Ellen Lee, Course Registrar, Learmonth & Burchett, 22 Newman Street, London, W1. Tel: 01-637 9699.

● **25-27** **PL/Z Workshop.** Venue: Holiday Inn, Swiss Cottage, London. This three-day course is run by Software Architects in conjunction with Zilog and promises to provide participants with the ability to design and program systems effectively in PL/Z, a subset of PL/1. Delegates are expected to have some familiarity with programming concepts. The course costs £200 plus VAT and further details are available from Software Architects on 01-734 9402.

Life with the TRS-80

LIFE is one of the magic words of computing. It is conventionally called a 'game', but it goes much further than most games. Some would claim that it goes as far as life itself.

Life was invented by J H Conway in 1970 and first published in *Scientific American* in October of that year. Conway's interest was in making a Turing machine and he was looking for a dynamic structure which could reproduce itself under controllable conditions.

The precise structure needed eluded him but was discovered shortly afterwards at the Massachusetts Institute of Technology; the 'glider' and with it the 'glider-gun' which generates it.

With other structures which invert, eat and reflect gliders, it was possible to build an elegant and practical version of von Neumann's self-replicating automaton. Unfortunately, these refinements need much more computing power than microcomputers can give, but, using the listing, you can enjoy the hypnotic evolution of Life's colonies.

The listing in machine code by Danny Creagan runs on the TRS-80, very well and very fast.

TO ENTER this program on your TRS-80, you will need a machine language monitor (such as T-BUG) or an assembler/editor for the TRS-80.

There are several good Basic programs which play the game of Life but they are very slow. Each generation of cells may take as long as 20 seconds to reproduce, depending on the complexity of the colony. This program circumvents this problem by using the much faster Z-80 machine language in the TRS-80 — a generation takes about half a second. You may watch the colonies grow, stabilise, move around and/or die in fractions of the time you would spend normally.

Life is played on a grid of squares which are either occupied or unoccupied; you determine initially which are which. You then start the program. The computer, using a few basic rules, generates colonies of cells — squares which are 'on'.

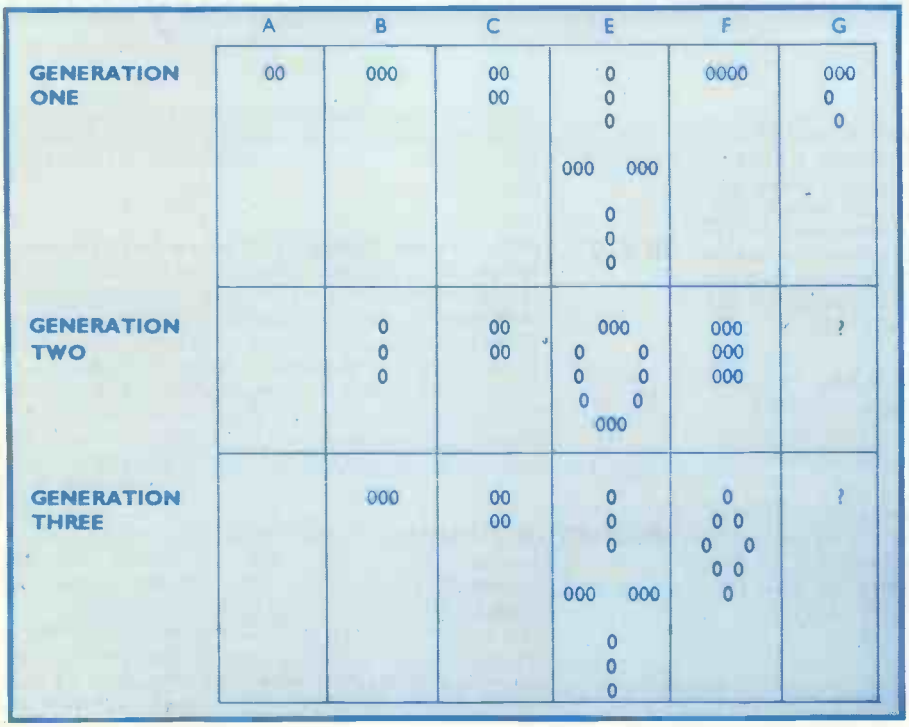
The rules are simple. Imagine a three by three grid with the cell in question in the centre of the grid.

- **BIRTH:** if the cell is unoccupied, and three *and only three* of its neighbours are occupied, then in the next generation that cell will be born.
- **SURVIVAL:** if the cell is occupied and *either* two or three of its neighbours are occupied, no change will occur in the next generation.
- **DEATH:** if the cell is occupied and has *no* neighbours, only *one* neighbour, or *four or more* neighbours, then on the next generation the cell will die.

If the cell is unoccupied and the foregoing happens then there will be no change.

The application of the rules simultaneously to every cell on the grid on the screen constitutes one generation.

Using the rules, many elaborate and interesting designs may be developed.



Some colonies will grow indefinitely, others will last only for a few generations. The chart shows some examples.

You will notice that example A dies after the first generation. Colony B becomes a simple blinker which repeats itself after two generations. C remains stationary. E is similar to B but produces a more pleasing pattern. F is still changing and will continue to do so for five more generations, at which time it will assume the condition of E and start repeating itself. And what will G do? Try it and you will be pleasantly surprised.

The program was assembled using the TRS-80 Editor/Assembler Version 1.1. Included along the comments column is a fairly complete commentary. In general, the program allows you initially to set up the colony you wish to observe and then pauses slightly at the end of each generation to see if you want to start again, edit or quit the game.

The screen update is accomplished by moving the data from the screen into a table. The information regarding the next generation is determined from the table area and updated on the screen. After checking all the table, the program then transfers the updated screen into the table area and starts again.

If you use an editor/assembler when writing this program, you may wish to re-locate it. Currently it resides in high memory of my 16K machine. If you have less than 16K memory, you will have to re-locate it; lines 120 to 180 and line 200 must be adjusted accordingly.

If you have a Level I machine, change the keyboard scan routines to CALL OB4OH. You will then have to save the A register immediately and enter a blank in the current cursor position. You must also execute a RST at location 10H. For instance, lines 340 to 360 would be changed to read as follow:

```
AGN     CALL    OB4OH
        LD      (STORE3), A
        LD      A, 20H
        RST     10H
        LD      A, (STORE3)
        JR      Z, AGN
```

How to play

Enter LIFE with the SYSTEM command (for Level I use your monitor). After loading, type /28160 if you have not re-located the program. A plus sign will appear in the upper left of the screen; this is your cursor.

To place cells on the screen use this table:

Key	Results
U	Cursor goes up
D	Cursor goes down
B	Backspace
Space bar	Space
O	Put cell at current cursor location

When you are ready to process your creation, type an exclamation mark. The computer will then process a generation about twice a second. If you want to stop the processing, hold down the P key. When the current screen update is complete, the computer will go into a holding mode. In the holding mode you have four options. Pressing the following keys will give you the listed results.

Key	Results
C	Continue more processing
S	Stop everything and go to BASIC
H	Erase screen and start new game
E	Put cursor on screen. You may now add or erase the cells as when you first started. The screen will still have the present generation displayed.

There is complete wraparound with this game. If a cell tries to go off the top, it will pop up at the bottom of the screen; if it goes off to the left, it will appear immediately on the right and vice-versa. If a generation wraps around and intermingles you will get an untrue representation of the colony growth.

There is a good Life on cassette from Supersoft, 28 Burwood Avenue, Eastcote, Pinner, 01-866 3326. It runs slightly faster than this one.

```
6E01            00100           ORG     6E01H
6E01 110000     00110           LD      DE,00H
6E01            00120 START     EQU     6E01H       :ESTABLISHES BEGINNING OF PROG
6FF0            00130 STORE1    EQU     6FF0H       :STORAGE FOR CURSOR REFERENCE
6FF2            00140 STORE2    EQU     6FF2H       :STORAGE FOR CELL COUNT
6FF9            00150 STORE3    EQU     6FF9H       :STORAGE FOR KEYBOARD SCAN
6A00            00160 TABLE     EQU     6A00H       :START OF VIDEO REF. AREA
006E            00170 COMP1     EQU     6EH         :MSB OF END OF TABLE
006A            00180 COMP2     EQU     6AH         :MSB OF START OF TABLE
3C00            00190 VIDEO     EQU     3C00H       :LOCATION OF FIRST VIDEO BYTE
002E            00200 ADJUST    EQU     2EH         :MOVES TABLE BYTES TO VIDEO AREA
6E04 ED53F06F   00210           LD      (STORE1),DE :CLEAR CURSOR REF.
6E08 ED53F26F   00220           LD      (STORE2),DE :CLEAR CELL COUNT
6E0C 21003C     00230           LD      HL,VIDEO
6E0F 11013C     00240           LD      DE,VIDEO+1
6E12 010004     00250           LD      BC,400H
6E15 3620       00260           LD      (HL),020H
6E17 EDB0       00270           LDIR                :CLEAR SCREEN
6E19 D5         00280 SCAN      PUSH    DE
6E1A FDE5       00290           PUSH    IY
6E1C 2AF06F     00300 AGN3      LD      HL,(STORE1) :UPDATE CURSOR LOCATION
6E1F 11003C     00310           LD      DE,VIDEO
6E22 19         00320           ADD     HL,DE
6E23 362B       00330           LD      (HL),2BH
6E25 CD2B00     00340 AGN       CALL    2BH         :SCAN KEYBOARD
6E28 B7         00350           OR      A
6E29 28FA       00360           JR      Z,AGN       :IF NOTHING PRESSED, GO BACK
6E2B 2AF06F     00370           LD      HL,(STORE1)
6E2E 11003C     00380           LD      DE,VIDEO
6E31 19         00390           ADD     HL,DE
6E32 3620       00400           LD      (HL),20H    :TURN OFF CURSOR
6E34 32F96F     00410           LD      (STORE3),A  :SAVE A
6E37 FE44       00420           CP      44H         :CHECK FOR DOWN CURSOR REQUEST
6E39 CA7A6E     00430           JP      Z,LNFDD
6E3C 3AF96F     00440           LD      A,(STORE3)
6E3F FE55       00450           CP      55H         :CHECK FOR UP CURSOR REQUEST
6E41 CA876E     00460           JP      Z,LNFDU
6E44 3AF96F     00470           LD      A,(STORE3)
6E47 FE42       00480           CP      42H         :CHECK FOR BACKSPACE REQUEST
6E49 CA976E     00490           JP      Z,BACK
6E4C 3AF96F     00500           LD      A,(STORE3)
6E5F FE21       00510           CP      21H         :CHECK FOR PROCESSING REQUEST
6E51 CAA76E     00520           JP      Z,PROC      :  AN "!" BEGINS PROCESSING
6E54 ED5BF06F   00530           LD      DE,(STORE1)
6E58 21003C     00540           LD      HL,VIDEO
6E5B 19         00550           ADD     HL,DE       :SET UP CURSOR TO DISPLAY BYTE
6E5C 3AF96F     00560           LD      A,(STORE3)
6E5F FE20       00570           CP      20H         :CHECK FOR SPACE REQUEST
6E61 CA6C6E     00580           JP      Z,MOD
6E64 3AF96F     00590           LD      A,(STORE3)  :CHECK FOR "O"
6E67 FE4F       00600           CP      4FH
6E69 C21C6E     00610           JP      NZ,AGN3     :GO BACK IF NOT AN "O"
6E6C 3AF96F     00620 MOD       LD      A,(STORE3)
6E6F 77         00630           LD      (HL),A
6E70 2AF06F     00640           LD      HL,(STORE1) :DISPLAY EITHER A SPACE OR "O"
6E73 23         00650           INC     HL          :INCREMENT CURSOR
6E74 22F06F     00660           LD      (STORE1),HL :SAVE CURSOR
6E77 C31C6E     00670           JP      AGN3        :GO BACK,TURN ON CURSOR,WAIT
                                                    :  FOR KEYBOARD INPUT
6E7A 2AF06F     00680 LNFDD     LD      HL,(STORE1) :DOWN CURSOR ROUTINE
```

(continued on next page)

(continued from previous page)

```
6ED7 114000   00690          LD      DE,64          ;REMEMBER IT'S 64 DECIMAL
6E80 19       00700          ADD     HL,DE
6E81 22F06F   00710          LD      (STORE1),HL    ;MOVE CURSOR REF. DOWN
6E84 C31C6E   00720          JP      AGN3
6E87 2AF06F   00730 LNFDU    LD      HL,(STORE1)    ;UP CURSOR ROUTINE
6E8A 114000   0740           LD      DE,64
6E8D 37       00750          SCF
6E8E 3F       00760          CCF
6E8F ED52     00770          SBC     HL,DE          ;MOVE CURSOR REF. UP
6E91 22F06F   00780          LD      (STORE1),HL
6E94 C31C6E   00790          JP      AGN3
6E97 2AF06F   00800 BACK     LD      HL,(STORE1)    ;BACKSPACE AND ERASE ROUTINE
6E9A 2B       00810          DEC     HL
6E9B 22F06F   00820          LD      (STORE1),HL
6E9E 11003C   00830          LD      DE,VIDEO
6EA1 19       00840          ADD     HL,DE
6EA2 3620     00850          LD      (HL),20H       ;PUT A BLANK IN THE NEW PLACE
6EA4 C31C6E   00860          JP      AGN3
6EA7 FDE1     00870 PROC     POP     IY
6EA9 D1       00880          POP     DE
6EAA 21003C   00890 RELOAD   LD      HL,VIDEO       ;MOVE ALL VIDEO INFORMATION
                                                    ;  TO TABLE AREA
6EAD 1006A    00900          LD      DE,TABLE
6EB0 010004   00910          LD      BC,400H
6EB3 EDB0     00920          LDIR
6EB5 21FF69   00930          LD      HL,TABLE-1     ;SET UP FIRST BYTE OF TABLE
6EB8 23       00940 THERE    INC     HL
6EB9 C3CC6E   00950          JP      PRO1
6EBC 110000   00960 MORE     LD      DE,0           ;CLEAR CELL TALLY
6EBF ED53F26F 00970          LD      (STORE2),DE
6EC3 7C       00980          LD      A,H            ;CHECK MSB OF FIELD
6EC4 FE6E     00990          CP      COMP1          ;  IF OVER "COMP1" GOTO PAUSE
6EC6 CA856F   01000          JP      Z,PAUSE
6EC9 C3B86E   01010          JP      THERE
6ECC 22F06F   01020 PRO1     LD      (STORE1),HL
6ECF 114100   01030          LD      DE,65          ;CHECK UPPER LEFT NEIGHBOR
6ED2 CDD86E   01040          CALL    UPPER
6ED5 C3E96E   01050          JP      LD2
6ED8 37       01060 UPPER    SCF                    ;COMPUTE NEIGHBORS LOCATED
6ED9 3F       01070          CCF                    ;  LEFT AND ABOVE PRESENT CELL
6EDA ED52     01080          SBC     HL,DE
6EDC 7C       01090          LD      A,H
6EDD FE6A     01100          CP      COMP2
6EDF DC076F   01110          CALL    C,ADD          ;IF CELL IS OVER ON THE TOP
                                                    ;  OF THE SCREEN, THEN WRAP
                                                    ;  AROUND
6EE2 7E       01120          LD      A,(HL)
6EE3 FE4F     01130          CP      4FH            ;SEE IF CELL IS ALIVE
6EE5 CC4C6F   01140          CALL    Z,TEST         ;IF CELL ALIVE, TALLY SCORE
6EE8 C9       01150          RET
6EE9 2AF06F   01160 LD2      LD      HL,(STORE1)    ;CHECK UPPER MIDDLE NEIGHBOR
6EEC 114000   01170          LD      DE,64
6EEF CDD86E   01180          CALL    UPPER
6EF2 2AF06F   01190          LD      HL,(STORE1)    ;CHECK UPPER RIGHT NEIGHBOR
6EF5 113F00   01200          LD      DE,63
6EF8 CDD86E   01210          CALL    UPPER
6EFB 2AF06F   01220          LD      HL,(STORE1)
6EFE 110100   01230          LD      DE,1           ;CHECK LEFT NEIGHBOR
6F01 CDD86E   01240          CALL    UPPER
6F04 C30C6F   01250          JP      CK2            ;GOTO RIGHT AND LOWER NEIGHBOR
6F07 110004   01260 ADD      LD      DE,400H
6F0A 19       01270          ADD     HL,DE          ;MAKE CELL WRAPAROUND
6F0B C9       01280          RET
6F0C 2AF06F   01290 CK2      LD      HL,(STORE1)
6F0F 110100   01300          LD      DE,1           ;CHECK RIGHT NEIGHBOR
6F12 CD186F   01310          CALL    LOWER
6F15 C3266F   01320          JP      LD3            ;GOTO REST OF NEIGHBORS
6F18 19       01330 LOWER    ADD     HL,DE          ;WRAPAROUND IF CELL IS OFF
6F19 7C       01340          LD      A,H            ;  BOTTOM OF SCREEN
6F1A FE6E     01350          CP      COMP1
6F1C CC446F   01360          CALL    Z,SUB          ;ADUSTS WRAPAROUND IF NEEDED
6F1F 7E       01370          LD      A,(HL)
6F20 FE4F     01380          CP      4FH            ;SEE IF CELL IS ALIVE
6F22 CC4C6F   01390          CALL    Z,TEST         ;IF SO THEN TALLY
```

```
6F25 C9       01400          RET
6F26 2AF06F   01410 LD3      LD      HL,(STORE1)  ;CHECK LOWER LEFT NEIGHBOR
6F29 113F00   01420          LD      DE,63
6F2C CD186F   01430          CALL    LOWER
6F2F 2AF06F   01440          LD      HL,(STORE1)  ;CHECK LOWER MIDDLE NEIGHBOR
6F32 114000   01450          LD      DE,64
6F35 CD186F   01460          CALL    LOWER
6F38 2AF06F   01470          LD      HL,(STORE1)  ;CHECK LOWER RIGHT NEIGHBOR
6F3B 114100   01480          LD      DE,65
6F3E CD186F   01490          CALL    LOWER
6F41 C3546F   01500          JP      FINAL
6F44 37       01510 SUB      SCF
6F45 3F       01520          CCF
6F46 110004   01530          LD      DE,400H      ;WRAPS CURSOR REFERENCE
6F49 ED52     01540          SBC     HL,DE
6F4B C9       01550          RET
6F4C 2AF26F   01560 TEST     LD      HL,(STORE2)  ;TALLY A LIVE CELL
6F4F 23       01570          INC     HL
6F50 22F26F   01580          LD      (STORE2),HL
6F53 C9       01590          RET
6F54 2AF06F   01600 FINAL    LD      HL,(STORE1)  ;RESTORE HL (CURSOR REFERENCE)
6F57 3AF26F   01610          LD      A,(STORE2)   ;GATHER IN TALLY
6F5A FE02     01620          CP      2            ;CHECK IF THERE IS 2 NEIGHBORS
6F5C CABC6E   01630          JP      Z,MORE       ;NO CHANGE IF THERE IS
6F5F 3AF26F   01640          LD      A,(STORE2)   ;GATHER IN TALLY
6F5A FE03     01650          CP      3            ;CHECK IF 3 NEIGHBORS
6F64 CA736F   01660          JP      Z,NEW        ;MAKE A BABY IF THERE IS
6F67 7C       01670          LD      A,H
6F68 D62E     01680          SUB     ADJUST       ;ADDRESS VIDEO AND KILL
6F6A 67       01690          LD      H,A          ;  IF THERE IS A CELL THERE
6F6B 3620     01700          LD      (HL),20H     ;20H IS AN ASCII BLANK
6F6D 2AF06F   01710          LD      HL,(STORE1)  ;PUT CURSOR REFERNCE IN HL
6F70 C3BC6E   01720          JP      MORE
6F73 7C       01730 NEW      LD      A,H          ;ADJUST HL TO ADDRESS VIDEO
6F74 D62E     01740          SUB     ADJUST
6F76 67       01750          LD      H,A
6F77 364F     01760          LD      (HL),4FH     ;MAKE A NEW CELL
6F79 210000   01770          LD      HL,0         ;RESTORE TALLY
6F7C 22F26F   01780          LD      (STORE2),HL
6F7F 2AF06F   01790          LD      HL,(STORE1)  ;PUT CURSOR REFERENCE IN HL
6F82 C3BC6E   01800          JP      MORE
6F85 D5       01810 PAUSE    PUSH    DE
6F86 FDE5     01820          PUSH    IY
6F88 CD2B00   01830          CALL    2BH          ;SCAN KEYBOARD TO SEE IF
6F8B FDE1     01840          POP     IY           ;  A PAUSE IS REQUESTED BUT
6F8D D1       01850          POP     DE           ;  ONLY SCAN ONCE
6F8E B7       01860          OR      A
6F8F CAAA6E   01870          JP      Z,RELOAD     ;PROCESS ANOTHER LOAD IF NOT
6F92 FE50     01880          CP      50H
6F94 C2AA6E   01890          JP      NZ,RELOAD    ;IF ANY KEY BUT "P" IGNORE IT
6F97 D5       01900 SCAN1    PUSH    DE
6F98 FDE5     01910          PUSH    IY
6F9A CD2B00   01920 AGN4     CALL    2BH          ;"P" WAS PRESSED SO FIND OUT
6F9D B7       01930          OR      A            ;  WHAT IS WANTED
6F9E CA9A6F   01940          JP      Z,AGN4       ;KEEP LOOKING, HE MUST WANT
                                                  ;  SOMETHING
6FA1 FDE1     01950          POP     IY
6FA3 D1       01960          POP     DE
6FA4 32F96F   01970          LD      (STORE3),A
6FA7 FE43     01980          CP      43H          ;IF "C" PRESSED GO BACK
6FA9 CAAA6E   01990          JP      Z,RELOAD     ;  TO PROCESSING
6FAC 3AF96F   02000          LD      A,(STORE3)
6FAF FE48     02010          CP      48H          ;IF "H"PRESSED START NEW GAME
6FB1 CA016E   02020          JP      Z,START
6FB4 3AF96F   02030          LD      A,(STORE3)
6FB4 3AF96F   02040          CP      53H          ;IF "S" PRESSED JUMP TO BASIC
6FB9 CA191A   02050          JP      Z,1A19H
6FBC 3AF96F   02060          LD      A,(STORE3)
6FBF FE45     02070          CP      45H          ;IF"E" NOT PRESSED THEN IGNORE
6FC1 C2976F   02080          JP      NZ,SCAN1     ;  INPUT AND GO SCAN AGAIN
6FC4 210000   02090          LD      HL,0         ;"E" WAS PRESSED SO PUT
6FC7 22F06F   02100          LD      (STORE1(,HL  ;  CURSOR ON SCREEN AND SAVE
6FCA C3196E   02110          JP      SCAN         ;  CURRENT GENERATION FOR EDIT
0000          02120          END
00000  TOTAL ERRORS
```


A. LEHAIR

Matching the abilities of man and computer

"Memory is necessarily for all operations of reason" — Blaise Pascal (1623-1662)

THE interest generated by the short PASCAL item by Francis Cox two issues ago has prompted us to commission this fuller assessment. If, when you have read it, or even before, you would like us to run a complete PASCAL course, like Donald Alcock's Illustrating Basic, would you please circle the number opposite in the questionnaire on and send it to us? Answer the other questions, too, if you wish.

PASCAL was outlined in 1968 and the first compiler for the language worked about two years later. The language is the brainchild of Nicklaus Wirth and others at the Zurich Technical Institute; it is a clear descendant of the Algol family, which was popular in Europe before being steamrollered by the Fortran-Cobol bandwagon.

The essential idea of PASCAL is to produce a structured, algorithmically-orientated language which matches realistically the abilities of both man and computer. The result is an elegant language which enables long programs to be written with few errors.

PASCAL executes programs quickly compared to other languages, especially in comparison with interpretative languages like Basic. Perhaps there is more to learn before you can use

by Richard Stevens and Ian Graham

PASCAL properly, though there is little of the unnecessarily fussy punctuation of Fortran.

Computer languages have shown none of the steady development of electronic hardware; the two most common of them, Fortran and Cobol, are both more than 20 years old. Basic has slipped into a different niche rather than displacing the two from their scientific and business environments.

At first sight, to the hardened Basic user, PASCAL has many tiresome points. Addicts tend to have the religious fervour of 16th century Jesuit priests and would deny this completely. It is not as "English" in its form, in the sense that it requires more learning of syntax than Basic. A PASCAL program is not interpreted line by line and it involves more new facilities — how to use an editor, for example — and extra statements for data types.

Converts to a new language tend to be carried away with it and are sometimes unwilling to take a balanced view about the relative merits of other languages, but PASCAL has many advantages which compensate for those disadvantages, even though many of which are more apparent than real.

Pure distillation

A PASCAL program looks very like the algorithm it represents. It is worth a slight diversion to understand the concept of an algorithm in relation to computers in general and PASCAL in particular. It is useless looking at the dictionary definition because the meaning has changed so much. Today an algorithm is a fixed routine or set of rules which produces the desired answer whatever the input data.

Every time you do a multiplication with rows and columns — remember, before you bought the calculator? — you are performing an algorithm.

Modern computing dates from 1936 when Alan Turing showed that it was possible to build a single and relatively-simple computing machine to solve any problem, provided it was algorithmic. He also proved that there were other problems which could not be solved by such a machine. Previously people had thought that it might be necessary for different machines to be built for different tasks — and that is perfectly true in mechanical engineering.

The microprocessor is almost a pure distillation of Turing's algorithmic processor. Until the happy day when computers can understand English, it makes sense, therefore, to design the computer language round algorithms, which are at least comprehensible in human terms.

PASCAL and algorithms are also closely related to "structured programming", a set of ground rules for producing programs which are easy to correct, alter, understand and have few bugs. The structured program should be well larded with comments and the interfaces between the blocks should be strongly defined. The program should have a tree structure, with the central task represented by the trunk, and smaller branches representing the modules of the program. The program flow is up and down the branches, so that it is impossible to leap about from one part of the program to another.

Not rigid

Although it is algorithmic, PASCAL is not really rigidly "coded" and it is not too concerned with exact punctuation, unlike, for example, Fortran. If you state the problem in words, and then break down the analysis into its component parts, you have an algorithm and it does not look very different from the PASCAL program.

This can be seen by comparing the small example and its algorithm in figure 1. The equivalence of a program and algorithm becomes more obvious and important on longer programs. A remark by Pascal 300 years ago, obviously a pre-emptive strike against highly-symbolic languages like APL, is "Speak against language that is too deeply figurative".

Another attribute of PASCAL is its specific requirement for the definition of data types. This can be something of a mixed blessing. It is wasteful and irrelevant in short programs but it is almost essential for long, complex ones.

Take Basic, for instance, which normally defines numbers as floating point by default — though exceptions are allowed. This sounds sensible; it means you don't have to waste time specifying apparently unnecessary details. Basic goes through the same routine for finding how many people there are in two groups of two as it does for multiplying $2 \cdot 3425645 \times 1 \cdot 45364757$. Why should you care if it takes 10 milliseconds instead of a few microseconds?

If the program had been told that the first two numbers were integers instead of floating point, however, it could have reduced the multiplication times and the amount of memory required for data storage.

This may not matter much for small programs but it is disastrous if you are doing millions of multiplications or need to store thousands of data elements. Then it becomes necessary to define data structures properly.

Four standard types

PASCAL has four standard data types — real, integer, Boolean and character. It also allows you to define other types — for example, days of the month from 1 to 31. The title of Wirth's book *Algorithms + Data Structures = Programs* therefore defines the language beautifully in one phrase.

PASCAL uses labels and sensible names for procedures — equivalent to subroutines — functions and variables, as befits a

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structured language. It is organised into separate blocks, each with standard elements. They must be in specific order and form as in figure 2, if they occur at all. All routines, variables or types are referred to by their labels and not by their line numbers.

By comparison, Basic is a line-orientated language; every statement is numbered. That has several advantages, and in particular it is easy to locate, alter and insert another line.

On the other hand, you have to refer to line numbers instead of sensible names: "120 IF X ⟩ A THEN 490 ELSE 370" instead of "IF MONTH LENGTH = 28 THEN MONTH: =FEBRUARY."

Basic is generally interpretative. This means you can say RUN and instantly see what happens. This is an excellent way to eliminate errors from a program. For instance, a spelling error in a Basic line produces a message like "SYNTAX ERROR IN LINE 37753".

It takes about 10 seconds to correct this and type RUN. If the same mistake occurred in a Fortran program on a PDP-11 — or any other system with relatively-bad error reporting — you would first have to identify the position of the error without the benefit of line numbers. This may involve printing the whole program. You then load the editing program, find the error, correct it and leave EDIT. All are slow tasks because you are manipulating the whole program.

Sensible compromise

But you haven't finished yet. You have then to compile the program and then link it with any routines used. At last you can input RUN. So if anyone says there are no advantages in interpretative languages, you have our full approval for clubbing that person with a box of punched cards.

Interpretative languages, however, have disadvantages. In particular, they run slowly because they have to decode each line of the program sequentially as they reach it, whereas a compiling language has done all this the best way during the compilation stage.

A sensible compromise might be to develop a program in the interpretative mode and then compile it to run fast when it is finished.

PASCAL adopts another approach. It is a compiling language and is designed so that the program could be compiled in one "pass". This means that the functions, data types, and so on must be defined before they are used. In turn, this allows easy checking of the use of these functions and sensible allocation of memory space. One of the great strengths of PASCAL is the amount of checking it does before the program is run.

The language defines the data structures very tightly and usually has good error reporting. This tends to eliminate one major source of errors — those syntax-type faults like spelling mistakes. They are found quickly and corrected.

The other principal group of errors is logical; you have told the computer to do something stupid, so it has done it. This type of mistake tends to predominate in a long program. PASCAL can minimise these by its algorithmic structure, which makes it fairly easy to add lines to a long program without introducing logical errors. Another common source of problems, alteration to make a program more powerful, is reduced by a structured language.

An important feature of PASCAL is that it is unusually machine-independent. The syntax has already suffered from the same fate as other popular programming languages — the evolution of different dialects. There is no logical financial structure for producing, co-ordinating and evolving computing languages, although there is now an American National Standards Institute committee trying to corral the evolution of PASCAL.

Figure 1: An algorithm and its PASCAL program

Problem: To print the factorials of the positive integers, where factorial 5 (5!) is equal to 5×4×3×2×1 = 120

The *algorithm* is: Factorial 0 is equal to one; the factorial for the next number (N) is equal to the factorial of the previous number multiplied by N.

Program example:

```
CONSTANT LIMIT = 10;
VAR I,N: INTEGER;
FUNCTION FACTORIAL (N:INTEGER): INTEGER;
BEGIN
IF N 0 THEN FACTORIAL: = N* FACTORIAL (N−1)
ELSE IF N = O
THEN FACTORIAL: = 1
ELSE WRITELN ("ARGUMENT ERROR", N)
END;
BEGIN
FOR L: = 1 TO LIMIT DO WRITELN (I, FACTORIAL (I))
END.
```

Out of balance

The trouble is that there is no immediate money to be made from languages. One result is that their development is now out of balance with the capabilities of computer hardware. People adapt the language for features they fancy and there is no central co-ordination of natural evolutionary tendencies.

Fortran has suffered less than most because there has been a committee defining and re-defining the language, though the members of the committee have lost financially for the work they have performed. It is ludicrous that this vital kind of work is carried-out in such a penny-pinching way.

The different feature about PASCAL, the key to its portability, is that it is designed so that the intermediate, partially-compiled P-code is machine-independent. The P-code is the rather complex machine language code of an imaginary computer and all Pascal compilers should convert into this on the way to machine code.

To adapt a version of the language to a new machine, the main work is in translating the P-codes into the particular machine language, a relatively simple step. A good dialect of PASCAL developed at the University of California in San Diego has become a virtual standard, especially for small computers; it is

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Figure 2: PASCAL functions
If the following functions appear in a procedure, they must appear in this order:
- *Label* — defines a label, seldom used in good PASCAL.
- *Constant* — defines a constant, such as π = 3.142, message = "help".
- *Type* — creates a special data type, such as days: (1 . . . 31); month: = (Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, Dec).
- *Variable* — indicates one of the standard data types, e.g. people: integer; decision: Boolean.
- *Procedure* — an independent chunk of program.
- *Statement* — the program itself.

available for most micros. As the P-code is machine-independent, the intermediate code for any program should also transfer between any pair of machines.

PASCAL needs a good deal of memory — about 48Kbytes for a workable system — and floppy discs are essential. The implementation for PDP-11s by OSMI takes 22KB itself; this is claimed to be a minimal amount for a working system. That is for 16-bit minis, so PASCAL will take even more for eight-bit machines and the coding produced will be less efficient.

Faster than Basic

To set against that, it produces a faster program than the equivalent in Basic. The exact differential is hard to gauge; it depends on the type of program. There would be little difference between the two languages in the time and manner they evaluated a SIN function. If the languages are dealing with integers or bit manipulation, it is a different story. PASCAL uses less memory in the final program than Basic because it stores data in a more efficient manner.

A vital difference between interpreting and compiling languages occurs where the program is meant to be used away from the computer in which it is developed, for example as a process controller of some kind. With an interpretative language, the whole of the interpreter must be stored even if only a fraction of it will be used. The compiling language uses only the pieces of the language it needs. This is vital where multiple copies of a program are to be made.

PASCAL was designed in 1971, when constraints such as minimum memory usage and speed of execution were relatively more important than ease of programming. As hardware becomes cheaper and faster, it makes sense to use computer power to reduce the programming effort.

More cost-effective

In the last seven years, memory has become at least 100 times more cost-effective. One megabyte costs about £10,000 now; if present trends continue, it could be down to less than £50 in 10 years.

It is economically sensible to use cheap and powerful hardware as efficiently as possible to reduce programming effort, rather than the other way round. PASCAL, or any language which evolves from it, is likely to change to reflect this potential, especially with the availability of extremely cheap 16-bit systems able to address much more memory directly.

It is difficult to make computer languages richer in syntax — the total number of words they "understand" — than they are at present. One reason is that programmers find it difficult to remember more than a few hundred functions. More convenient operating systems, with manuals and language aids stored on disc, will mean, however, that some increase in syntax will be possible. After all, you can now buy an 80-megabyte disc for £2,800 and a 1,000-page manual would occupy only a small proportion of that.

PASCAL Users Group (PUG)
The PASCAL Users' Group is an *ad hoc* band devoted to spreading the gospel, principally through the Group newsletter, which costs only £4 a year. Contact PASCAL Users' Group, Computer Studies Group, Mathematics Department, Southampton University.

For which system is PASCAL available?

PASCAL is available for machines as large as the CDC 7600. If that is too slow for you, you will have to buy a Cray — about £5 million, mains plug included in the price. There is an implementation for all the PDP-11s and the LSI-11, which means that the language can also be used on the Heathkit LSI-based equipment.

At the micro end, a version of the San Diego implementation is available for the Zilog Z-80, Intel 8085 (and presumably therefore the 8080), the Texas Instruments 9900 and the Motorola 6800. There is a San Diego version for the Digital Research CP/M, too, so any micro using this popular operating system should be able to buy it. We understand Abacus Computers will sell it, either separately or with its TEI S100-based system.

Three other firms selling systems with PASCAL are Compelec, Research Machines — soon if not now — and Equinox. A North Star implementation should now be available for any system using that company's discs.

It should be pointed out that although the San Diego system is good, these are early days for the PASCAL micro versions, so when you get it, don't expect it to be perfect. Page 74 of the manual contains the chilling message "the debugging program is not yet issued because it is full of bugs".

The authors have been looking around for a PASCAL system to borrow and, as of mid-February, there was nothing lightweight available. "We'll have one in 14 days" was a typical quote, and we believe them.

This is a list of all the firms we could find selling PASCAL systems here and in the States. Anyone selling anything else related to PASCAL, please write with details.

- Microdasys, P.O. Box 36051, Los Angeles, CA 90036 (Motorola 6800).
- Altos Computer Systems, Santa Clara (Zilog Z-80) — U.K. agents are Compelec (01-636 1392) which will also supply PASCAL on CP/M for its Series I system (based on the Z-80).
- Marinchip Systems, 16 St. Jude Road, Mill Valley, California (16-bit Texas 9900 on an S-100 card).
- North-West Microcomputer Systems, 121 East Eleventh Street, Eugene, Oregon 97401 (Intel 8085). Potential U.K. source, Abacus.
- Computer Interface Technology, 2080 South Grand, Grand Centre, Santa Ana, CA 92705 (system based on Western Digital chips).
- Equinox Computer Systems, Kleeman House, 16 Anning Street, New Inn Yard, London EC2A 3HB. (01-739 2387 — North Star Equinox systems).
- Abacus Computers, New Cavendish Street, London (01-639 0777) has PASCAL running on its TEI equipment.
- Casu Electronics, Ferndown, Northwood Hills, Middlesex (Northwood 29402), has its own S-100 system with CP/M and PASCAL about to be implemented.
- Oregon Minicompter Software Inc has PASCAL software for all PDP-11 and LSI-11 operating systems.
- Research Machines, P.O. Box 75, Chapel Street, Oxford 49792 (soon if not now).

An interesting piece of hardware which will be available soon is a 16-bit micro system based on chips produced by Western Digital. In this, the machine instructions are optimised specifically by microcoding for the machine to run the intermediate P-code directly, so there is a speed improvement of perhaps four or five times over a standard software version. This means that the system, costing something around £3,000, will out-perform reasonably powerful minicomputers using PASCAL software. That "imaginary computer" for the P-code is imaginary no more.

A note on Pascal

Blaise Pascal (1623-1662) was French and lived in the 17th century, at a time when Frenchmen in particular were distinguished by their breadth of vision. Even so, Pascal was an exceptional polymath — writer, mathematician, scientist, religious thinker, natural philosopher.

He also built the world's first mechanical calculator (about 1647) to help his father, who was a taxman in Rouen. It used wheels marked with digits, and turning a wheel through a full revolution (from 0 to 9) caused its neighbour on the left to move one notch.

Pascal apparently built about 50 but they suffered from mechanical problems because he couldn't get the interlocking cogs cut accurately enough. So he invented the hypodermic needle, the hydraulic press, the basis of probability theory and the first public transport system in Paris.

He was as eminent as a theologian as he was a mathematician and also as an author. It was he who said: "The heart has its reasons which reason knows nothing of," which would, in itself, be enough to ensure his fame.

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★

★

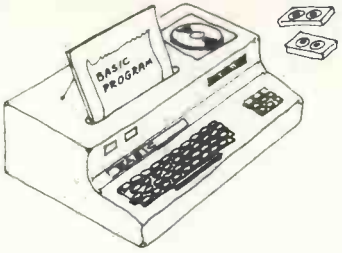
CONTENTS

7 COMMANDS AND SIGNING ON

SIGNING ON

CONSULT YOUR USER'S MANUAL ➪ EVERY SYSTEM HAS ITS OWN RULES.

BASIC RUNS ON MINI-COMPUTERS AND MONSTERS ALIKE.

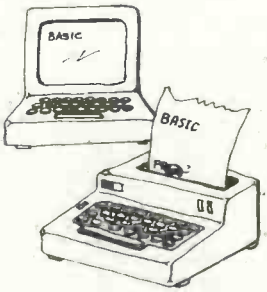


YOU MAY USE A MODERN "DESK-TOP" COMPUTER DESIGNED EXCLUSIVELY FOR DEVELOPING AND RUNNING *BASIC* PROGRAMS.

(SOME OF THESE HAVE KEYS MARKED WITH THE WORDS OF THE LANGUAGE TO SIMPLIFY TYPING.)

OR YOU MAY USE ONE OF SEVERAL "TERMINALS" CONNECTED TO A COMPUTER IN THE BUILDING ➪ OR CONNECTED BY TELEPHONE TO A COMPUTER MILES AWAY.

SOME TERMINALS HAVE A KEYBOARD AND VISUAL-DISPLAY SCREEN LIKE A TELEVISION: OTHERS A KEYBOARD AND PRINTING HEAD FOR TYPING ON PAPER.



BIG COMPUTERS OFFER A CHOICE OF LANGUAGE ➪ *BASIC* IS JUST ONE OF THEM. SOMEHOW YOU HAVE TO TELL THE COMPUTER YOU WANT TO USE *BASIC* AS YOU "SIGN ON".

WHEN YOU SWITCH ON A TERMINAL (AND, IF IT IS CONNECTED TO A TELEPHONE LINE, DIAL THE NUMBER OF A COMPUTER BUREAU) THE FIRST INTELLIGIBLE RESPONSE YOU GET COMES FROM THE COMPUTER'S "OPERATING SYSTEM". YOU THEN HAVE TO TYPE COMMANDS IN A CODE THE OPERATING SYSTEM CAN UNDERSTAND. UNFORTUNATELY THESE CODES ARE TOTALLY DIFFERENT FROM ONE OPERATING SYSTEM TO ANOTHER. SOME HELP YOU BY ASKING QUESTIONS AND SUPPLYING PROMPTS. THE EXAMPLE OPPOSITE CONCERNS AN IMAGINARY SYSTEM SUCH AS THIS BUT YOU WOULD BE LUCKY TO FIND A REAL ONE AS INTELLIGIBLE.

ILLUSTRATING BASIC PAGE 112

CONVERSATION WITH AN IMAGINARY OPERATING SYSTEM:

```
YOU ARE CONNECTED TO THE "THANATOS" SYSTEM OF
NECROPOLITAN LIFE ASSURANCE INCORPORATED, MORSVILLE.
PLEASE TYPE YOUR ACCOUNT NUMBER
?  123021/6
PASSWORD
?  DAVYJONES
```

MOST SYSTEMS PRINT AND OVERPRINT A BLACK MESS OF CHARACTERS WHEN ASKING FOR YOUR PASSWORD SO THAT WHAT YOU TYPE ON TOP OF THE MESS CAN'T BE DECIPHERED BY CURIOUS BYSTANDERS:

```
PASSWORD
? ▪▪▪▪▪▪▪▪▪▪

USER 123021 SUBACCOUNT 6 SIGNED ON AT 17.03 HRS
WHAT PROCESSOR OR LANGUAGE
?  BASIC
```

THE CONVERSATION WITH THE OPERATING SYSTEM IS NOT QUITE FINISHED BUT THIS IS THE POINT AT WHICH SIMPLER OPERATING SYSTEMS (THOSE FOR COMPUTERS DEDICATED TO *BASIC*) BEGIN WHEN YOU SWITCH ON.

```
NEW PROGRAM OR OLD
?  NEW
GIVE NEW PROGRAM A NAME
?  EXAMPL
```

THE NAME YOU INVENT IS RESTRICTED BY MOST OPERATING SYSTEMS TO ABOUT SIX LETTERS AND DIGITS OF WHICH THE FIRST MUST ALWAYS BE A LETTER.

```
BASIC IS READY
```

THIS IS THE POINT AT WHICH MOST EXAMPLES IN THIS BOOK BEGIN READY TO RECEIVE A NEW PROGRAM TYPED LINE BY LINE PRIOR TO TYPING "RUN".

HAVING SIGNED ON, TYPED A PROGRAM AND RUN IT YOU WILL THEN WANT TO "SIGN OFF". IN MANY SYSTEMS YOU DO THIS BY TYPING "BYE" OR "GOODBYE".

```
BYE

USER 123021 SUBACCOUNT 6 SIGNED OFF AT 17.15 HRS.
TIME CONNECTED = 12 MINS, PROCESSOR TIME = 1.385 SEC.
```

IF YOU GET CONFUSED WHEN CONVERSING WITH AN OPERATING SYSTEM, TRY TYPING "HELP". SOME SYSTEMS DO RESPOND HELPFULLY: OTHERS JUST SAY "WHAT?" BUT IT'S WORTH A TRY.

CHAPTER 7

COMMANDS

EACH COMMAND MAKES *BASIC* DO SOMETHING THE MOMENT IT IS TYPED.

THE MOST IMPORTANT COMMAND OF *BASIC* IS "RUN" BUT THERE ARE OTHERS COMMON TO MANY VERSIONS OF *BASIC* AND BRIEFLY DESCRIBED HERE. MOST *BASICS* HAVE USEFUL COMMANDS FOR PROVIDING LINE NUMBERS AUTOMATICALLY, FOR RE-NUMBERING THE LINES OF A PROGRAM, AND FOR JOINING PROGRAMS TOGETHER, BUT THESE COMMANDS VARY TOO MUCH IN DETAIL TO BE INCLUDED IN THIS BOOK. *ALWAYS CONSULT YOUR MANUAL ABOUT THE COMMANDS OF BASIC.*

```
BASIC IS READY

10  REM JUST AN EXAMPLE
20  FOR A = 1 TO 8
30  PRINT A;
40  EMD
40  END
32  NEXT A
10
RUN
 1  2  3  4  5  6  7  8
```

RUN

NO LINE NUMBER — "RUN" IS NOT PART OF THE PROGRAM. IT CAUSES IMMEDIATE ACTION

IF YOU TYPE "RUN" A SECOND TIME YOU WILL GET THE SAME RESULT AGAIN: *BASIC* DOESN'T FORGET A PROGRAM HAVING OBEYED IT.

```
RUN
 1  2  3  4  5  6  7  8
```

IF YOU TYPE "LIST" *BASIC* WILL PRINT A COPY OF THE PROGRAM YOU HAVE TYPED. IT WILL BE A *CLEAN* COPY HAVING BAD LINES REPLACED OR REMOVED AND OUT-OF-SEQUENCE LINES CORRECTLY INSERTED. COMPARE THE ORIGINAL PROGRAM ABOVE WITH THAT BELOW. (SEE ALSO PAGE 7.)

```
LIST
20  FOR A = 1 TO 8
30  PRINT A;
32  NEXT A
40  END
```

LIST

IN SOME *BASICS* TYPING "LIST 30" WOULD CAUSE JUST LINE 30 TO BE PRINTED; IN OTHERS THIS WOULD CAUSE LINE 30 AND ALL SUBSEQUENT LINES TO BE PRINTED. IN SOME *BASICS* TYPING "LIST 20,32" (IN OTHERS "LIST 20-32") CAUSES JUST THAT PART OF THE PROGRAM INCLUDED WITHIN THE STATED RANGE OF LINE NUMBERS TO BE PRINTED.

IF YOU TYPE "SAVE" THEN *BASIC* WILL SAVE IN A "FILE" A COPY OF THE PROGRAM YOU ARE CURRENTLY WORKING ON. THE COMPUTER HAS A *WORKING AREA* (USUALLY IN ITS FAST CORE STORE) AND A *FILES AREA* (USUALLY IN ITS BACKING STORE OF MAGNETIC TAPES AND DISKS). WHEN YOU TYPE "SAVE" A COPY OF THE PROGRAM CURRENTLY IN THE WORKING AREA GOES TO THE FILES AREA. YOU CAN GET IT BACK AGAIN BY TYPING ITS NAME AS DESCRIBED LATER.

```
LIST
20  FOR A = 1 TO 8
30  PRINT  A
32  NEXT A
40  END
SAVE
```

SAVE

SENDS A COPY OF THIS PROGRAM TO THE FILES AREA UNDER THE NAME "EXAMPL" ~ THE NAME GIVEN ON PAGE 113

SEE PAGE 117 ALSO

ONCE IT IS IN THE FILES AREA YOUR PROGRAM WILL NOT DISAPPEAR WHEN YOU SIGN OFF: BUT YOU WILL BE CHARGED RENTAL (USUALLY BY THE DAY) AS LONG AS IT REMAINS IN THE FILES AREA. IT IS ON SUCH RENTALS THAT COMPUTER BUREAUX MAKE THEIR PROFIT.

YOU MAY DISCOVER WHAT YOU HAVE STORED IN THE FILES AREA BY TYPING "CATALOG" (IN BRITAIN YOU MAY TYPE "CATALOGUE").

```
CATALOG

USER 123021/6    FILES STORED:

NAME      TYPE          SIZE   DATE CREATED
----      ----          ----   ------------
EXAMPL    SOURCE CODE      1   01 MAR  77
PROG27    SOURCE CODE      2   28 FEB  77
DATA65    DATA            27   13 JUN  75
DAT4      DATA            15   24 AUG  77
```

CATALOG

"SOURCE CODE" IS JARGON FOR A PROGRAM IN ITS ORIGINAL FORM ~ IN THIS CASE *BASIC*.

THE MEANS OF CREATING AND STORING FILES OF *DATA* ARE DESCRIBED ON PAGE 120.

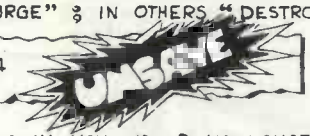
"SIZE" DETERMINES THE DAILY RATE CHARGED FOR RENTAL: THE UNITS OF SIZE MIGHT BE *BLOCKS* OR *TRACKS* OR SOME OTHER MEASURE DEPENDING ON THE KIND OF EQUIPMENT IN USE.

CHAPTER 7

COMMANDS (CONTINUED)

YOU MAY REMOVE A FILE FROM THE FILES AREA ⇒ *DESTROY IT COMPLETELY* ⇐ BY TYPING "UNSAVE" FOLLOWED BY THE NAME OF THE FILE, OR A LIST OF NAMES SEPARATED BY COMMAS. IN SOME SYSTEMS THE WORD IS "PURGE"; IN OTHERS "DESTROY".

```
UNSAVE DATA65, DAT4
```



IF YOU THEN TYPED "CATALOG" AGAIN YOU WOULD NO LONGER FIND FILES DATA65 OR DAT4 ⇐ AND RENTAL CHARGES FOR THEM WOULD CEASE. IN MANY SYSTEMS YOU CAN MAKE COPIES OF FILES ON PUNCHED PAPER TAPE OR PUNCHED CARDS: ON SUCH MEDIA YOU CAN STORE FILES WITHOUT PAYING RENTAL YET HAVE THEM READ BACK INTO YOUR FILES AREA WHEN NEEDED AGAIN. THE MEANS OF DOING THESE THINGS VARY GREATLY FROM SYSTEM TO SYSTEM SO CAN'T BE DESCRIBED IN THIS BOOK.

TO BRING A FILE FROM THE FILES AREA TO THE WORKING AREA YOU TYPE THE COMMAND "OLD" FOLLOWED BY THE NAME OF THE FILE WANTED:

```
OLD PROG27
```

WHATEVER WAS PREVIOUSLY IN THE WORKING AREA HAS NOW DISAPPEARED, SO REMEMBER TO USE "SAVE" *BEFORE* "OLD" IF YOU WANT TO PRESERVE A COPY OF THE WORKING AREA.

YOU MAY NOW TYPE "LIST" IN ORDER TO SEE A COPY OF PROG27, OR YOU MAY TYPE "RUN" TO EXECUTE PROG27, OR YOU MAY TYPE INSTRUCTIONS IN *BASIC* WHICH WILL ADD TO THE PROGRAM OR REPLACE LINES OF IT. WHEN YOU TYPE "OLD" IT IS EXACTLY AS THOUGH YOU HAD *JUST TYPED* THE PROGRAM NAMED. AND THAT PROGRAM DOES, OF COURSE, REMAIN INTACT IN THE FILES AREA: THE COMMAND "OLD" TRANSFERS A *COPY* OF THE NAMED PROGRAM TO THE WORKING AREA.

SO WHAT IF YOU ALTER PROG27 IN THE WORKING AREA BY TYPING SEVERAL NEW LINES OF *BASIC* AND THEN TYPE "SAVE" AGAIN? THERE IS ONE PROG27 IN YOUR FILES AREA AND A *DIFFERENT* PROG27 IN YOUR WORKING AREA. THE ANSWER IS THAT *BASIC* PRINTS AN ERROR MESSAGE TO SAY THAT PROG27 IS ALREADY SAVED.

HOWEVER, MOST "SAVE" COMMANDS WOULD ALLOW THIS:

```
SAVE   PROG27A
```

IT SAYS "SAVE THE PROGRAM IN THE WORKING AREA *AS THOUGH IT WERE NAMED PROG27A*". YOUR FILES AREA WOULD NOW CONTAIN BOTH PROG27 AND PROG27A; THE PROGRAM IN THE WORKING AREA WOULD STILL BE CALLED PROG27.

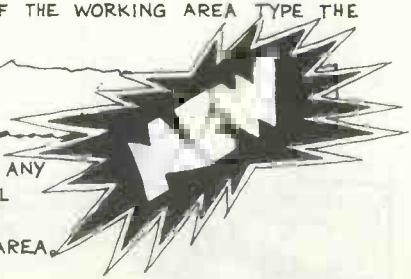
HERE IS ANOTHER SOLUTION TO THE PROBLEM OF DUPLICATED NAMES. THE ILLUSTRATION SHOWS AN INITIAL ABORTIVE ATTEMPT TO FILE TWO PROGRAMS UNDER THE SAME NAME.

```
SAVE
***ERROR***  PROG27 ALREADY SAVED
UNSAVE  PROG27
SAVE
```

IN MOST SYSTEMS THE COMMAND "UNSAVE" WORKS ONLY ON FILES IN THE FILES AREA ~ NOT ON THE CURRENT FILE IN THE WORKING AREA. IF YOU NOW TYPED "CATALOG" YOU WOULD FIND PROG27 BACK IN THE FILES AREA BUT ITS DATE OF CREATION WOULD BE TODAY'S DATE.

TO CLEAR EVERYTHING OUT OF THE WORKING AREA TYPE THE COMMAND "NEW".

```
NEW
```



IF YOU DON'T DO THIS THEN ANY LINES OF *BASIC* YOU TYPE WILL GO TO CHANGE THE PROGRAM CURRENTLY IN THE WORKING AREA.

NOTICE HOW THE PROCESS OF SIGNING ON ILLUSTRATED ON PAGE 113 *FORCES* THE VERY FIRST COMMAND TO BE:

"OLD" OR "NEW".

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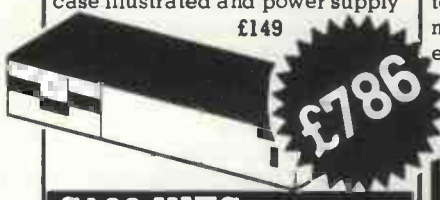

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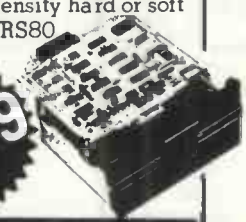

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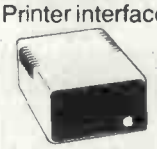

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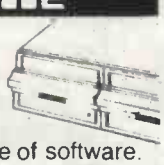

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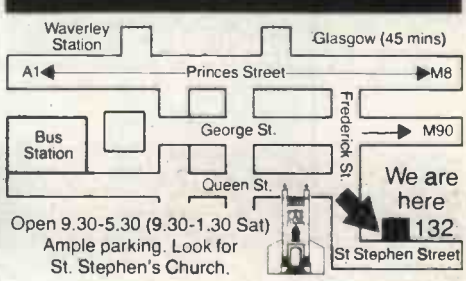

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Tell us about you

MICROCOMPUTING has grown so fast that no-one really knows anything about it. All we know at *Practical Computing* is that you seem to approve of our magazine, that our advertisers find it worth telling you about their wares in our pages, and that microcomputer shows are crowded with interested people.

Everyone has impressions but no-one has any hard facts. It would be helpful to us in planning to make our magazine more what you would like it to be, if you could take time to fill in this questionnaire and send it to us.

To encourage the busier of our readers, from whom we particularly want to hear, a draw will be made from completed questionnaires received in this office by August 15. The first five drawn will be sent the small but useful prize of £10. Provided, that is, they have included their names and addresses.

It is possible that you are interested in computing but that you cannot get your hands on a machine. We sympathise but let us hear from you, too, because otherwise the results will be distorted by people who, quite unfairly, are able to answer questions further down the page.

PLEASE CIRCLE THE APPROPRIATE NUMBERS — YOU MAY NEED MORE THAN ONE PER SECTION.

*Are you male	1
female	2

*Age under 16	3
16-20	4
21-40	5
over 40	6

*Which newspapers do you read regularly?

Financial Times	7
Telegraph	8
Guardian	9
Mail	10
Express	11
Mirror	12
Sun	13
Star	14
Observer	15
Sunday Times	16
Sunday Telegraph	17
Sunday Express	18
Sunday Mirror	19
Sunday People	20
News of the World	21
Local paper	22

*Which periodicals do you read regularly?

Practical Computing	23
Computer World	24
Computing Today	25
Byte	26
Kilobaud	27
New Scientist	28
Wireless World	29
ETI	30
Electronic Times	31
Electronic Engineering	32
Computing	33
Computer Weekly	34
Practical Electronics	35
Datalink	36
Computer Talk	37

*Are you

a school teacher	38
a college/university teacher	39
a school student	40
a college/university student	41
in research	42
a computer professional	43
in business with less than 50 employees	44
with more than 50 employees	45

*Do you regularly use a computer of any kind?

No	46
Yes, for amusement	47
professionally	48

*Rather than ask you to deluge us with specifications, please indicate the approximate value of the system(s) you use (if any).

Up to £99	49
£100-299	50
£300-699	51
£700-999	52
£1,000-1,499	53
£1,500-2,999	54
£3,000-5,999	55
£6,000-9,999	56
£10,000 plus	57

*Do you write programs?

Yes	58
No	59

*Do you write in

Basic	60
Cobol	61
Fortran	62
Machine Code	63
Pascal	64
Pilot	65
Algol	66
Lisp	67
APL	68
Snobol	69
Coral	70
other	71

*Would you be interested in a PASCAL course in ***Practical Computing?*** 72

*What have you written programs for?

Business	73
Science	74
Engineering	75
Games	76
System management	77
Other	78

*Have you ever used program listings from ***Practical Computing?***

Yes	79
No	80

*How many lines was the longest listing?

0-50	81
51-100	82
100 plus	83

*If you are in business, do you use a microcomputer?

Yes	84
No	85

*When you have problems with it, are they due to

hardware	86
software	87
both	88

*If software causes the main problems, how much would a software package which solves those problems be worth to you?

Up to £49	89
£50-99	90
£100-199	91
£200-599	92
£600-999	93
£1,000-1,999	94
£2,000 plus	95

*If your machine breaks down, how long does it take you to get it running again?

less than a day	96
day	97
week	98
month	99

*Are you satisfied with the maintenance service you receive?

Yes	100
No	101

If you, or your firm or department, is likely to purchase a system, or to expand your existing system in the next six months, how much is likely to be spent?

Up to £99	102
£100-299	103
£300-699	104
£700-999	105
£1,000-1,499	106
£1,500-2,999	107
£3,000-5,999	108
£6,000-9,999	109
£10,000 plus	110

*How often do you read ***Practical Computing?***

every month	111
occasionally	112
this is the first time	113

*How do you obtain ***Practical Computing?***

buy at newsagent	114
buy at computer shop	115
own subscription	116
company subscription	117
library	118

*It would be very useful if you would give us your name and address. If you prefer not to disclose your identity, could you please at least tell us your postcode so that we can do a regional breakdown?

Name .....

Address .....

.....

Postcode .....

Thank you very much for helping. We hope to publish the results in the early autumn. Please tear out or photocopy this page and send it to:

Practical Computing Reader Questionnaire
30-31 Islington Green,
London N1.

Cribbage

Cassette for TRS-80. Available from Microcomputer Applications, 11 Riverside Court, Caversham, Reading RG4 8AL.

"IN A NUTSHELL, cribbage happens to be one of the best two-player card games," the instructions proclaim. My feelings exactly.

So scattering sawdust over the office floor and quaffing my pint of ale, I settled down to play this most traditional of card games against my TRS-80.

Cribbage is a game for gentlemen and, with scrupulous honesty, the computer explains the rules of the game clearly and precisely. To avoid any hint of foul play, it suggests a browse through Hoyle's *Book of Card Games* should the instructions prove inadequate.

The cards are dealt — "This is your hand" — and having been told whose "box" it is — "It is my kitty" — we proceed through the "lay-down" and the "take". Each stage of the game is admirably explicit, although it might add to the excitement if each "take" was shown individually on the screen rather than all together with the scoring at the end of the hand. This produces a slightly bewildering array of digits.

Considering myself something of a crib wizard, I was somewhat taken aback to lose my first two games; could there be dirty work afoot as the computer always shuffles and deals? By no means. Next time I was victorious. In the true competitive spirit, the computer is less than gracious in defeat. "Played the game before?" Whereas having slammed me by 30 points, it crows, "I win. I feel wonderful".

Some discrepancies, however, were noticed. With a hand of ace of clubs, 10 of clubs, 4 of clubs, 3 of clubs and a cut card of queen of spades, I was awarded 9 points; 15-2, 15-4, and a flush of 4 makes 8. Where does the extra point come from?

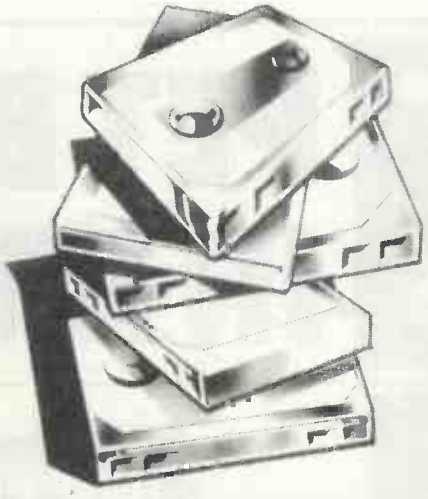
Never have I played cribbage when the ace counted as either high or low for the runs. These are minor "cribs", though. My grandfather might turn in his grave at the thought of playing cribbage with a computer, but I loved it. — K.F.

Step by step

Cassette for Apple, Pet and TRS 80 Levels I and II. Available from PDI, 11 Idar Court, Greenwich, Connecticut 06830. Price, $13.95.

I RAN my life for so long without any need of computers. I saw myself as fully functioning, alive and well without having heard of ROMs or RAMs. Then things began to change. Suddenly everyone was talking about the great sociological upheaval we are all about to experience. I decided I wanted to know how to write simple programs using Basic.

My original state of ignorance was total but I was enthusiastic. This combination



of factors must be common among those people who want to use microcomputers in their work and need to write their own programs. For instance, in the educational sphere there is an argument that programmers should talk to teachers and then write what they think teachers want.

Alternatively, teachers might be taught to write programs and then given time to produce their own material. I tend to favour the latter approach as being most likely to produce relevant and useful material; but there are problems, not least of which is the difficulty of learning Basic.

Step by step is one way of doing that. It is designed for people with no programming experience and its aim is to enable you to program in Basic. One Friday afternoon I borrowed an Apple II, packed the computer and the learning package (62 pages in ring file and three cassette tapes) into my, car, and left, with the intention of mastering Basic by Sunday evening.

There are 10 lessons, each followed by a quiz; a final text reassures you that you really have learned something. In many ways this is necessary, because my feeling on finishing lesson 10 was that it had all been a little too easy.

The advantage of familarity is reflected in the times required for the lessons. Lesson 1 needed three hours, the second ran to 75 minutes and lesson 3 took 90. If you had some prior instruction on the use of the computer — probably about an hour would be enough — the course can be completed in 15 hours.

The program displayed many healthy educational approaches. For instance, the start of each lesson was a statement telling you exactly what you would be covering.

What I appreciated particularly was that the learning steps were small and easily mastered, there was plenty of practice material and the quiz after each lesson gave a great sense of making progress. In educational terms the scores obtained by tests show, among other things, the success of the teaching method.

My scores varied between 90 to 100 percent. Bearing in mind I was a complete novice, I view this as showing that the program achieves its objective.

My enthusiasm needs to be qualified by one problem I encountered, which was that half of a lesson refused to be loaded into the computer — the second half of the session on graphics. The cassette has been tried on another machine and it would seem to be a tape problem.

There is a reassuring statement at the start of the course declaring that if all else fails you can send back the tapes and they will be replaced. I look forward to completing the session on graphics.

The course is easy to follow and comprehensive but there is no easy way to refer back if you want to remind yourself of some aspect of Basic. The notes are not general enough to be used without the tapes. There is some advantage, therefore, in complementing this approach with a book such as Donald Alcock's *Illustrating Basic*.

In general, though, this method and particular program is to be recommended. I feel that I have developed some mastery of writing programs using Basic and the business of computing is less puzzling.—M.H.

Submarine Chase

Cassette for Tandy TRS-80, level II.Available from A. J. Harding, 28 Collington Ave., Bexhill, East Sussex. Price £5.95.

IF YOU left school more than six years ago this game might give you problems. Anybody who has done a modern maths course will find it simple and perhaps a little tedious.

The aim is to find and destroy a submarine within a set area. The board is a set of axes, the x-axis (horizontal) being divided into 110 and the y-axis being divided into 30. You drop your depth charges by specifying the co-ordinates. After each move you are told where the submarine was last located as a bearing from where you dropped your depth-charge, e.g. 10 North-east, 5 West.

There are three levels of play — novice, moderate and expert. The grading governs how far the submarine moves between each turn. We found that it took very litle time to reach expert level once you grasped the fundamentals of the game.

As far as we can see the program has no faults. There are only three input stages and all seemed to be validated adequately. The graphics used are unexciting and showed no real imagination but they serve their purpose. The documentation with the game is intelligible and complete.

We are not enthusiastic about this game. It scarcely seems worth paying nearly £6 for a game simple enough to write yourself.—K.F.

P.E.T NEWS

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The Big Memory PETS
The BIG MEMORY PETS contain the same main features as for the 2001-4 and 8 models except that they incorporate a full typewriter size keyboard and have larger internal memory of 16K and 32K bytes RAM respectively.

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The Dual Drive Floppy Disk is the latest in Disk technology with extremely large storage capability and excellent file management.

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There are a large number of programs that can readily be used with the PET. Personalised programming is available from many Authorised Dealers. Over 200 programs are now available from Commodore and other software suppliers for the PET. Popular program titles include Stock Control, Statistics, Payroll, Strathclyde Basic Course, Chess, Lunar Landing and Education Packs.

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User group news

DAY BY DAY the user group grows and there are now something like 20 members, which is good considering the number of Apple IIs being used in the U.K. and the length of time since the group was formed.

More dealers are needed to join the ranks; the group exists for the benefit of all Apple users and can provide Apple sellers with an extra sales angle, as well as assisting with after-sales back-up. American experience has shown that one of the most important selling points of any micro is the existence of a users' group, and to offer the kind of service expected from it the group needs members among users and dealers.

Dealers also encounter many of the same problems as everyone else and receive important feedback from their customers. So, they are invaluable to the group when it comes to lobbying the manufacturer for modifications and improvements in the product. They can provide information about the problems encountered by their customers. They can also act as a valuable interface between the user and the group. If you are a dealer, in the interest of the group as a whole, you might consider offering your support.

Various services and discounts are in the process of being organised. We are arranging members' discounts on several items, among them cassettes, diskettes, certain programs, and books. Full lists and details will be published as soon as they are finalised. Members must quote their membership numbers.

What numbers? Membership cards are being prepared now and will be mailed soon.

Low-cost cassettes

AN EARLY item on the subject of discounts is from DJM Services of 82 Hilden Park Road, Hildenborough, Kent. This company offers user group members a 10 percent discount on C12 cassettes. Prices are five for £3, 10 for £5 and 50 for £22.50, including VAT and postage, so you need to deduct the discount. Cash must be sent with order and some proof of membership will be requested.

Program library

ONE of the aims of the group is to establish a library of programs available to members on an exchange basis or for purchase for a nominal amount. Andy Keen would be grateful to receive contributions to the library — it's rather sparse at present.

Contributions can be anything from games to machine-code routines for screen dumps. They can be sent as listings, although cassettes or discs are preferable — these would be returned as soon as the group has taken a copy. Any

documentation would also be appreciated.

Similarly, the group would like to hear from anyone about problems with the Apple II and how they were resolved. Keep us in touch with new applications and discoveries, too.

NoRom

A NUMBER of Apple owners don't have the Applesoft Basic on ROM. This can cause problems when they are using the Applesoft from tape or disc because of the way the memory is mapped.

One of the problems encountered frequently is blowing-up Applesoft by typing HGR instead of HGR2. If this happens, type in POKE 2318,7. Accidental use of the HGR command will then give 'Syntax Error'.

Random-length records

CONTINUING our summary and hopeful explanation of the DOS, I'll try and illustrate the writing of random-length records. You simply open the file and start printing.

Each PRINT statement creates one logical record, ending with a carriage return. So to put items into separate records, you must print them using separate PRINT statements. Each record should be just long enough to hold the data you put into it.

For example, the program shows how to write random-length records. Run the program using strings of fewer than 20 characters. It produces files called FILE and FILE PTR; they are used in the following examples.

```
10 HOME: DIM A$ (20), B$ (20),A(20)
) : N = 1
20 LET D$=",REM "CTRL D"
30 PRINT "ENTER 'END' TO QUIT" : PRINT
"ENTER STRING ";N;: INPUT A$
(N)

35 IF A$ (N) = "END" THEN 60
40 PRINT "ENTER ANOTHER STRING"
: INPUT B$ (N) : PRINT "ENTER
A NUMBER" ; : INPUT A (N)
50 PRINT :N = N + 1: GOTO 30
60 PRINT D$; "OPEN FILE"
70 PRINT D$; "WRITE FILE"
80 FOR X = 1 TO N – 1
90 PRINT A$ (X): PRINT B$ (X) : PRINT
A (X): NEXT
100 PRINT D$; "CLOSE FILE"
110 PRINT D$; "OPEN FILE. PTR"
120 PRINT D$; "WRITE FILE. PTR"
130 PRINT N– 1
140 PRINT D$; "CLOSE FILE. PTR"
150 END
```

The second program reads the two files created. First it reads FILE. PTR, which tells it how long the data file will be; then it reads in that many records from FILE. This is a sequential read, where INPUT statement brings in the next record.

Lines 210-220 are random access reads — this has nothing to do with random length — where we read a particular record from the middle of the file. To be able to do random reads, you specify the desired record number minus 1.

Note, however, that your Apple does not know how long each logical record is — they're random-length. So it uses the physical record size, which is one byte long. All records are physically one byte long unless specified in an OPEN statement. This means that if we say READ FILE R3 the next input statement will start reading at the fourth character of the file.

```
10 LET D$=" ": REM "CTRL D"
20 HOME: DIM C$ (20), E $ (20),C (20)
30 PRINT D$; "OPEN FILE. PTR"
40 PRINT D$; "READ FILE.PTR"
50 INPUT PTR
60 PRINT D$:"CLOSE FILE.PTR"
70 PRINT D$:"OPEN FILE"
80 PRINT D$; "READ FILE"
90 FOR X = 1 TO PTR
100 INPUT C$ (X) : INPUT E$ (X) ; input c)x): NEXT
210 PRINT D$;"READ FILE,R3"
220 INPUT C$(1),E$(1), C(1)
230 PRINT D$;"CLOSE FILE"
235 PRINT: PRINT: PRINT
240 PRINT C$ (1), E$ (1),C(1)
1000 END
```

On the other hand, for READ FILE, R Ø the next input statement will start reading at the first character of the file.

Finding statements

IT IS often useful to know where references to expressions, statements and variables occur in a particular program. The program can be listed and then searched laboriously; alternatively, you could use this listing contributed by C. Phillips, of Microdigital, a Liverpool Apple distributor.

```
2900 REM PROGRAM FINDS ALL REFERENCES TO
ANY VARIABLES, EXPRESSIONS OR STATEMENTS
IN A PROGRAM.
2901 REM TO USE PUT AFTER YOUR OWN
PROGRAM, AND PLACE THE DESIRED PATERN IN
LINE 1
2902 REM E.G. TO FIND ALL PRINT STATEMENTS IN
A PROGRAM
2903 REM TYPE '1 PRINT' (CR)
2904 REM 'RUN 3000' (CR)
2905 REM PROGRAM RETURNS LINE NUNBERS
WHERE EACH PATTERN OCCURS.
2906 REM WRITTEN BY C. PHILLIPS OF
MICRODIGITAL, LIVERPOOL
2907 REM BASED ON MICRO NO. 6
3000 A = 2049:X = PEEK (2053): FOR J = 1 TO 10000:
FOR K = A + 4 TO A + 235:P = PEEK (K): IF P = X
THEN GOSUB 3005: IF P < > 0 THEN NEXT K
3003 A = 256 * PEEK (A + 1) + PEEK (A): IF A > 0
THEN NEXT J
3004 END
3005 FOR L = 1 TO 239:Y = PEEK (2053 + L): IF Y = 0
THEN PRINT 256 * PEEK (A ^ 3) ^ PEEK (A + 2):
RETURN
3006 IF Y = PEEK (K + L) THEN NEXT L
3007 RETURN
```

The Keen connection

ANDY WITTERICK of the Apple Users' Group has asked us to point out that the connection between the group and Keen Computers is one of convenience only.

How you can e in distribute

LAST MONTH'S article showed how to connect Pet to a mainframe computer, or even to another Pet, with the basic capability of input and output. This time we outline a terminal simulator routine and more interesting forms of communication are discussed.

Have you ever wondered how a dumb terminal works, or have you always just taken them for granted? If we intend to make our microcomputer behave like one, we had better analyse the operation closely.

Superficially, a terminal like the trusty Lear Siegler ADM-3A transmits the appropriate code every time you strike a key and displays the corresponding symbol for every incoming character code. That seems simple, until you begin to wonder when the terminal is looking for input from the keyboard, and when it is looking for input from the other computer. The answer is that the terminal spends all its time bouncing back and forth between sampling the two inputs.

THIS is the second of two articles showing how a micro can be used in distributed computing networks. Michael Whitehead discusses the use of the Pet but most of this is relevant to other micros, and certainly to other 6502 systems.

Logically, a terminal emulator routine could be broken-down like this:

- Sample keyboard input; if no character, go to step four.
- Transmit the keyboard input to the RS232 interface.
- If in half-duplex mode, display the keyboard input on the screen.
- Sample RS232 input; if no character, go to step one.
- Display the RS232 input character on the screen.
- Go back to step one.

You can see that during periods of inactivity this routine spends all its time going from step one to four and back again.

Refinements

There are refinements one could wish to make to this routine. For one thing, we haven't provided a way to exit from it. It would be satisfactory if by hitting one special key on the keyboard we could arrange to break out of the terminal emulator routine back to a normal operating environment. It would also be useful to have a delete key for correcting errors, since we all make typing mistakes.

First, what is half-duplex mode, and how does it differ from full-duplex? Put simply, in *full-duplex mode* when you press a key on the keyboard it is transmitted to whatever computer you are speaking to but is not displayed locally. When the remote computer receives that character, however, it echoes it back to you to verify its receipt.

That echoed character will be picked-up by the RS232 input routine and displayed on your screen like any other incoming data. In *half-duplex mode*, the remote computer does not echo back every character it receives, so your terminal emulator routine must display it locally if you hope to see it.

If you don't know whether the computer at the other end of the line operates in half- or full-duplex, you should start with half-duplex and change it if every key depression produces two images on the screen.

Figure 3 shows the 6502 assembler code for a half-duplex terminal emulator for the Pet. The two lines after TRSMIT should be removed if you do not require the half-duplex local echo. This routine refers to figures 1 and 2 in last month's article.

It should be reasonably clear that the HOME key is used to exit from the terminal emulator routine, and that the two cursor control keys have been implemented to help to generate vital control characters. Since the Pet keyboard has no control key, and since escape, control C, control X, control U, and others are often crucial to effective communication with almost any computer, I felt it would be appropriate to provide dedicated control keys in this fashion.

Different control codes may be more useful for your own computer, in which case you should make suitable modifications to the program in figure 3.

With luck you should then be able to type-in and assemble the programs in figures 1 and 3. They are not very long, so an origin of $1E00 might be appropriate. Once loaded, you should be able to execute this code with a SYS call and return to Basic by pressing the HOME key at any time.

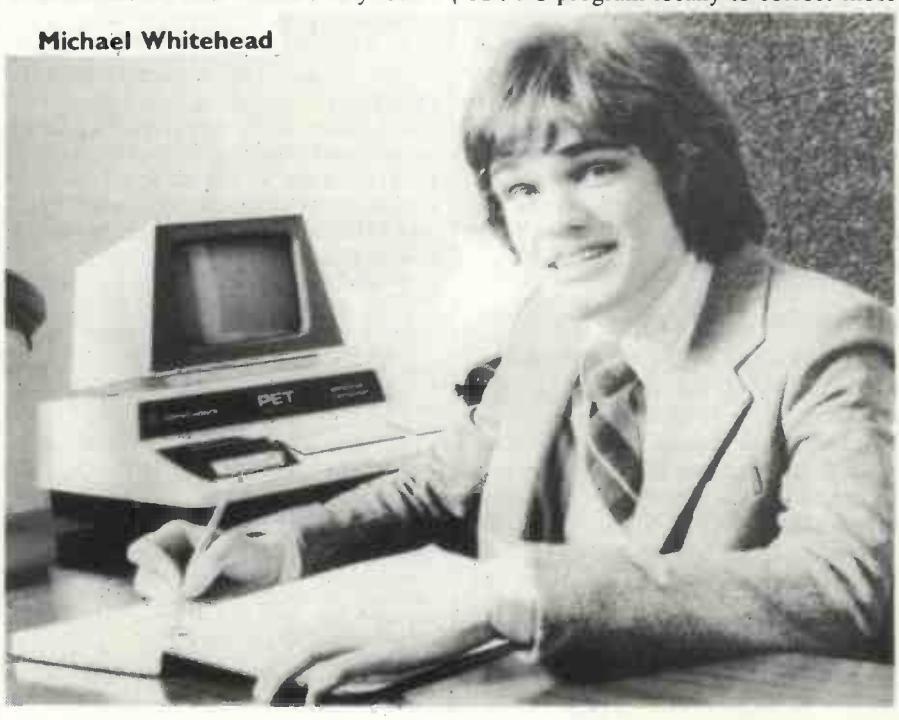
A Pet and Bailey interface together cost about £750, which compares reasonably to most VDUs. As the ADM 3A sells from about £550, an extra £200 does not seem too much of a premium to pay for the intelligence of your Pet.

Those goals

Perhaps there is something more we could do to justify the added expense. Smart editing terminals cost about £1,000, so if we could match their performance we would be doing very well indeed. That is the kind of goal I set myself when I went about designing the Computastore program PETE.

I wanted to be able to type Cobol programs in on my Pet and save them on cassette; I wanted to be able to print that Cobol program locally, study it for errors, edit the program locally to correct those

Michael Whitehead



mploy micros
d networks

errors, and only then link with a mainframe and transmit the Cobol program to it.

Another goal was to be able to transfer datasets from a mainframe to the Pet so that they could be processed locally, assuming that the dataset and processing involved were of manageable proportions.

Larger aggregations

I am sure that many readers would like to implement forms of communication I have never visualised. With microcomputers, one comes to expect the unexpected.

Accepting that we know how to handle the transmission of single characters, it is time that we progressed to larger aggregations of data. Logically one could define lines of text, eight-digit numbers, or any other sort of 'data packet,' so long as the buffers at both ends were large enough to hold the unit of information. The level of aggregation above this 'data packet' might be a text file, a vector, a matrix, or some other form of dataset.

Within PETE I try to refer to these two levels of aggregation as the dataline and datafile respectively. A *dataline* can contain up to 132 ASCII alphanumeric characters. A key concept is the dataline de-limiter, in my case a carriage return. De-limiters are important when an entire datafile is being transmitted, to identify the end of one dataline and the start of the next.

To clarify matters, I will describe the details involved in having a Pet either send or receive a datafile. Receiving is straightforward. PETE contains a line-orientated context editor which facilitates the insertion of a new line into a file. Incoming data is fed into an input buffer until a dataline de-limiter is received. Then the contents of the input buffer are passed to the editor's regular line insertion routine.

Datalines

After insertion, the buffer is re-initialised and the process begins again. In that way any data on a mainframe computer which can be displayed on a VDU screen can be built into a datafile. Datafiles subsequently can be saved to tape and read in as input datasets by Basic.

Sending a datafile from the Pet to another computer is a little more difficult. Having sent the equivalent of a dataline, you must wait for some acknowledgment before sending the next line. That is because the remote computer is likely to be a time-sharing system and it may take a little time to respond with the appropriate action after each line it is sent.

Say, for example, you wanted to transmit a program file from the Pet to a large mainframe. Your best approach might well be to execute the mainframe editor program and get it into input mode. From then, each line of data sent to the mainframe will be saved in a mainframe temporary file until you break out of input mode and save the file.

After each line you transmit, however, you will have to wait for the sequence of carriage return, line-feed, and input mode prompt which will acknowledge receipt of your dataline. Any data you send before that acknowledgment will be lost. As you may often be sending two different programs, or even two different computers, it is probably a good idea to provide facilities to vary the acknowledge character.

Granted that we now can send or transmit datalines or datafiles, let us put our knowledge to some practical use. What kind of jobs are we now capable of performing? One relatively straightforward application would be point-of-sale capture of sales data; the Pet could be programmed to behave like an electronic cash register.

The cashier would type-in the code or description for a product sold. The price could either be typed-in or generated from a table look-up. Details such as cash or credit card sale, and amount of cash tendered, could also be input and change calculated. The Pet user port can even be programmed to release the latch on a cash drawer.

During the course of the day a summary of all sales is written-out to the built-in cassette. At the end of the day each branch of a store can take its turn to transmit its summary of the day's business to the company's central computer.

More power

From another viewpoint, intelligent use of a mainframe can be used to extend the processing power of the Pet whenever required.

Those who have other useful ideas in this area may write to me, as I would like to hear about them, and *Practical Computing* would like to print them. ■

If you feel lazy, or are not confident of your ability to write large programs in 6502 assembler, you can still buy PETE (Personal Editing Terminal Environment) from Computastore Ltd. (061-224 9545) for £100. Included in it are most of the facilities discussed in this series. Michael Whitehead is technical director of Computastore.

Figure 3. Half-duplex terminal emulator for the Pet

```
TERMU   JSR   LISTEN   READY FOR OUTPUT
HI      JSR   SYSIN    SAMPLE KEYBOARD INPUT
        BEQ   TINU     IF NOTHING, GO TRY RS-232 INPUT
        CMP   #20      IF SOMETHING, IS IT A DEL?
        BNE   NODEL    NOPE, KEEP GOING
        JSR   SYSOUT   YES,ECHO LOCALLY
        LDA   #8       BUT SEND CNTL H
        JSR   OUTPUT   DOWN THE LINE
        JMP   TINU     GO CHECK RS-232 INPUT
NODEL   CMP   #19      WAS IT A HOME KEY?
        BNE   NOHOME   IF NOT, KEEP GOING
        JSR   UNLSTN   IF IT WAS, BREAK OUT AND
        RTS            RETURN TO PET BASIC
NOHOME  CMP   #17      WAS IT THE UP-DOWN CURSOR KEY?
        BNE   NOTKYI   NOPE, KEEP GOING
        LDA   #3       IF YES, TRANSMIT A SPECIAL
        JSR   OUTPUT   CONTROL CHARACTER, CNTL C
        JMP   TINU     GO CHECK ON RS-232 INPUT
NOTKYI  CMP   #29      WAS IT THE LEFT-RIGHT CURSOR KEY?
        BNE   TRSMIT   NOPE, GO SEND IT!
        LDA   #24      YES, TRANSMIT CONTROL CHARACTER
        JSR   OUTPUT   #2, IN THIS CASE CNTL X
        JMP   TINU     GO CHECK ON RS-232 INPUT
TRSMIT  JSR   OUTPUT   TRANSMIT CHARACTER TO RS-232
        LDA   CHAR     RETRIEVE CHARACTER (HALF-DUPLEX ONLY)
        JSR   SYSOUT   ECHO ON SCREEN FOR HALF-DUPLEX
TINU    JSR   UNLSTN   UNLISTEN RS-232 BEFORE
        JSR   TALK     LETTING HIM TALK
        JSR   LISTEN   RESET TO LISTEN
        LDA   #2       DID HE SAY ANYTHING?
        AND   STATUS
        BNE   HI       IF NOT, GO CHECK KEYBOARD
        LDA   CHAR     RETRIEVE INPUT CHARACTER
        CMP   #$20     IF NOT A CONTROL CHARACTER
        BCS   TERM2    KEEP GOING
        CMP   #13      CARRIAGE RETURN IS OK TOO!
        BEQ   TERM2
        BNE   HI       IGNORE ALL OTHER CONTROL CODES
TERM2   JSR   SYSOUT   DISPLAY THE INPUT CHARACTER
        JMP   HI       AND GO CHECK THE KEYBOARD INPUT
SYSIN=$F1CC            STANDARD INPUT ROUTINE
```

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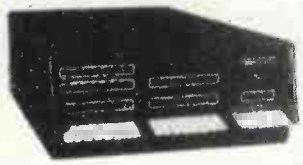

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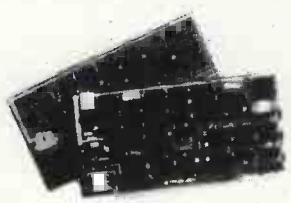

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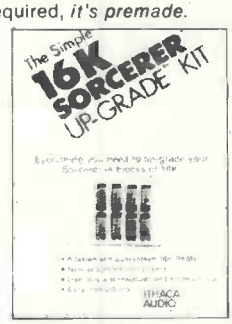

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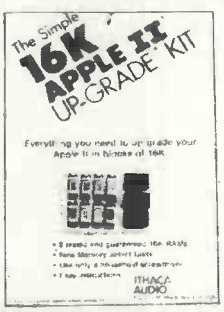

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No instructions

"IT IS my misfortune to own a T-BUG program without instructions," writes B. Fairburn of Burton-on-Trent, "I have managed to deduce, after hours of trial and ERROR, the functions of keys J, M, X, B, G, but I am still unsure as to the full functions of keys R, P, L, F. I would be grateful if you could inform me as to the nature of these functions. Also is there any other useful information in the instructions which I should know?

"If there are any other TRS-80 users with temperamental tape recorders, then I have found it possible to create many little T-BUG programs with the command #P4380 4852 4380 TBUG ENTER. These can then be entered using the SYSTEM command.

"On the subject of faulty recordings, I have found the use of a demagnetiser means the difference between retrieval and 4K of rubbish.

"I have not yet obtained a Z-80 instruction set but when I do I can imagine wanting to control the tape recorder from machine language programs; but the technical information does not seem to be available. Perhaps one of your readers could advise?

"I would like to reinforce a previous request for information on the S100, RS232, and I EEE-488 (HP-IB) interfaces; also a knowledge of the communication to and from the TRS-80 line printer and the Pet 2020 printer could be useful.

"I became interested in computing through making a hobby of electronics and would not mind constructing my own interfaces, any details of which I would be glad to forward. I am sure this must apply to many of your readers and such technical knowledge would be invaluable."

Taking over

The Electric Pencil word processor is due for a full-scale review by us soon. Meanwhile here's a user report from Leon Heller.

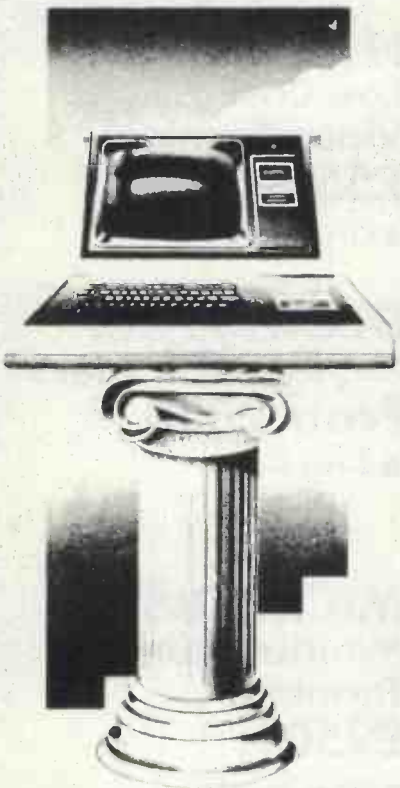
BEING rather a poor typist, I was delighted when the Electric Pencil word processor became available for the TRS-80.

The Electric Pencil is supplied on cassette for Level I or Level II machines with 16K. If you are content with upper-case only, no hardware modifications need to be made to the computer, but most people would probably require lower-case capability, which can be obtained easily by the addition of a 2102 to the video RAM, a few wiring changes, and a push button to act as a control key.

The operator's manual supplied with the Electric Pencil software is a bit sketchy but you can follow the advice given — the best way to learn to operate this system is to use it.

Doing that you should become quite proficient within a few hours — as I work

TANDY FORUM is devoted to the Tandy TRS-80. We will be using it to pass on news about the TRS-80 and its supplier and product announcements from Tandy and other vendors of compatible equipment. Above all, these are pages for users, and would-be users, of this personal computer. We want you to send tips, queries, moans and comments, and we want this page to become a market-place for TRS-80 information.



with text processing systems I was able to use it effectively in a few minutes.

The Electric Pencil is character-orientated word processing. This means that the operator types in the text character by character, not bothering about hyphenation or carriage returns as partially-completed words at the end of a line are shifted to the beginning of the next line. Any key held down for more than half a second will repeat at about 10 characters per second.

All text manipulation is carried out with the aid of a flashing rectangular cursor which can be placed anywhere on the screen; as text is inserted or deleted, the existing text is pushed down or pulled up. Variable speed scrolling up or down enables the operator to scan through the text at will.

Character strings can be located and/or replaced by any other string as required. A useful facility is that specific sets of characters within specially encoded strings can be located and used to create selective mailing lists. Blocks of text can be transferred or deleted, which is very useful if, like me, you prefer to type straight into the computer without writing first a draft. In fact, that is how this was written.

Finally, when the text is to be printed, the operator selects various parameters such as line length, page length, line spacing, and right-justification. Pages may also be numbered and titled; underlining can be done, although this is a bit tricky. The number of words in a text file can also be counted.

Are there any snags? Plenty, when you compare it to a Wordplex or a Rank Xerox system, but purpose-built, screen-based word processors cost upwards of £8,000. A major problem with the Pencil, though, is the illegibility of the lower-case characters due to the method of character generation used in the TRS-80, lower-case characters such as 'p' and 'y' have no descenders below the base line; and 'a' is right up to the top of the character cell. The TRS-80 was obviously not designed with lower-case in mind.

Another problem is the absence of rollover on the keyboard; the TRS-80 normally has N-key rollover but this has had to be sacrificed to provide the key repeat feature.

The system would be much easier to use if there were dedicated function keys for the various operations. That cannot be done on the TRS-80 keyboard, so the control key has to be used in conjunction with alpha keys.

All in all, though, a word processor as good as this one for about £700 plus printer can't be bad?

Catalogues

ANOTHER BATCH of catalogues of TRS-80 programs has arrived and, as always, there are some nuggets among them.

Microcomputer Applications offers some of the cheapest games we have seen (from £3.50) and this list includes many of the U.S. classics by Lance Miklaus (including *Breakaway* and *Startrek III*), George Blank (*Pork Barrel* – for aspiring politicians) and Tim Quinlan (the impenetrable but gripping *Galactic Blockade Runner*).

There is also a batch of maths and statistics packages, a 'Ham Package' containing AC and DC calculations, some business programs — including disc versions — and a good tip about using printers without LPRINT.

More details from 11 Riverside Court, Caversham, Reading RG4 8AL — 0734 470425.

Micro Gems is also new, small, and a TRS-80 specialist. Its catalogue has 50 U.S. and British programs and, like most TRS-80 enthusiasts, Micro Gems has added a few tips.

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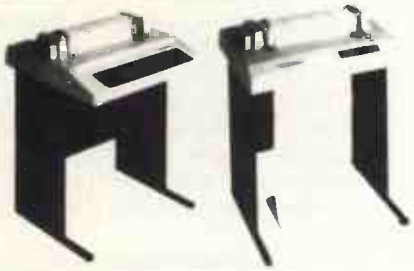

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File oriented mass data storage minidisc terminal featuring random access by file name to 200,000 characters stored per diskette, interfacing through terminal and modem/CPU RS232 interfaces at up to 9600 baud. Powerful string search and editing options.

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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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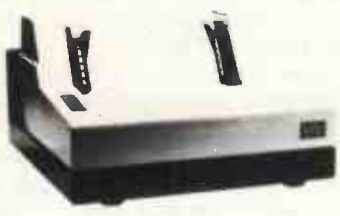

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Search process for large files

by Nick Hampshire

THIS ARTICLE looks at the different techniques which can be used to search for a particular item of data in a data file or table. Linear and binary searches are considered, together with an introduction to the powerful method known as hash tabling.

ONE of the central problems encountered in writing computer programs is how to store and then retrieve data. In practice, it is often found that this latter operation, recovering previously-acquired data from storage, presents the greater problem, to such an extent that the algorithms used to store the data initially are determined by what will happen to it later.

Many examples of this data storage/retrieval problem are to be found in the current crop of microprocessor-based programs.

A typical problem would be faced by a business package writer. Important information is stored under the name of a person or company to whom an invoice, receipt or some goods must be sent, or from whom something is expected.

To access the record of this person or organisation within a file the name must be entered with a request for the desired details. The program will then search through all the records until the name input matches one in the file; then the information stored in the record under that name may be processed and printed.

Primary interest

While it is true that circumstances will determine the best search strategy, and a number of well-known techniques exist, three of them will be looked at in this article. They all have certain requirements. They must be short in terms of computer time and program length. They must guarantee to find a record if it exists and must stop if no record is found to match the key. Failure to do this would put the program in an infinite loop if no such record exists, or the key were mistyped.

In each of the three cases it will be assumed that the key, the name of some data, is to be stored in a list, and associated with each key will be some further information, which is the thing of primary interest.

In the business example the list of keys would be stored in the main memory of the computer and each entry will have a pointer stored with it. This pointer will provide sufficient information to allow the program to locate the rest of the record immediately.

It might, for instance, be the disc/track/sector number on a floopy disc file store, where the bulk of the information is to be found. Further examples where searching is important may be found in the writing of compilers and assemblers.

The great advantage of an assembly language, like the one produced by Motorola for the MC6800 microprocessor, is that symbolic names can be used for the instructions, for labels (machine locations) and in the operands (like variable names and named constants).

Key words

This means that the user can have alphabetic names instead of numbers. Similarly, a compiler or interpreter such as Basic has a number of special keywords — often called reserved words —

Program 1

```
#LOAD
0001 DATA ABA      0019 DATA BPL      0037 DATA INC      0055 DATA SBA
0002 DATA ADC      0020 DATA BRA      0038 DATA INS      0056 DATA SBC
0003 DATA ADD      0021 DATA BSR      0039 DATA INX      0057 DATA SEC
0004 DATA AND      0022 DATA BVC      0040 DATA JMP      0058 DATA SEI
0005 DATA ASL      0023 DATA BVS      0041 DATA JSR      0059 DATA SEV
0006 DATA ASR      0024 DATA CBA      0042 DATA LDA      0060 DATA STA
0007 DATA BCC      0025 DATA CLC      0043 DATA LDS      0061 DATA STS
0008 DATA BCS      0026 DATA CLI      0044 DATA LDX      0062 DATA STX
0009 DATA BEQ      0027 DATA CLR      0045 DATA LSR      0063 DATA SUB
0010 DATA BGE      0028 DATA CLV      0046 DATA NEG      0064 DATA SWI
0011 DATA BGT      0029 DATA CMP      0047 DATA NOP      0065 DATA TAB
0012 DATA BHI      0030 DATA COM      0048 DATA ORA      0066 DATA TAP
0013 DATA BIT      0031 DATA CPX      0049 DATA PSH      0067 DATA TBA
0014 DATA BLE      0032 DATA DAA      0050 DATA PUL      0068 DATA TPA
0015 DATA BLS      0033 DATA DEC      0051 DATA ROL      0069 DATA TST
0016 DATA BLT      0034 DATA DES      0052 DATA ROR      0070 DATA TSX
0017 DATA BMI      0035 DATA DEX      0053 DATA RTI      0071 DATA TXS
0018 DATA BNE      0036 DATA EOR      0054 DATA RTS      0072 DATA WAI
```

```
0500 PRINT "TYPE - 1 FOR LINEAR SEARCH DEMONSTRATION"
0510 PRINT "        2 FOR BINARY SEARCH DEMONSTRATION"
0520 PRINT "        3 FOR AUGMENTED LINEAR SEARCH DEMO"
0530 INPUT Q
0540 ON Q GOTO 1000,2000,3000
1000 REM LINEAR SEARCH
1010 GOSUB 5000
1020 INPUT "TARGET",T$
1030 FOR I=1TOL
1040 IF T$=L$(I)THEN1100
1050 NEXT I
1060 PRINT T$;" NOT FOUND AFTER ";I;" ITERATIONS"
1070 INPUT "TRY AGAIN",T$
1080 IF T$="YES"THEN1020
1090 STOP
1100 PRINT T$;" FOUND AFTER ";I;" ITERATIONS"
1110 GOTO 1070
2000 REM BINARY SEARCH
2010 GOSUB 5000
2020 INPUT "TARGET",T$
2030  T=1
2040  B=L+1
2050  M=T+INT((B-T)/2)
2055 PRINT M;
2060 IF T$<>L$(M)THEN2090
2070 PRINT "FOUND ";T$;" AT ";M
2080 GOTO 2160
2090 IF T=M THEN2150
2100 IF T$>L$(M)THEN2130
2110  B=M
2120 GOTO 2050
2130  T=M
2140 GOTO 2050
2150 PRINT "ERROR - ";T$;" NOT FOUND"
2160 INPUT "TRY AGAIN",T$
2170 IF T$="YES"THEN2020
2180 STOP
3000 REM AUGMENTED LINEAR SEARCH
3010 GOSUB 5000
3020 INPUT "TARGET",T$
3030  X$=LEFT$(T$,1)
3040 IF X$<"S"THEN3070
3050  G0=55
3060 GOTO 3140
3070 IF X$<"J"THEN3100
3080  G0=40
3090 GOTO 3140
3100 IF X$<"C"THEN3130
3110  G0=24
3120 GOTO 3140
3130  G0=1
3140 FOR I=G0 TO L
3150 IF T$=L$(I)THEN3210
3160 NEXT I
3170 PRINT "ERROR - ";T$;" NOT FOUND AFTER ";I-G0+1;" ITERATIONS"
3180 INPUT "TRY AGAIN",T$
3190 IF T$="YES"THEN3020
3200 STOP
3210 PRINT T$;" FOUND AFTER ";I-G0+1;" ITERATIONS"
3220 GOTO 3180
5000 REM READ IN TABLE
5005 RESTORE
5010  L=72
5020 DIM L$(L)
5030 FOR I=1 TO L
5040 READ L$(I)
5050 NEXT I
5060 RETURN

READY
```

which are recognised by the compiler or interpreter. In Basic, READ, IF-THEN, GOTO, DATA, FOR-NEXT, INPUT and PRINT are all reserved words.

A table of them will be stored in the interpreter program. Whenever a word is extracted from the program during interpretation, the table is searched. If the word is found and identified as a reserved word, some code will be called to interpret the program text which follows.

The reserved word INPUT will jump to the code which expects input from a keyboard. Since each time a reserved word is encountered in the Basic program the whole list of reserved words must be searched, efficiency is obviously of great importance if the source program is to run quickly.

A first approach to designing all these systems is to store the words in the list in any arbitary order and then to search from the top, checking each one in turn. If the target word is found the search stops; if the bottom of the list is reached a "not-found" error message is generated.

The DATA list in Program 1 shows all

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the mnemonic opcodes for the M6800 assembler. They are equivalent to the reserved words of the Basic interpreter. Every machine code instruction will contain one of these opcodes, so for each assembly code program line — excluding comments and some assembler directives — this list must be searched by matching the target opcode against members of the list.

In a real assembler further data would be stored, with each of the mnemonics providing such information as the instruction class and some pointer into a further table containing the various hex values of the opcodes in all the modes.

The list is in alphabetical order. It should be noted, however, that this ordering bears little relation to the functional ordering, the one which affects the microprocessor chip directly. INX is no more related to JMP than it is to ADD, even though in the first case they are lexically adjacent and in the second they are widely-separated.

We take pot-luck when searching the list about how many matches must be tried between target and stored members of the list before one succeeds.

The Basic program from 1,000 to 1,110 demonstrates how such a search is coded. Subroutine 5,000 reads in the table. The target mnemonic is read-in from the keyboard and a FOR loop is entered to compare each member of the list to the target in turn.

When the target matches, the program jumps out of the loop, the current value of the FOR loop counter I is the position in the list which held the target value. This printed value is the same as the Basic DATA statement number.

Test Run 1 shows this program in operation. If we search for ABA, the first in the list, it is located very rapidly the first time round the loop. If we search for WAI, the last in the loop, it takes 72 iterations around the loop before a match is made. Intermediate targets, such as BVS, CBA and NOP are found after 23, 24 and 47 iterations respectively.

The time taken to locate any item is linearly almost proportional to the number of iterations required to find it. Timing the performance of this program when coded in SWTP 8K Basic shows that it takes about three seconds to find WAI.

The list of opcodes in Table 1 shows how the program can be speeded by taking advantage of the MC6800 structure. It transpires that about 10 percent of the instructions are used 90 percent of the time. Table 1 was produced by counting the number of times each opcode appeared in a large program. JSR and LDX are clear winners, followed closely by CMP, LDA, BEQ, BSR, STA, STX, BNE, JMP, BRA and TRS.

This shows that subroutine calls (JSR, BSR and RTS) are the most common operations followed by pointer manipulation (LDX and STX), then tests and branches (CMP, BEQ, BNE, JMP and BRA), with accumulator stores and loads being about equal (LDA and STA).

Then there are many instructions which are used occasionally, including the arithmetic ones. About one-third of the instructions were not used at all in this program.

This new ordering is probably not too far from the "average best" ordering, although counting with a wide range of programs might make the average search time slightly shorter. Moving the first few to the top, however, and leaving all the others alone would produce great savings in overall search time.

Test run 1

```
TYPE - 1 FOR LINEAR SEARCH DEMONSTRATION
       2 FOR BINARY SEARCH DEMONSTRATION
       3 FOR AUGMENTED LINEAR SEARCH DEMO
? 1
TARGET? ABA
ABA FOUND AFTER 1  ITERATIONS
TRY AGAIN? YES
TARGET? WAI
WAI FOUND AFTER 72  ITERATIONS
TRY AGAIN? YES
TARGET? BVS
BVS FOUND AFTER 23  ITERATIONS
TRY AGAIN? YES
TARGET? CBA
CBA FOUND AFTER 24  ITERATIONS
TRY AGAIN? YES
TARGET? NOP
NOP FOUND AFTER 47  ITERATIONS
TRY AGAIN? YES
TARGET? AAA
AAA NOT FOUND AFTER 72  ITERATIONS
TRY AGAIN? YES
TARGET? ZZZ
ZZZ NOT FOUND AFTER 72  ITERATIONS
TRY AGAIN? NO
STOP 1090
READY
```

No special ordering

When there is no special ordering, the average search time for an item is approximately ½n, where there are n items in the list. Little can be said about special ordering cases as it depends on the effects the ordering will cause in the individual instance.

Special-case ordering is not limited to assembler design. A business system could sort its customer list according to how often an order is placed. A periodic shuffle would be required to update the lists. The disadvantage of this special-case shuffling scheme is that it leaves the list in a very unhelpful order for any other task, such as printing a list of customers in alphabetical order. Nevertheless, it is a possibility not to be overlooked, particularly if a few entries make up the bulk of the search task.

A second technique is demonstrated by statements 2000 to 2180 in program 1 which exploits lexical ordering and reduces search time in the binary search. To find the target item a point is chosen halfway between the two ends of the list. A check is first made to see if the target matches the middle item in the list (st.2060); if it does, the target succeeds and the program exits, with the middle point value being printed as the result (st.2079).

1	JSR	43	37	STS	2
2	LDX	43	38	ABA	1
3	CMP	36	39	ADC	1
4	LDA	30	40	BLE	1
5	BEQ	28	41	BLS	1
6	BSR	26	42	CLC	1
7	STA	23	43	RTI	1
8	STX	22	44	SBC	1
9	BNE	18	45	BGE	0
10	JMP	18	46	BHI	0
11	BRA	15	47	BIT	0
12	RTS	13	48	BLT	0
13	CLR	11	49	BPL	0
14	DEC	7	50	BVC	0
15	PSH	7	51	BVS	0
16	PUL	7	52	CBA	0
17	SUB	7	53	CLI	0
18	ADD	6	54	CLV	0
19	INX	6	55	DAA	0
20	TST	6	56	DES	0
21	AND	5	57	EOR	0
22	DEX	5	58	INS	0
23	ASL	4	59	NEG	0
24	ASR	4	60	ORA	0
25	BCC	4	61	ROL	0
26	BCS	4	62	ROR	0
27	INC	4	63	SBA	0
28	LSR	4	64	SEC	0
29	TAB	4	65	SEI	0
30	COM	3	66	SEV	0
31	TSX	3	67	SWI	0
32	BGT	2	68	TAP	0
33	BMI	2	69	TBA	0
34	CPX	2	70	TPA	0
35	LDS	2	71	TXS	0
36	NOP	2	72	WAI	0

Table 1

If the match fails, the list being searched will be divided into two, and one of the halves will be searched. If the target is less than the mid-point, the same process is repeated with the bottom of the list taken as the mid-point used on the previous occasion (st.2110).

If the target was lexically greater than the item at the mid-point, the top of the new sub-list is taken as the old mid-point (st.2130). The new sub-list is subjected to the same procedure until one of the mid-points generated equals the target.

If the top or bottom point becomes equal to with middle point without a match (st.2090), the whole list has been searched and no entry equal to the target exists, and an error message is printed (st.2150).

This algorithm obviously fails if the list is not in lexical order but the search time is guaranteed to be short. The overall search time is also kept down. Average search length will be close to $\log_2 N$, where N, where N is the length of the table. In this example $\log_2 N$ is 6·16 for 72 entries.

Tested with targets

Compare this to the linear search average of 36. The situation is not so promising, as two comparisons between the target string and those in the list are made per trial (st.2060 and st.2100), whereas there was only one per iteration in the previous example, and there is more calculation to be performed, mainly caused by statement 2050, which calculates the new mid-point (variable M) by bisecting the top (T) and the bottom (B) of the list.

Trial Run 2 shows this algorithm in action. It takes about seven bisections to locate an entry — for instance RTS, ABA and WAI. In only one case, INC, the first middle point matches the target. In two cases, of which BPL is one, only two bisections are required.

CLV is one of the four cases where three attempts are needed, eight with four tries (BVS) and so on. It is important to test both extremes to ensure that the algorithm locates them correctly. Both ABA, the first, and WAI, the last, present no problem and are located correctly in seven attempts.

It is also tested with targets which do not appear in the search list. PQR fails after seven attempts, as does AAA, which is before any of the entries. The worst case with the current program design is ZZZ which fails after eight attempts. Note that 123 is lexically before AAA because ASCII "1" is before ASCII "A". Similarly "[AA" comes after ZZZ because the opening square bracket is after "Z".

If data containing these characters is used it should be remembered that the digits come before colon, semi-colon, commercial at "@" etc, and that they come before the capital letters. These in turn are before the square brackets and the lower-case letters. Space is the first ASCII "printing" character, so any string beginning with a space comes before all the rest.

The numbers printed-out in Run 2 show the mid-point of the sub-lists at each stage (st.2055). The first attempt is always 37, the next either 19 or 55, and the next 10, 28, 46 or 64 and so on. With the SWTP 8K Basic, the worst case search took about 1·5 seconds, including printing-out the intermediate mid-points on a high speed video terminal.

With tables of this length the gains over a linear table are marginal. When the table has 1,000 entries, the linear search average has risen to 500, but the binary search to somewhat less than 9·97.

Perhaps the least desirable aspect of an ordered list of this type is the difficulty of adding new items. Any new item must be added in the correct place or the search algorithm will fail. This means that all the items below the one being added must be shifted down one place to make room for the addition. So binary search is best for applications where the complete list is known from the start, or where few additions have to be made.

When additions must be made, they can all be done in a batch. While on the subject of alphabetical ordering, statements 3000-3220 show how the linear search can be speeded by starting it part of the way down the list.

If the first letter of the target is "S" there is no point in checking those entries begining "A" to "R", so we start at entry 55 — SBA. Start at 40 if the target begins with "J", 24 if "C", one otherwise.

Run Three shows ABA still takes one iteration and BVS still takes 23, the next one in the list, CBA, now takes only one

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```
 RUN
TYPE - 1 FOR LINEAR SEARCH DEMONSTRATION
       2 FOR BINARY SEARCH DEMONSTRATION
       3 FOR AUGMENTED LINEAR SEARCH DEMO
? 2
TARGET? RTS
37 55 46 50 52 53 54 FOUND RTS AT 54
TRY AGAIN? YES
TARGET? ABA
37 19 10 5 3 2 1 FOUND ABA AT 1
TRY AGAIN? YES
TARGET? INC
37 FOUND INC AT 37
TRY AGAIN? YES
TARGET? BPL
37 19 FOUND BPL AT 19
TRY AGAIN? YES
TARGET? CLV
37 19 28 FOUND CLV AT 28
TRY AGAIN? YES
TARGET? BVS
37 19 28 23 FOUND BVS AT 23
TRY AGAIN? YES
TARGET? ROR
37 55 46 50 52 FOUND ROR AT 52
TRY AGAIN? YES
TARGET? PSH
37 55 46 50 48 49 FOUND PSH AT 49
TRY AGAIN? YES
TARGET? NOP
37 55 46 50 48 47 FOUND NOP AT 47
TRY AGAIN? YES
TARGET? WAI
37 55 64 68 70 71 72 FOUND WAI AT 72
TRY AGAIN? YES
TARGET? PQR
37 55 46 50 48 49 48 ERROR - PQR NOT FOUND
TRY AGAIN? YES
TARGET? AAA
37 19 10 5 3 2 1 ERROR - AAA NOT FOUND
TRY AGAIN? YES
TARGET? ZZZ
37 55 64 68 70 71 72 72 ERROR - ZZZ NOT FOUND
TRY AGAIN? YES
TARGET? 123
37 19 10 5 3 2 1 ERROR - 123 NOT FOUND
TRY AGAIN? YES
TARGET? [AA
37 55 64 68 70 71 72 72 ERROR - [AA NOT FOUND
TRY AGAIN? NO
STOP 2180
READY
```

Test run 2

try. WAI, our previous worst case, now takes only 18 iterations. Non-existent entries now take a variable time, the worst being AAA and the best ZZZ, because the search is mostly finished before it starts.

Clearly what is required is a technique for storing and retrieving information which is easy to extend by adding more entries; that allows quick access to the previously-stored information, and also uses minimum program and data storage space. There is a number of contenders for the title. One is the hash table technique and the second is linked lists, which will be left for another time. The hash table allows independent insertion and recovery.

In either case, the key string is subjected to a "hash-function", which should randomise the input completely. Program Two shows such a function. It takes a string as input and returns a number, which should be totally unrelated to the input — except, of course, that if the function is applied a second time it returns the SAME number, and continues to return the same number every time the same key-string is entered. The listing after Program Two shows the effect on a number of data strings.

Hash function

Program Two works by translating each of the first five characters in the string into their decimal equivalent (A = 65, Z =), retaining only the last digit (A = 5, Z = O) and forming a decimal number from the (NEXT = 78,69,88,84,32 = 89842). The two is added to the end because the strings are always padded up to five characters with spaces (32), and only the first five characters are used.

This number is then divided by a prime number and the remainder is extracted (89842/53 = 1695·13207). The remainder is then multiplied by the table length to give the position of the table entry, in this case 6 (0.13207*50).

To add an item to the table, the hash function is applied to the key-string and an attempt is made to store both the input

```
 RUN
TYPE - 1 FOR LINEAR SEARCH DEMONSTRATION
       2 FOR BINARY SEARCH DEMONSTRATION
       3 FOR AUGMENTED LINEAR SEARCH DEMO
? 3
TARGET? ABA
ABA FOUND AFTER 1  ITERATIONS
TRY AGAIN? YES
TARGET? WAI
WAI FOUND AFTER 18  ITERATIONS
TRY AGAIN? YES
TARGET? BVS
BVS FOUND AFTER 23  ITERATIONS
TRY AGAIN? YES
TARGET? CBA
CBA FOUND AFTER 1  ITERATIONS
TRY AGAIN? YES
TARGET? NOP
NOP FOUND AFTER 8  ITERATIONS
TRY AGAIN? YES
TARGET? AAA
ERROR - AAA NOT FOUND AFTER 72  ITERATIONS
TRY AGAIN? YES
TARGET? ZZZ
ERROR - ZZZ NOT FOUND AFTER 18  ITERATIONS
TRY AGAIN? NO
STOP 3200
READY
```

Test run 3

string and the data to be associated with it in the Nth entry point, where N is the value returned from the hash function. The key string will be stored in the Nth entry of the key-table, and the data in the corresponding Nth entry of the data table.

If the Nth location in the two tables is empty, then it is stored. If something is already stored in that entry — the hash function cannot return a value for each key-string — then an attempt is made to store it in the next location N+1.

The listing from Program Two shows that both HASH (VALUE) and HASH (OCODE) return the value 42. If location N+1 is empty the data is stored there. If the end of the table is reached before a free space is found, it wraps round to the beginning of the table and continues from entry 1.

If M attempts are made to store the data, where M is the length of the table, the table is full and the size of the table must be increased. This is done most easily with a 're-hash'. Entries from the full table are extracted, fed through a different hash function and placed in a bigger table. Thence the new hash function is always used.

To locate an item already stored in the table, the input key is hashed, the search starts at the location pointed to by the returned value HASH(VALUE) and HASH(OCODE) both still equal 42. The search for either VALUE or OCODE would start at 42. Since VALUE was stored first, it would be located immediately.

When searching for OCODE, the first match at 42 would fail, because it contains VALUE, the next location; 43 is matched which succeeds, because OCODE has been stored there. If we search for a third item which hashes to 42, and the match with both VALUE and OCODE fails and location 44 contains a null string (no entry), we know that the third item was never stored.

Hash tables

Hash tables are ideal for search/store applications in which data is often being saved and then located. The two operations may be mixed and there is no need to build the table first. The technique is often used in compiler and assembler symbol tables.

Each time a label or variable is mentioned the table is searched. If the item is already there, its value is extracted from the data field and returned; if it has not been defined previously, it is added into the next free location.

The run after Program Two shows that the hash function is equally happy with peoples' names (perhaps for an address list), variable names (from a high level language program) such as SYMBOLNAME and MODE, reserved words from the Basic language, and even assorted ASCII strings.

Since only the first five characters are significant, HEXOUT and HEXOUT1 both return two. AAAA, AAAB and AAAC, however, produce very different table entries. One disadvantage of the hash table is that a slight typing error in the key-string leads to a gross error in the table entry point. A second disadvantage is that the size of the table is fixed, and must be somewhat larger than the total number of entries expected.

Hash functions can also be somewhat tempermental and should be chosen with care. The one used in Program Two was by no means my first attempt. Clumping, where many entries all map on to a single

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location, leaving the majority clear, can occur, and will increase search time dramatically.

This happened when I used both digits of the decimal equivalent of the string and divided by a small prime number: SYMBOL = 8389776679 divided by 727 produced 11540270·5, with only a single digit remainder in each case, because this

Program 2

```
1000 REM HASH FUNCTIONS FOR STRINGS
1010 REM HASH TABLE SIZE
1011  S=50
1020 REM A PRIME NUMBER
1021  P=53
1030 INPUT "KEY STRING",Q$
1040  Q$=Q$+"        "
1050  Q$=LEFT$(Q$,6)
1060  R$=""
1070 FOR I=1TO5
1075  T=ASC(MID$(Q$,I,1))/10
1080  R$=R$+STR$(INT((T-INT(T))*10))
1085 NEXT I
1090  R=VAL(R$)
1100  H=R/P
1110  O=INT((H-INT(H))*S)
1120 PRINT "HASH(";Q$;")= ";O;"[";R$;",";H;"]"
1130 GOTO 1030
```

```
READY
#RUN
KEY STRING? AAAA
HASH(AAAA  )= 7 [55552,1048.15094 ]
KEY STRING? AAAB
HASH(AAAB  )= 16 [55562,1048.33962 ]
KEY STRING? AAAC
HASH(AAAC  )= 26 [55572,1048.5283 ]
KEY STRING? ANDERSON
HASH(ANDERS)= 8 [58892,1111.16981 ]
KEY STRING? BACKUS
HASH(BACKUS)= 33 [65755,1240.66037 ]
KEY STRING? BROOKER
HASH(BROOKE)= 29 [62995,1188.5849 ]
KEY STRING? CHOMSKY
HASH(CHOMSK)= 42 [72973,1376.84905 ]
KEY STRING? FLOYD
HASH(FLOYD )= 1 [06998,132.037735 ]
KEY STRING? HORWITZ
HASH(HORWIT)= 16 [29273,552.320754 ]
KEY STRING? KNUTH
HASH(KNUTH )= 28 [58542,1104.56603 ]
KEY STRING? NAUR
HASH(NAUR  )= 31 [85522,1613.62264 ]
KEY STRING? ZAND
HASH(ZAND  )= 49 [05882,110.981132 ]
KEY STRING? SYMBOLNAME
HASH(SYMBOL)= 17 [39769,750.35849 ]
KEY STRING? MODE
HASH(MODE  )= 19 [79892,1507.39622 ]
KEY STRING? VALUE
HASH(VALUE )= 42 [65659,1238.84905 ]
KEY STRING? OPCLASS
HASH(OPCLAS)= 27 [90765,1712.54716 ]
KEY STRING? OCODE
HASH(OCODE )= 42 [97989,1848.84905 ]
KEY STRING? HEXOUT
HASH(HEXOUT)= 2 [29895,564.056603 ]
KEY STRING? HEXOUT1
HASH(HEXOUT)= 2 [29895,564.056603 ]
KEY STRING? READ
HASH(READ  )= 7 [29582,558.150943 ]
KEY STRING? PRINT
HASH(PRINT )= 49 [02384,44.981132 ]
KEY STRING? RESTORE
HASH(RESTOR)= 37 [29349,553.754716 ]
KEY STRING? NEXT
HASH(NEXT  )= 6 [89842,1695.13207 ]
KEY STRING? 1234
HASH(1234  )= 20 [90122,1700.41509 ]
KEY STRING? 1024
HASH(1024  )= 23 [98022,1849.47169 ]
KEY STRING? 1025
HASH(1025  )= 33 [98032,1849.66037 ]
KEY STRING? #$%&
HASH(#$%&  )= 17 [56782,1071.35849 ]
KEY STRING? AAAA
HASH(AAAA  )= 7 [55552,1048.15094 ]
KEY STRING?
READY
#
```

was at the limit of the arithmetic accuracy in Basic.

When a larger prime was chosen to combat the clumping around multiples of five (894581), similar strings began to appear at the same locations. This would be undesirable for an address list.

It seems that choosing a prime just larger than the size of the table gives the best performance (prime P = 52, for a table of size S = 50). It might help when using this function to reverse the order of the characters as they are converted into digits if any trouble is encountered.

To give some idea of how much better over linear and binary search the hash table can be, here are a few performance figures. When the table is only 10 percent full, the average search length is 1·053; at 50 percent full it rises to only 1·52 and at 90 percent full it is about 5·5. A completely full table is a pathological case and the search length increases to about 15-16.

It should be noted, however, that these search lengths are essentially independent of the table size. So for problems involving continuous storage and retrieval of data, in a hurry, the hash table algorithm may be the best solution.

Getting to grips with the Mk 14

We reviewed the Science of Cambridge Mk 14 kit in our May, 1979 issue. It is popular and inexpensive but it is not without its quirks, as owner and enthusiast Guy Inchbald reports.

IF YOU haven't built your Mk 14 yet, stop. Go and buy a load of IC sockets. You will need them. I you've built your machine but it doesn't work, check your soldering again; about 90 percent of faults are due to duff soldering. Most of the rest are because of wrongly-inserted components. On the Mk 14 all ICs should have the coding on top, the same way round as the keyboard; if you have that upside-down, Heaven help you.

If you've used sockets and your ICs are unlikely to have suffered a heat-death, the problem may be in the power supply. Have you checked the fuse?

Drawing current from a supply causes its voltage to drop, so a nominally-sufficient supply may drop below the required 7V under load — especially if it has to cope with extra RAM, a cassette interface, and other add-ons. The ripple from mains power supplies also worsens under load, and can appear as keyboard bounce, though this is due usually to the keyboard. The cure is a larger smoothing capacitor — C2 on the circuit board.

Over-heating

Over-heating of the on-board regulator IC 19 causes it to cut out. Switch off quickly and let in cool for a temporary respite. The problem may be excessive current drain; it's rated at 500 mA, so any peripherals should have their own regulator, though you should get away with the cassette interface.

Alternatively, it may be an over-enthusiastic power supply, for which the cure is a heatsink — rule of thumb, if it's too hot to touch, it's too small — and/or a resistor between power supply and regulator. Should the instruction book leave you baffled, try a 4.7ohm one rated at least at 1·5W. If necessary, add more of them nose-to-tail. A heatsink is a good idea in any case, since the cooler any component is the longer it will last.

If you use batteries, for example as a portable power source, it's still worth putting in C2. It provides a small reservoir of current in case of momentary power loss and also eliminates the risk of HF instability, which can affect regulation.

To round off the subject of hardware, what can one do about the keyboard? When keyed in entries start producing garbage on a previously well-behaved machine, the most likely culprit is the rubber sheet sticking to the PCB. Temporary relief is gained by turning over the sheet or making a paper spacer to aid the transparent one; and if you haven't yet started building your kit, don't peel the spacer from its backing. A new keyboard is really almost essential. A set of push-keys will cost £5 but old pocket calculators provide an excellent alternative. The 16-way edge connector is fine for the job; figure 1 shows the keyboard connections, figure 2 the edge connector.

So much for the easy part. The newcomer to machine-code programming often finds negative numbers and complements a confusing business. Even the revised instructions supplied by Science of Cambridge leave something to be desired. Perversely, perhaps, I shall start with binary addition. By the way, Section 7 of the instruction book is incorrect — the third rule of addition is '1×1=0 with carry', just like adding 5+ in decimal.

When large numbers are added, they can overflow available storage and leave behind a number smaller than either original. Take this four-bit addition:

```
  1010
+ 1001
=(1)0011
```

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In decimal it would appear as 10+9=3, which is patently incorrect. 10−7=3 would be more like it:

```
  1010
− 0111
------
= 0011
```

Computers cannot store plus and minus signs, only 0s and 1s; so storing negative numbers is a problem. If every negative number has a positive equivalent which gives the same result, this can be used instead.

The problem then is to convert the number into its equivalent. In the foregoing example, −0111 is equivalent to +1001. Either number can be converted into the other by changing its 0s for 1s, and vice versa, and adding 1s so 0111 first becomes 1000 which is called its complement or *ones complement*. Adding 1 gives 1001 which is called its *twos complement*. Similarly 1001 becomes 0110; and adding 1 gives 0111.

The SC/PM CAD (complement and add) instruction performs this task, with the extra 1 to make the twos complement coming from the CY/L (carry/link) bit of the status register. That is why it is usual to precede a CAD instruction by SCL (set CY/L).

Hex digits complement each other in pairs.

0 1 2 3 4 5 6 7

F E D C B A 9 8

The complement of 1B is E4, its two complement is E5.

The various adding instructions affect the CY/L and OV (overflow) bits as follows:

ADD, ADI, ADE

Carry from most significant bit (MSB) of result sets CY/L, which is otherwise cleared. If sign of result differs from that of both numbers OV is set; otherwise it is cleared.

DAD, etc

Carry from most significant digit sets CY/L, otherwise cleared. If sign differs from both numbers OV is set; otherwise it is cleared.

CAD, etc

Carry from MSB sets CY/L, otherwise cleared. If sign of result is same as EA but opposite to AC, CY/L is set; otherwise it is cleared.

Note that the most significant bit contains the sign, O for positive numbers and 1 for negative numbers

The momory reference and jump instructions of the SC/MP assume that address displacements are in twos complement form. All numbers with the MSB (bit 8) set to 1 are assumed to be negative. So bit 8 is used as a sign indicator, leaving only seven bits to give the actual size. Which is why maximum displacement is 127, or $2^7 - 1$, or Hex 7F (also written X'7F).

There are two more traps lurking for the unwary. In relative addressing, memory reference instructions count from the second byte of the instruction. So instruction C0E6 at location 0F30 means 'LD from 0F31−1A=0F17'.

But jump instructions increment the PC again after jumping, so displacements are calculated from the following instruction. Thus 90E6 at location OF30 means 'JMP to F32−1A=0F18'. Similarly with indexed addresing, memory reference instructions count from the indexed address and jump instructions from the next one.

Logic functions appear very strange to many of us. The computer compares the same bit from each of two numbers (in AC and EA) and sets that bit in the result according to a table of values called a truth table — they were invented by philosophers. Here are the tables for the SC/MP:

AC	EA	AND	OR	XOR
0	0	0	0	0
0	1	0	1	1
1	0	0	1	1
1	1	1	1	0

For example, 11010011 0R 00011001 becomes 11011011 (X0R is short for exclusive-0R, the other two are self-explanatory). Logic functions do not affect CY/L or OV.

Be clear

When writing programs, it is essential to use clear and profuse annotations with suitable remarks for future reference. If you don't believe me, try unravelling the programs in the Science of Cambridge instruction book.

It is also worth drawing a neat flowchart of the finished program for the same reason; as a useful side-effect, it also impresses other people, such as job interviewers.

It's a good idea to leave plenty of odd gaps full of NOPs in a new program. The thing is unlikely to work first time and you will have to insert the odd extra instruction here and there. Having a gap handy saves re-locating the latter part of the program and re-calculating all those address displacements.

Debugging aid

Another aid to debugging is the use of XPPC 3 to stop your program in mid-flight and display the next byte. You can then forage around looking at registers and the like. Return to where you left off and hit GO, and the program continues.

Some of you may have tried the 'Message' program from the official guidebook, which I found a little agricultural. Here is a more comprehensive version: it allows text up to 128 characters to be entered forwards, and caters for spaces. No characters need repeating. In addition, any part of a larger text may be displayed.

To run, enter text address in 0F12 and 0F13 with length in oF14. If length is entered as 00, the program will substitute contents of the location immediately before the text, a useful feature if your memory is as bad as mine.

The eight segments of each display digit are coded as in figure 3: so the test code for A is 01111110, or 7E.

```
RUNNING TEXT
RELOCATABLE
DATA

0F12                    TAH
  13                    TAL
  14                    TL
ENTRY
SET POINTERS ETC
0F15   COFC             LD     T H     set P2 to text adr. (T O)
  17   36               XPAH   2
  18   COFA             LD     TAL
  1A   32               XPAL   2
  1B   C40D             LDI    13      set P1 to diaplay adr.
  1D   35               XPAH   1
  1E   C400             LDI    0
  20   31               XPAL   1
  21   COF2             LD     TL      if TL=0, set to T-1
  23   9CO4             JNZ    WST
  25   C8EC             ST     TL
  29   C4FF      WST    LDI    -1      set window to adr(T-1)
  2B   C83D             ST     WPOS
MAIN LOOP STARTS HERE
0F2D   A83B      MOVE   ILD    WPOS    move window to right
  2F   08               NOP
  30   03               SCL            test for window overrun
  31   F8E2             CAD    TL
  33   9C04             JNZ    DSWET
  35   C400             LDI    0       reset window to adr(T 0)
  37   C831             ST     WPOS

ENTER DELAY LOOP FOR WINDOW DISP

OF39   C420      DSET   LDI    32      set delay count 1
  3B   C82E             ST     CD1
  3D   C406      DL1    06     set delay count 2
  3F   C82B             ST     DC2

DISPLAY WINDOW

OF41   C408      DL2    LDI    08      set display seg to 1 over
  43   C816             ST     DSEG
  45   Co23             LD     WPOS    set window seg
  47   C810             ST     WSEG
  49   B810      SEG    DLD    DSEG    Next segs
  4B   A80C             ILD    WSEG
  4D   08               NOP
  4E   03               SCL            test for seg overrun
  4F   F8C4             CAD    TL
  51   9C04             JNZ    DISP
  53   C400             LDI    0       reset window seg
  55   C802             ST     WAEG
  57   C2        DISP   LD     (2)     display segment
  58   xx        WSEG
  59   C9               ST     (1)
  5A   xx        DSEG
  5B   COFE             LD     DSEG    all segs displayed?
  5D   9CEA             JNZ    SEG     if not, loop back

DELAY LOOP COUNT & RETURN

OF5F   B80B             DLD    DC2
  61   9CDE             JNZ    DL2
  63   B806             DLD    DC1
  65   9CD6             JNZ    DL1

EXIT DELAY LOOP

RETURN TO MOVE WINDOW

OF67   90C4             JMP    MOVE

DATA VARIABLES

OF69   WPOS
  6A   DC1
  6B   DC2
```

Problems with Zombie

SEVERAL readers have had difficulty with the Zombie game in our June issue. Author Trevor Lusty comments:

"There is, so far as I know, no bug in Zombie but a number of people to whom I have spoken seem to have very poor random number generators. The values 17·95 and 18·5 were, as I stated, obtained by trial and error and may be changed to suit a different machine.

"I suggest that the value 17·95 should be reduced gradually in line 420 if the number of Zombies needs to be increased. The following statements should be added during trials so that there is no subscript error and so that the number of Zombies can be found without having to print the board.

```
425 IF Z1= 25 THEN 480
504 PRINT "ZOMBIES TOTAL"; Z1
506 STOP
```

Lines 504 and 506 may be removed when a suitable value has been found.

"I also enclose two small programs which give a quick check on random number generators. For a full explanation I suggest *The Art of Computer Programming – Volume 2* by D.E. Knuth.

The second program produces a bar graph of the frequency distribution of each number generated by your machine's random number generator. On

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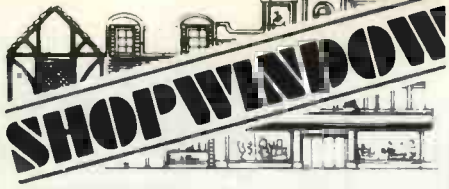

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average, each one should come up 2000/100 = 20 times. A vertical line at 20 repetitions should split the bars fairly evenly. To show how his program works, we reproduce the first 10 bars from Lusty's print-out. (the whole print-out goes down to 99.)

```
100 REM ***** THIS PROGRAM PRINTS 20 RANDOM NUMBERS *****
110 FOR N = 1 TO 20
120 PRINT RND(0):
130 NEXT N
140 PRINT
150 END

RUN

 .325513        .746588        .793349        .718831        5.45087E-02    .347161
 .825523        .839135        .693399        .496481        .75892         .982701
 .358503        .481969        .168806        .22735         .588125        .23184
 .84723         .504948

DONE


79/06/05. 15.34.01.
PROGRAM RANDOM
00100 REM ***** THIS PROGRAM GENERATES 2000 NUMBERS BETWEEN *****
00110 REM ***** 0 AND 99, AND DRAWS A BAR GRAPH OF THE *****
00120 REM ***** FREQUENCY DISTRIBUTION. *****
00130 DIM P(100)
00140 FOR N1=1 TO 100
00150 LET P(N1)=0
00160 NEXT N1
00170 FOR N1=1 TO 2000
00180 LET R=INT (100*RND (0))
00190 LET R=R+1
00200 LET P(R)=P(R)+1
00210 NEXT N1
00220 FOR N1=1 TO 100
00230 PRINT
00240 PRINT N1-1; TAB(4);
00250 FOR N2=1 TO P(N1)
00260 PRINT "*";
00270 NEXT N2
00280 NEXT N1
00290 PRINT
00300 END
READY.

RUN

79/06/05. 15.35.15.
PROGRAM RANDOM

0  ..........
1  ..........
2  ..........
3  ..........
4  ..........
5  ..........
6  ..........
7  ..........
8  ..........
9  ..........
```

Readers who still have problems can reach Lusty on 0952 583422.

Aladdin's Cave

Deep in the Surrey countryside is a warehouse full of obsolete computer peripherals, Telex and Potter disc drives, Teletypes and line printers. The owners are selling the machines for scrap and are willing in principle for them to go to private users. Because they do not want any long faces, the owners require that people who apply for the equipment show some evidence that they can make it work. There are no manuals or documentation, so if you don't understand it, don't ask.

Letters of application to *Practical Computing*, **31 Islington Green, London N1.** The editor reserves the right not to forward letters which in his opinion do not give us evidence of sufficient competence.

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XITAN (software requires Z-80 CPU)

☐ **Disk BASIC** — Fast powerful interactive interpreter. PRIVACY password security. Can dynamically open a large number of files simultaneously for random or sequential I/O ..... **£119/£20**

☐ **Z-TEL** — Text editing language. Expression evaluation iteration and conditional branching ability. Registers available for text and commands. Macro command strings can be saved on disk for re-use ..... **£52/£20**

☐ **ASM** Macro Assembler — Mnemonics per Intel with Z-80 extensions. Macro capabilities with absolute Intel hex or relocatable linkable output modules ..... **£52/£20**

☐ **LINKER** — Link-edits and loads ASM modules .. **£52/£20**

☐ **Z-BUG** debugger — Trace, break-point tester. Supports decimal, octal and hex modes. Dissassembler to ASM mnemonic set. Emulation technique permits full tracing and break-point support through ROM ..... **£67/£20**

*CP/M is a trade name of Digital Research

All Microsoft prices are discounted!!

Structured Systems prices are discounted!!

Software with Manual / Manual Alone

☐ **TOP** Text Output Processor — Creates page-numbered, justified documents from source text files ..... **£52/£20**

☐ **Super BASIC** — Sub-set of Xitan Disk BASIC with extensive arithmetic and string features but without random access data file support. Available optionally with features to support VDB Xitan video output board ..... **£75/£20**

☐ **A3 package** includes Z-TEL, TOP, ASM and Super BASIC ..... **£187/£40**

☐ **A3+ package** Includes Disk BASIC, Z-TEL, TOP, ASM, Z-BUG and LINKER ..... **£307/£40**

MICROPRO

☐ **Super Sort I** — Sort, merge, extract utility as absolute executable program or linkable module in Microsoft format. Sorts fixed or variable records with data in binary, BCD, Packed Decimal, EBCDIC, ASCII, floating, fixed point, exponential, field justified, etc. etc. Even variable number of fields per record! ..... **£188/£25**

☐ **Super Sort II** — Above available as absolute program only ..... **£150/£25**

☐ **Super Sort III** — As II without SELECT/EXCLUDE ..... **£112/£25**

☐ **Word Master** Text Editor — In one mode has super-set of CP/M's ED commands including global searching and replacing, forward and backwards in file. In video mode, provides full screen editor for users with serial addressable-cursor terminal ..... **£112/£25**

☐ **Corresponder** — Mail list system, supporting form letter generation with personalized greetings. Reference fields permit sorting and extraction by name, address fields or reference data using Super Sort. Requires CBASIC ..... **£72/£25**

SOFTWARE SYSTEMS

☐ **CBASIC-2** Disk Extended BASIC — Non-interactive BASIC with pseudo-code compiler and runtime interpreter. Supports full file control, chaining, integer and extended precision variables etc. Version 1 users can receive Version 2 and new manual for $45 with return of original diskette. Standard CP/M and TRS-80 CP/M versions available ..... **£68/£15**

STRUCTURED SYSTEMS GROUP

☐ **General Ledger** — Interactive and flexible system providing proof and report outputs. Customization of COA created interactively. Multiple branch accounting centers. Extensive checking performed at data entry for proof, COA correctness etc. Journal entries may be batched prior to posting. Closing procedure automatically backs up input files. All reports can be tailored as necessary. Requires CBASIC ..... **£675/£20**

☐ **Accounts Receivable** — Open item system with output for internal aged reports and customer-oriented statement and billing purposes. On-Line Enquiry permits information for Customer Service and Credit departments. Interface to General Ledger provided if both systems used. Requires CBASIC ..... **£525/£20**

☐ **Accounts Payable** — Provides aged statements of accounts by vendor with check writing for selected invoices. Can be used alone or with General Ledger and/or with NAD. Requires CBASIC ..... **£525/£20**

☐ **NAD** Name and Address selection system — interactive mail list creation and maintenance program with output as full reports with reference data or restricted information for mail labels. Transfer system for extraction and transfer of selected records to create new files. Requires CBASIC .... **£59/£20**

☐ **QSORT** — Fast sort/merge program for files with fixed record length, variable field length information. Up to five ascending or descending keys. Full back-up of input files created. Parameter file created, optionally with interactive program which requires CBASIC. Parameter file may be generated with CP/M assembler utility ..... **£71/£20**

Software for most popular 8080/Z80 computer disk systems, including
***NORTH STAR, MICROPOLIS, iCOM, SD SYSTEMS, DYNABYTE DB8/2, HELIOS, ALTAIR, TRS-80, 8" IBM** and **OHIO SCIENTIFIC** formats.*

Software with Manual / Manual Alone

GRAHAM-DORIAN SOFTWARE SYSTEMS

☐ **PAYROLL SYSTEM** — Maintains employee master file. Computes payroll withholding for FICA, Federal and State taxes. Prints payroll register, checks, quarterly reports and W-2 forms. Can generate ad hoc reports and employee form letters with mail labels. Requires CBASIC. Supplied in source code ..... **£454/£35**

☐ **APARTMENT MANAGEMENT SYSTEM** — Financial management system for receipts, disbursements and security deposits of apartment projects. Captures data on vacancies, revenues, etc. for annual trend analysis. Daily report shows late rents, vacancy notices, vacancies, income lost through vacancies, etc. Requires CBASIC. Supplied in source code. ..... **£454/£35**

☐ **INVENTORY SYSTEM** — Captures stock levels, costs, sources, sales, ages, turnover, markup, etc. Transaction information may be entered for reporting by salesman, type of sale, date of sale, etc. Reports available both for accounting and decision making. Requires CBASIC. Supplied in source code. ..... **£454/£35**

OTHER

☐ **Z80 Development Package** — Consists of: (1) disk file line editor, with global inter and intra-line facilities; (2) Z80 relocating assembler, Zilog/Mostek mnemonics, conditional assembly and cross reference table capabilities; (3) linking loader producing absolute Intel hex disk file for CP/M LOAD, DDT or SID facilities. Standard CP/M and TRS-80 CP/M versions available ..... **£71/£15**

☐ **TEXTWRITER II** — Text formatter to justify and paginate letters and other documents. Special features include insertion of text during execution from other disk files or console, permitting recipe documents to be created from linked fragments on other files. Ideal for contracts, manuals, etc. ..... **£56/£5**

☐ **DISINTEL** — Disk based disassembler to Intel 8080 or TDL/Xitan Z80 source code, listing and cross reference files. Intel or TDL/Xitan pseudo ops optional. Runs on 8080. Standard CP/M and TRS-80 CP/M versions available ..... **£49/£10**

☐ **DISZILOG** — As DISINTEL to Zilog/Mostek mnemonic files. Runs on Z80 only. Standard CP/M and TRS-80 CP/M versions available ..... **£49/£10**

Software with Manual / Manual Alone

☐ **WHATSIT?** — Interactive data-base system using associative tags to retrieve information by subject. Hashing and random access used for fast response. Requires CBASIC ..... **£94/£25**

☐ **XYBASIC** Interactive Process Control BASIC — Full disk BASIC features plus unique commands to handle bytes, rotate and shift, and to test and set bits. Available in Integer, Extended and ROMable versions.
Integer Disk or Integer ROMable ..... **£221/£25**
Extended Disk or Extended ROMable ..... **£296/£25**

☐ **SMAL/80** Structured Macro Assembled Language — Package of powerful general purpose text macro processor and SMAL structured language compiler. SMAL is an assembler language with IF-THEN-ELSE, LOOP-REPEAT-WHILE, DO-END, BEGIN-END constructs ..... **£56/£15**

☐ **Selector II** — Data Base Processor to create and maintain single Key data bases. Prints formatted, sorted reports with numerical summaries. Available for Microsoft and CBASIC (state which). Supplied in source code ..... **£146/£20**

☐ **Selector III** — Multi (i.e., up to 24) Key version of Selector II. Comes with applications programs including Sales Activity, Inventory, Payables, Receivables, Check Register, Expenses, Appointments, and Client/Patient. Requires CBASIC Supplied in source code ..... **£221/£20**
Enhanced version for CBASIC-2 ..... **£259/£20**

☐ **CPM/374X Utility Package** — has full range of functions to create or re-name an IBM 3741 volume, display directory information and edit the data set contents. Provides full file transfer facilities between 3741 volume data sets and CP/M files ..... **£146/£10**

☐ **Flippy Disk Kit** — Template and instructions to modify single sided 5¼" diskettes for use of second side in singled sided drives **£9.75**

☐ **BASIC Comparison** — A comprehensive features and performance analysis of five 8080 disk BASIC languages — CBASIC, BASIC-E, XYBASIC, Microsoft Disk Extended BASIC, and Xitan's Disk BASIC. Itemizes results of 21 different benchmark tests for speed and accuracy and lists instructions and features of each BASIC ..... (send **£1** S.A.S.E.) **FREE**

☐ **TRS-80 FORTRAN PACKAGE** — Professional disk-based language and utility package written by Microsoft, creators of Level II BASIC, the package runs on a TRS-80 system with 32K RAM, one or more drives and TRSDOS. The software is supplied on diskettes and consists of a relocatable machine code FORTRAN Compiler, Macro Assembler, a Linking Loader, Subroutine Library, Text Editor **£244**
Macro assembler, loader and editor alone **£124**

Fill it in.

All software requires CP/M for operation except TRS-80 FORTRAN

☎ (0276) 62506

TVJ Microcomputers 165 London Road, Camberley, Surrey GU15 3JS

Software		Price
	☐ manual alone	
	☐ manual alone	
☐ Cheque ☐ Visa ☐ Access	p+p	
Account # Exp. Date	+ VAT	
Signature	Total	

My computer configuration (specifying disk system): _____

Name _____

Address _____

Post Code _____

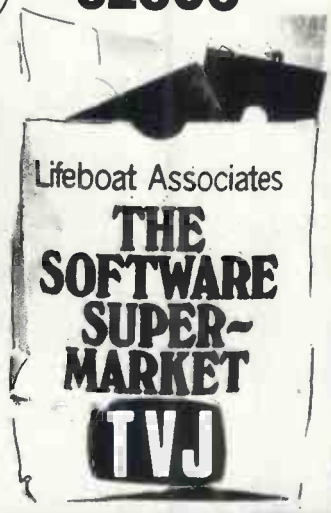
EFFECTIVE JUNE 1979

Disk systems and formats: North Star single or double density, IBM single or 2D/256, Altair, Helios II, Micropolis Mod I or II, 5¼" soft sector (Micro /COM/SD Sales/Dynabyte), etc.

Add 50p (item Post/Packing).

Manual cost applicable against price of subsequent software purchase.

The sale of each proprietary software package conveys a license for use on one system only.



● Circle No. 206

THE BUYER'S GUIDE is a summary of low-cost computers available in this country. It appears each month; we add new computers and amend existing information as required to keep up-to-date. The cut-off point is taken as £5,000, because we feel that computer systems costing more than that for a minimum configuration cannot be summarised adequately in a brief tablem Systems are listed by manufacturer.

If a computer has been reviewed by *Practical Computing*, the date of the appropriate issue is indicated.

This month's Guide was compiled before the Budget VAT chances were announced.

MANUFACTURER	HARDWARE /SOFTWARE & APPLICATIONS /AVAILABILITY	PRICE
ACORN COMPUTERS	**Acorn.** Single Eurocard-sized microcomputer with 6502 processor, IKB RAM, 16-way I/O. Max size: a second Eurocard adds hex keypad and CUTS cassette interface. Monitor and machine-code programming now. Basic and disc operating system in the future. "Highly cost-effective basis for a computer or an industrial development system". Sold by post of from Microdigital (051-236 0707).	£70.20 inc VAT and postage for kit. £81 complete for assembled Acorn.
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. (Reviewed July, 1978.)	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-CPUI:** Single-board processor with 6502 and no RAM. No applications software. Available from Data Precision Equipment (04862 67420). (Reviewed March, 1979.)	From £116
COMART	**Microbox.** Chasis 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 I, processor (6502 chip); small calculator-type keyboard; LED six-digit display; built-in interfaces for audio-cassette and Teletype; IK 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. (Reviewed October, 1978.)	£99.95
COMPELEC ELECTRONICS	**Series 1.** 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. (Reviewed June, 1979.)	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 kit: £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 I.** 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.	System 3, from £1,3 0
CROMEMCO	**Single-card computer.** 4MHz Z-80 CPU, S100 bus, IKB 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, MicroCentre and Datron Interform are agents, and have 12 distributors. (Reviewed February, 1979.)	£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

(continued on page 105)

SDS- 00

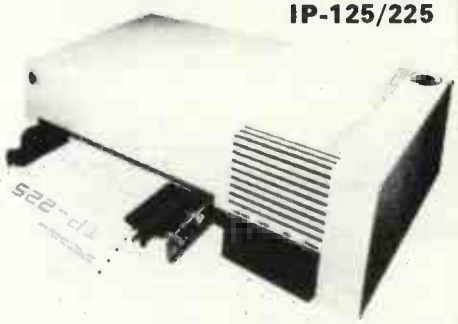
SDS-100 HIGHLIGHTS
- Up to 256K bytes of RAM
- 2 Megabyte Disk Storage On Line (IBM 3740 Compatible)
- 12 in. Video Display (24 lines of 80 characters)
- Z80 Central Processing Unit
- Full Upper and Lower Case Keyboard
- Numeric Key Pad and Cursor Controls
- Parallel Input and Output Ports for parallel I/O requirements
- Key Lock On/Off Switch
- Video Display features Blinking, Reverse, Underline and combinations
- RS-232 Serial Interface for on-line applications and serial printers
- Compatible with C-Basic, Disk Fortran, Cobol and CP/M DOS compatible software. (CP/M is a registered trademark of Digital Research of Pacific Grove, California)

AIRAMCO LTD
UNIT 2A
9 LONGFORD AVENUE,
KILWINNING INDUSTRIAL ESTATE, IRVINE, AYRSHIRE.
TELEX 779808

STANDARD FEATURES
- Mircoprocessor controller
- Serial RS-232C interface
- Parallel TTL level interface
- Full upper and lower case ASCII character set (96 characters)
- Full 8½ in. wide paper
- Line length of 80 columns at 10 characters per inch
- Impact printing
- 7 x 7 dot matrix
- Ordinary paper—roll, fanfold, or sheet
- Serial baud rate to 1,200 bits per second
- Multiple line buffer of 256 characters
- Built-in self test mode
- Instantaneous print rate to 100 characters per second
- Sustained throughput to 50 characters per second
- Multiple copies without adjustment
- Re-inking ribbon mechanism
- Expected ribbon life of 10 million characters
- Front panel operator controls
- Attractive table top console

OPTIONAL FEATURES
- Line lengths to 132 columns
- Instantaneous print rate to 165 characters per second
- Sustained throughput to 80 characters per second
- Print densities of 8·3, 10, 12 and 16·5 characters per inch
- Options program selectable by control codes
- Full CRT screen size multiline buffer (2,048 characters)
- Special set of graphic symbols
- Graphics dot plotting mode
- Form feed control
- Eight switch selectable form sizes
- Automatic page boundary skip
- Remote printer selection/deselection
- Automatic line feed on carriage return

IP-125/225



DEALER ENQUIRIES INVITED

● Circle No. 210

New Low-Cost ASCII Keyboards-Ex Stock Delivery.

KB771 — Latest addition to the range — ideal for the VDU-builder 71 Keystations incorporating separate numeric/cursor control pad and installed in a custom-built steel enclosure with textured enamel finish. Case dimensions: 17¼" x 7½" x 3⅜" Total weight: 4Kg.

Price £95.00 (mail order total £108.00) 25-way D-Type connector for KB771 £4.25 (mail order total £5.13)

		Mail order total
KB756 56-keystations, mounted on PCB	£49.50	£55.08
KB756MF, as above, fitted with metal mounting frame for extra rigidity	£55.00	£61.02
Optional Extras:		
KB15P Edge Connector	£ 3.25	£ 4.05
KB701 Plastic Enclosure	£12.50	£14.31
KB702 Steel Enclosure	£25.00	£28.62
KB710 Numeric Pad	£ 8.00	£ 9.18
KB2376 Spare ROM Encoder	£12.50	£14.04
DC-512 DC/DC Converter	£ 7.50	£ 8.64

Quantity discounts available

All the above keyboards are fully TTL-compatible, providing the full 128 ASCII character set, and requiring +5V —12V Power Supply. Full technical data and circuit diagrams supplied.

NEW KEYTOP/ KEYSWITCH KITS — ASCII CHARACTER SET BRAND NEW SURPLUS

Pack of 58 keytops and keyswitches comprising 49 "Qwerty" set TTY format + 9 Edit/Function keys.
PRICE: £15.00 (mail order total £17.28)

SEALECTRO PATCH BOARDS

Programme boards for switching and interconnecting input/output circuits. 11 x 20 XY matrix. Interconnection is by means of shorting Skip and component holding pins (not included). Dimensions: 7½" x 5¾" x 1".
PRICE: £12.50 (mail order total £14.58)

NEW SHUGART FLOPPY DISC DRIVES

SA400 Minifloppy — 110KB capacity. 35 tracks, transfer rate 125Kbits/sec. AV access time, 550msec. Power requirements +5VDC +12VDC.
PRICE: £195.00

SA800 Floppy — 400 KB capacity. 77 tracks, transfer rate 250Kbits/sec. AV access time 260msec. Power requirements +24DC +5VDC —5VDC.
PRICE: £395.00

Recon-ditioned **EDITING VDU SAVE £100!**

HAZELTINE H-2000A NOW ONLY £395.00
HAZELTINE H-2000B NOW ONLY £495.00

Superb specification includes full edit capability, direct cursor addressing, standard V.24 (RS232) interface. 90 days' warranty.

- ★ Teletype Compatible
- ★ 12" Diagonal Screen
- ★ TTY Format Keyboard
- ★ 27 Lines of 74 characters
- ★ 64 ASCII Character Set
- ★ 5 x 7 Dot Matrix
- ★ 5 Switch-selectable Transmission Speeds up to 9600 baud.
- ★ Switch-selectable Parity
- ★ Standard CCITT V.24 Interface
- ★ Direct Cursor Addressing
- ★ Full Edit Capability
- ★ Detachable Keyboard
- ★ Printer Port
- ★ 90-day Warranty

We also specialise in: DEC minis — PDP8 and PDP11 processors, add-on memory, peripherals and spares. Hard copy terminals — ASR33 and KSR 33 Teletypes, Data Dynamics 390, Texas Silent 700. Send for complete lists.

A copy of our trading conditions supplied on request.

Electronic Brokers

49/53 Pancras Road London NW1 2QB Tel: 01-837 7781. Telex 298694

● Circle No. 211

(continued from page 103)

MANUFACTURER	HARDWARE /SOFTWARE & APPLICATIONS /AVAILABILITY	PRICE
	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 (DCOS), Fortan, Cobol, Basic, assemblers, word processing, database manager. Multi-user system for software development, or scientific/industrial/business users.	£2,294 upwards
	System Two /64. New configuration featuring mini-diskette drives and 64K bytes memory. Software and application as System Two.	£3,050
	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 £10,800
	System Three/64. New configuration featuring dual 8in. diskette drives; Z-80A processor; 64K of 4MHz memory; console and printer interfaces. Macro Assembler, Fortran IV, Extended Basic, Cobol, Multi-user Basic.	£4,385
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 distributors Equinox Computers Ltd (01-739 2387).	£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), 12in. 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. (Reviewed March, 1979.)	£760 for 16K, £859 for 32K (excludes video monitor); £1,200 with floppy discs.
HEWART MICROELECTRONICS	**Mini 6800 Mk II.** IK monitor; IK user RAM, IK VDU RAM; CUTS. Upper- and lower-case VDU with graphic option. 128-byte scratchpad; decoder/buffer; power supply Basic in ROM; monitor command summary, SWTPC programs; Newbear 6800; Scelbi 6800 Cookbook. Markets are small business, education and home user. Cash with order to Hewart. (0625) 22030.	From £127.50 plus VAT
	6800S. 16K dynamic RAM. IK Mikburg-compatible monitor; room for 8K Basic in ROM; upper- and lower-case graphics; single floppy disc drive; printer and high-speed tape interfaces. "Mountains of software available." Test tape with CUTS test tones, test message and games with kit.	From £275 plus VAT.
DIGITAL MICROSYSTEMS	**DSC-2.** Min size: 32KB, but 64K standard; Z-80; over 1MB floppy disc on two single-sided 8in. drives; four programmable RS232 and one parallel interface. CP/M and Basic included in price. Extended Basic, Fortran, Cobol, text processing, Macro Assembler, Link Loader, business packages and CAP-CPP business software. Add-on rigid disc system (14 and 28MB) available soon. Modata (0892 39591) is sole U.K. distributor; dealers being appointed.	From £4,465.
IMSAI	**VDP 40:** 32K or 64K RAM memory; 9in. display screen, standard keyboard. Two 5¼in. floppy disc drives; serial I/O. Full software support, and packages available for the VDP 42, which has larger disc capacity. Packages for VDP 80 could be converted for smaller systems. This would be from about £700 per package. Two main dealers in the country.	£4,507 for 32K model. £4,950 for VDP 42
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 £827 for 4K and cassettes, to £1,114 for 32K plus floppy and printer. £3,003 for 48K version, two floppies and serial printer.
MICRONICS	**Micros.** Typical size: IK 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 machine and software.
MIDWEST SCIENTIFIC INSTRUMENTS	**MSI 6800.** Min size: 16K memory Act I 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 I.** Min size: CPU; 2K memory; parallel I/O; serial data interface; IK 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. (Reviewed January, 1979.)	£165 exc. VAT.
NATIONAL MULTIPLEX	**Pegasus.** Min size: 48K; Z-80; double-density floppies (320KB); S100 bus; 12in. CRT; 58-key keyboard; two serial and one parallel interfaces; bi-directional printer. Options: 8in. drives; 1-2MB additional drives; digital recorder 9,600 baud. Assembler, Cobol, Fortran, Extended Basic. General business package available as well as text editing and mailing list. All run under CP/M. Suitable for education, business and home users. London Computer Store (01-388 5721) sole supplier.	£2,700 exc. VAT.

(continued on page 107)

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MANUFACTURER	HARDWARE /SOFTWARE & APPLICATIONS /AVAILABILITY	PRICE
NETRONICS	**Elf II:** single-board computer in kit form or assembled. RCA Cosmac 1802 processor, hex keyboard, 256 bytes RAM; options include up to 64KB, ASCII keyboard, cassette and RS232 I/O, and video output. Machine code or Tiny Basic. Promoted as a teaching system in minimal form, but expandable for more general use. Sole U.K. distributor HL Audio (01-739 1582).	Basic kit £115·50 inc VAT, p&p, power supply. Assembled plus user manuals, £164·10. I/O board adds £40·95; Basic is £14·95.
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. (Reviewed April, 1979.)	£995 to £2,500.
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. (Reviewed June, 1979.)	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. Basic, assembler, word processors. Floppy disc systems available. Several distributors including Comart (0480 215005), which can offer nationwide maintenance contracts. (Reviewed, July, 1979.)	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. (Reviewed December, 1978.)	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. (Reviewed July, 1979.)	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. (Reviewed May, 1979.)	£39·95 basic.
SDS	**SDS 100.** Single unit containing 32K memory (expandable to 46K); 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

(continued on next page)

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MANUFACTURER	HARDWARE /SOFTWARE & APPLICATIONS /AVAILABILITY	PRICE
SORD	**M100.** Min size: 16K RAM; 4K ROM monitor; full keyboard plus function keypad; two-channel joystick dual cassette I/F; IIK EBasic on cassette; video; graphics; printer; S100 bus; converters; speaker; 24-hour clock. Max size; 48K RAM; 8K ROM; black and white or colour graphics; mini-floppy discs. Suitable for OEMs, small business, education, laboratory and scientific and home computing. Main distributor is Dectrade, but for London and South contact Midas Computer Services (0903) 814523.	From £726
	M222. Min size: 64K RAM; VDU; full keyboard; numeric keypad; graphics; real-time clock; 70K minifloppy disc drive; audio cassette interface; two serial ports; programmable 110 to 9,600 baud; three S100 slots; power and interface for two external minifloppy drives; ROM bootstrap. Max size: 70K byte minifloppies; black and white or colour graphics; bar code reader; TMS-1000 development system. EBasic interpreter; compiler EBasic; matrix Basic; Fortran; Cobol; assembler editor; re-locatable linker/loader; debugger. Application software includes word and graphics processor; business demonstration packages and games. For small business; industrial/research, education; software houses OEMs.	From £3,450–£4,123 including desk and printer.
	M223. Min size: 64K RAM; hardware as M222 plus one or two 350K byte minifloppy drives. Max size: Four 350K minifloppies; up to four 11.4Mb hard discs; range of S100 devices. As M222 plus Cobol-80, CAP-CPP BOS MicroCobol. Application software includes word and graphics processor; personal information processing system; games; CAP-CPP range of MicroCobol software.	From £3,775–£4,448
SYNERTEK	**Sym I:** 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 CORP.	**TRS-80.** Min size: Level I 4K memory; video monitor; cassette; power supply. Max size: Level II 48K up to 350K on-line via floppy discs; line printer; tractor feed printer and quick printer; floppy disc system. Modern, telephone interface soon available. Basic; some business packages. Level I aimed at the hobbyist and education market and Level II at small business applications. Hundreds of dealers. (Reviewed November, 1978.)	Level I–£499 Level II–from £578–£4,700
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, IKB monitor plus new option 4K firmware on board. Available from manufacturer. (01-402 8137).	£286 kit with 5KB.
ULBRICH AUTOMATION	**Powerhouse II.** 16K or 32K RAM, Z-80 processor, RS232 interface; 5in. built-in VDU; full keyboard; built-in mini cassette; real-time clock. Software: Programmable keyboard in 16K PROM; 2K monitor system; DOS; Extended Basic. Options: larger VDU; discs; 14K Basic; Tripoli interface; X-Y graphics; IEEE interface. Compatible with all computers and peripherals. Applications: file management, off-line data processing and assembling capabilities. Suitable for OEMs and expert users. Available exclusively Powerhouse Microprocessors Ltd. (0422) 42002, which will also manufacture it next year.	£1,480–£1,760
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 with M

Machine code

A programming language which identifies and alters the contents of memory locations by instructions encoded in a form which relates directly to the internal operation of a computer — the binary notation, which makes machine code programs an arcade of 0s and 1s.

The binary code the computer uses is the lowest possible level of programming. All other computer languages have to be translated into machine code before programs written in them can be executed. Machine code is sometimes called machine language.

Macro

Or macro instruction, or macroinstruction. One macro equals several instructions; it's a kind of shorthand by which the computer recognises the macro and generates several operating instructions for it.

Magnetic tape

A long strip of plastic, usually mylar or acetate, which is coated with a magnetisable oxide material.

Those spools you see whizzing round are normally 2,400ft. long and the tape is 0.5in. wide; some mainframe manufacturers opt for different widths; the length is not critical, so some tapes are 1,200ft. long, others top 3,600ft. More familiar to the personal computer world as *cassettes*, typically ¼in. wide and easier to handle. They don't store as much information and data cannot be read from or written to them as quickly.

Data is stored on tape by magnetising an invisible row of spots across the tape. Depending on which possible spot positions you magnetise, the computer is able to pick up and translate a line of spots as a particular character.

Magnetic tape is cheap and well understood these days, not least because all manufacturers are used to making tape for audio recording. The tape is much the same, and ordinary audio cassettes can be used on personal computers. On the big reels, the data tape has to be made to a much finer specification to guarantee maximum discrimination and maximum strength, because those spools are pulled around somewhat enthusiastically.

The only real disadvantages are transfer speed and the serial access. With disc you have random access to information; you don't have to read everything on the disc to see that it's the information you seek. With tape you have to move the read/write head over the tape — or the tape past the head — until you find the place you want.

That reduces speed, of course, and some applications become impossible — like interactive queries on files — because they would take too long.

Another problem can arise. How do you add information in the middle of a sequential stretch of records on tape? You can add it to the end but that way it is out of sequence. What you have to do is read the entire tape file into memory, insert your amendments — easy enough in the fast random-access world of semiconductor RAM — and then write it out to tape again as a new Master File.

Discs are fast enough to permit a degree of automation of this process in the disc operating system. Because they operate on non-sequential lines, the physical location on disc of the amendment is not necessarily relevant — it can somehow be linked or keyed to the right reference. That capacity varies from one operating system to another.

The problems with tape become heavy only when speed of access is the main criterion. So for the starter personal computer system, cassettes are a good, cheap, easy way to become acquainted with microcomputers. In any case, even if you have discs you will find that tape is a good, cheap easy way of providing back-up storage, called archiving — taking a copy regularly of your data just to forestall any disastrous disc crashes.

Map

A memory map is a diagram of memory showing which particular control routines take up which particular memory locations.

There are other kinds of map in computing but this one is most important. It allows what's called "memory-mapped I/O", which means you can address an I/O device by an address in memory. At that address the processor will find the start of a code routine which handles data transfers to and from the device. The technique is often easier and neater than addressing an I/O channel or port.

Mapcon

Microprocessor Awareness Project Consultancy, a Government scheme to fund the development of many small consultancies. It tries to promote the spread of micros in industry by contributing some of the cost of consultants' feasibility evaluations.

Mask

There are two relevant definitions, neither of which is particularly relevant. In the semiconductor chip manufacturing process, a mask is used to define the areas of the chip. In processing, a mask is part of a logical operation; it's a pre-set pattern of bits you can compare with another bit pattern.

Master

The word is used freely as a prefix to mean either "control" or "most up-to-date". A master file is the most accurate, most current version; a master/slave system is one in which a particular system component (the slave) cannot function without control signals from another (the master).

Matrix

Mathematicians won't need this definition and non-mathematicians won't understand it. A matrix is a rectangular arrangement of numbers in rows and columns, organised in such a way that certain specific mathematical operations can be applied to them.

A matrix really is a bunch of numbers on which you can perform matrix arithmetic. Most Basics include MATrix statements; and if the manual for yours is not clear enough about what they are and why you'd use them, try David Lien's *BASIC Handbook*.

Matrix printer

A matrix is a grid of rows and columns. Well, translate that into a rectangular array of needles — say 63 of them, seven rows of nine. If you push a needle forward so that it thumps against a typewriter ribbon and bangs it on to white paper, you'll have a dot printed. By firing forward the right combination of needles you'll have a dot pattern which resembles an alphanumeric character.

The needles move backwards and forwards in "barrels" rather like those of a gun; but this impact printing is not the only use for dot matrix techniques. Put a heating element in the barrel and use heat-sensitive paper, and you have thermal printing, which causes a kind of scorched dot on the paper. The other popular matrix print method is electrostatic; firing a minute electrical charge at special paper changes the nature of its coating so that a dot is created there.

Mega

Ugly prefix meaning million. A megabit (abbreviated Mb) is one million bits.

Memory

We at *Practical Computing* use "memory" to mean internal storage for data and programs. Other people call it "store", if they're British: or "core store" if they're British and outdated or "immediate access store", which is accurate but clumsy.

We don't use the term "memory" to refer to discs and tapes, although some do use the term to mean all possible media for storing things in a computer. What they call "main memory" is probably a strictly accurate description.

A fair definition used to cover the storage space which can be addressed directly by processor, but the newish upmarket "virtual memory" operating systems enable the processor to visualise all internal and external storage as one continuous block, so that's not really accurate any more.

Rather than take idealisitically pure definitions, let's go for a couple of pragmatic statements. Memory is RAM, ROM and derived abbreviations, or memory comprises printed circuit boards containing semiconductor chips or lattices of ferrite cores; or memory is what sold as KB.

Micro

Unwitty but workable and chatty abbreviation for microprocessor or microcomputer.

Microcode

How the *instruction* set of a particular computer is implemented. Microcode statements convert the machine instructions into electronic activity.

Normally you don't see microcode at all. It's there — typically implemented in *firmware* — and as it happens it's what you're using when you use the instruction set, but you don't have to know anything about it.

Some of the classier and more expensive micros, however, allow you to write your own microcode to create new instructions on your computer. If you have applications which frequently involve complicated references to an I/O channel you might create a new machine instruction or two to simplify that referencing. For this user-microcoding the vendor will give you a little software development package which includes a kind of *assembler*.

Advertisement Index

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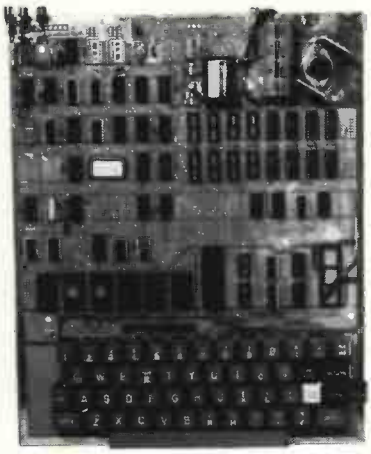

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STATEMENTS
CLEAR DATA DEF DIM END FOR
GOTO GOSUB IF..GOTO IF..THEN INPUT LET
NEXT ON..GOTO ON..GOSUB POKE PRINT READ
REM RESTORE RETURN STOP

EXPRESSIONS

OPERATORS
-,+,*,/,↑ NOT,AND,OR, >,<,<>,>=<= RANGE 10^{-32} to 10^{+32}

VARIABLES
A,B,C, ...Z and two letter variables
The above can all be subscripted when used in an array. String variables use above names plus $ e.g.A$

The Compukit UK101 Character Set

FUNCTIONS
ABS(X) ATN(X) COS(X) EXP(X) FRE(X) INT(X)
LOG(X) PEEK(I) POS(I) RND(X) SGN(X) SIN(X)
SPC(I) SQR(X) TAB(I) TAN(X) USR(I)

STRING FUNCTIONS
ASC(X$) CHR$S(I) FRE(X$) LEFT$(XS.I) LEN(X$) MID$(X$.I,J)
RIGHT$(X$,I) STR$(X) VAL(X$)

SPECIAL CHARACTERS
@ Erases line being typed, then provides carriage return, line feed.
◀ Erases last character typed.
CR Carriage Return — must be at the end of each line.
: Separates statements on a line.
CONTROL/C Execution or printing of a list is interrupted at the end of a line.
"BREAK IN LINE XXXX" is printed. Indicating line number of next statement to be executed or printed.
CONTROL/O No outputs occur until return made to command mode. If an Input statement is encountered, either another CONTROL/O is typed, or an error occurs.
? Equivalent to PRINT

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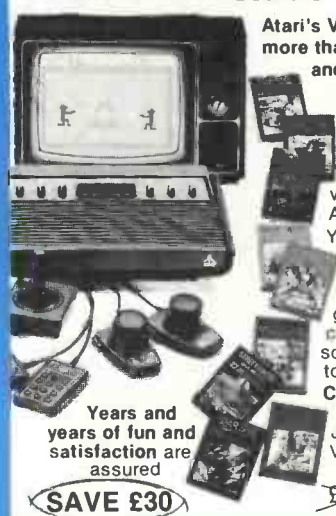

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