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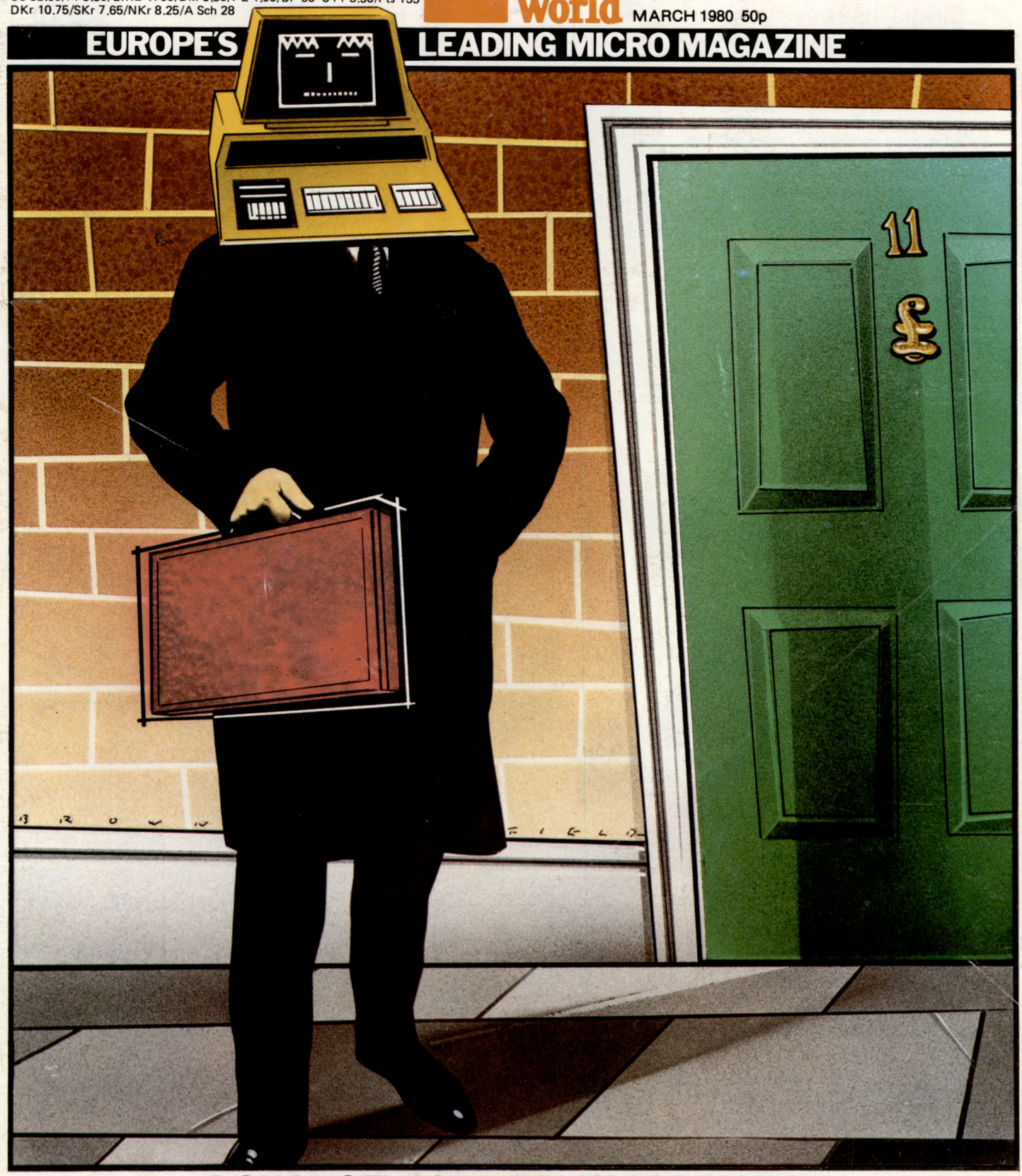
EUROPE'S LEADING MICRO MAGAZINE



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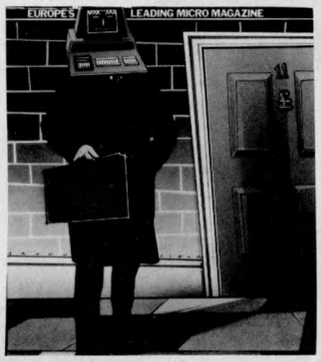

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Submitting programs to PCW

In order to keep our "Programs" section both full and interesting, we rely heavily on you, the readers, sending in useful and/or original contributions. PLEASE DON'T STOP! However, to make life easier for both you and us, it's worth our repeating the guidelines published last month.

Having written and thoroughly tested your original program (be it an application, a game, or a useful subroutine) send it to us, along with a suitable explanation. In order of preference we would like your program submitted as a clear, dark listing on plain paper. . . on cassette. . . or on disc. Please ensure that any typing or handwriting is clear and that it has been checked for accuracy.

We pay the sender of any listing published — at least £10 and often much more — depending on the size and quality of the contribution. If the program is too large or complex for the "Programs" section we will sometimes publish it as a feature in the magazine.

It seems that PET users are in the majority. . . we get more of their programs than any others. For the sake of balance, how about the "others" pitching in as well? Post your submissions to PCW Programs, 14 Rathbone Place, London W1P 1DE. We look forward to hearing from you.

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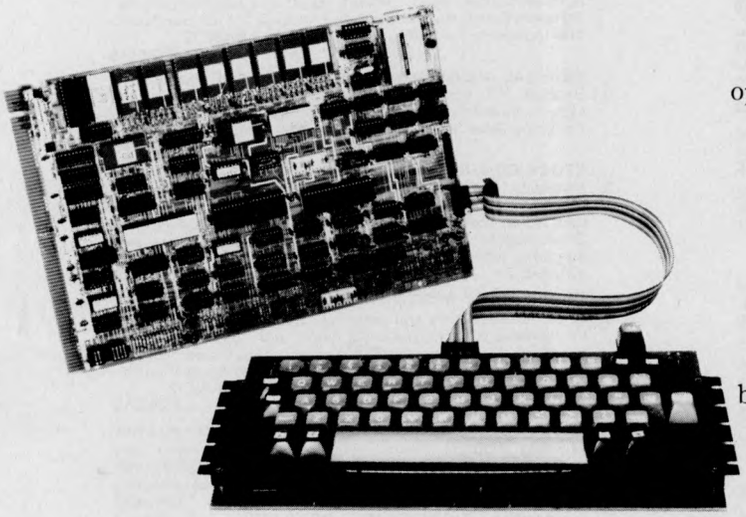

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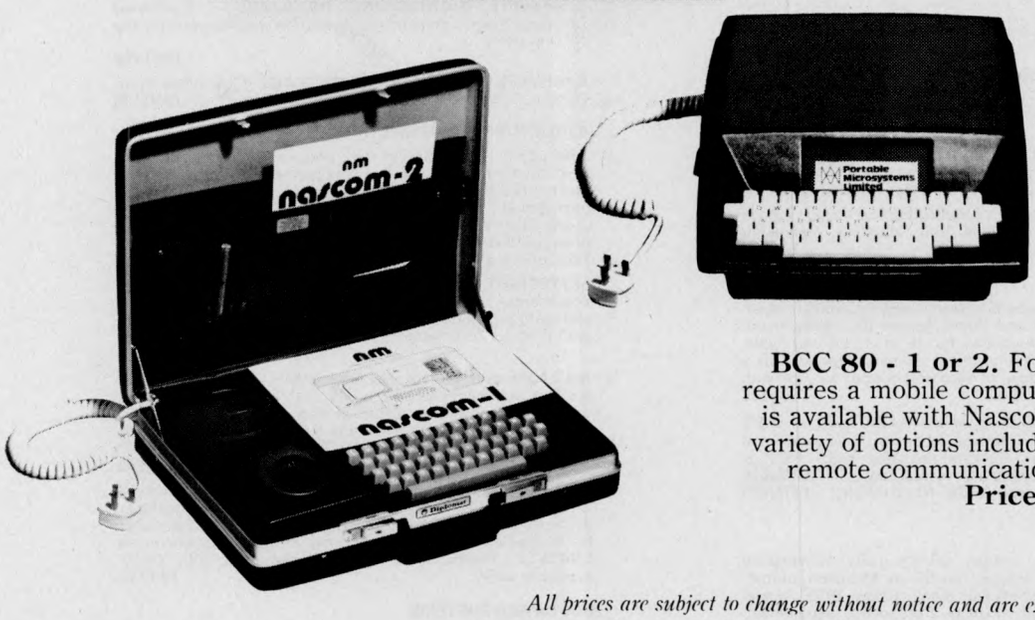

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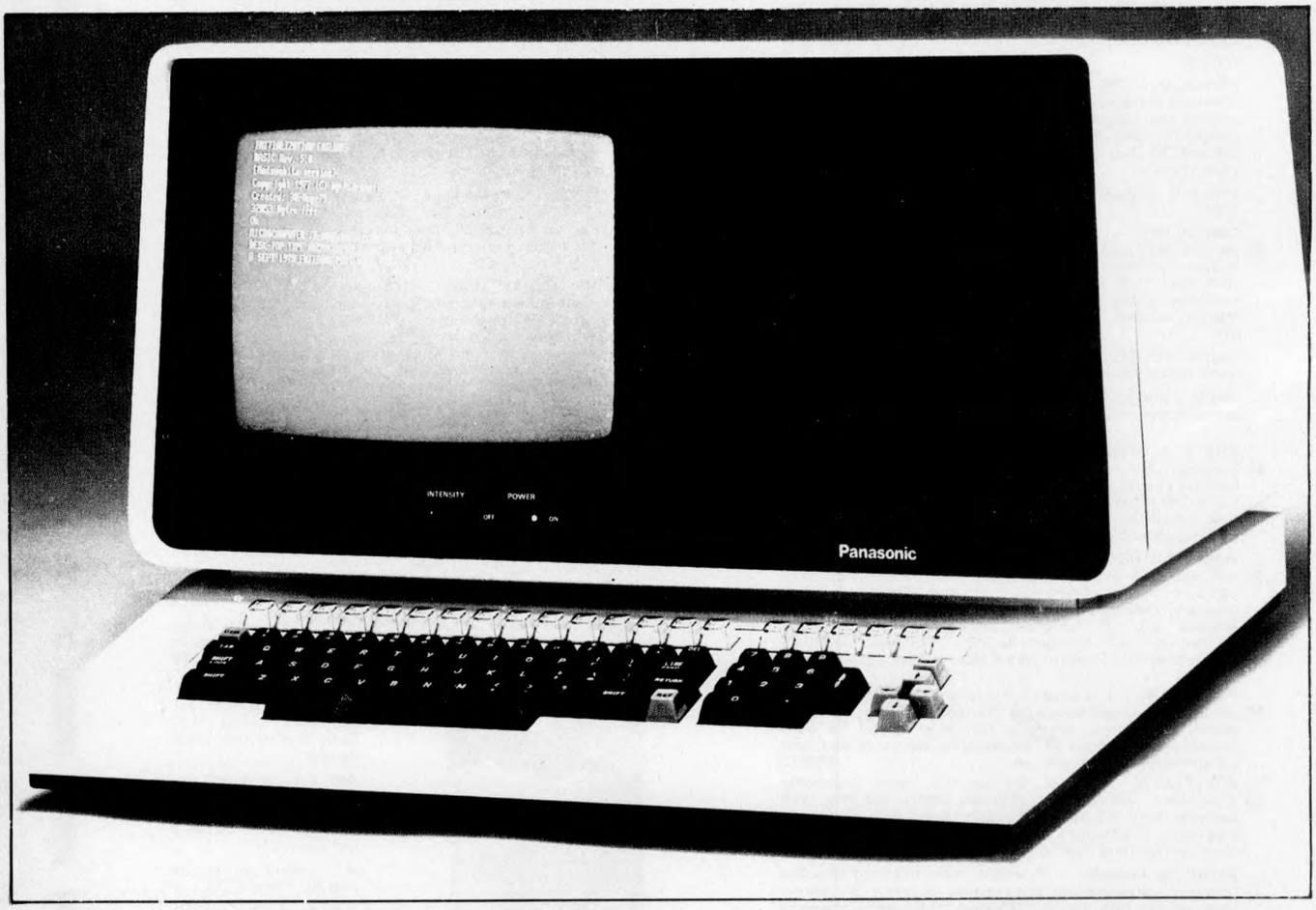

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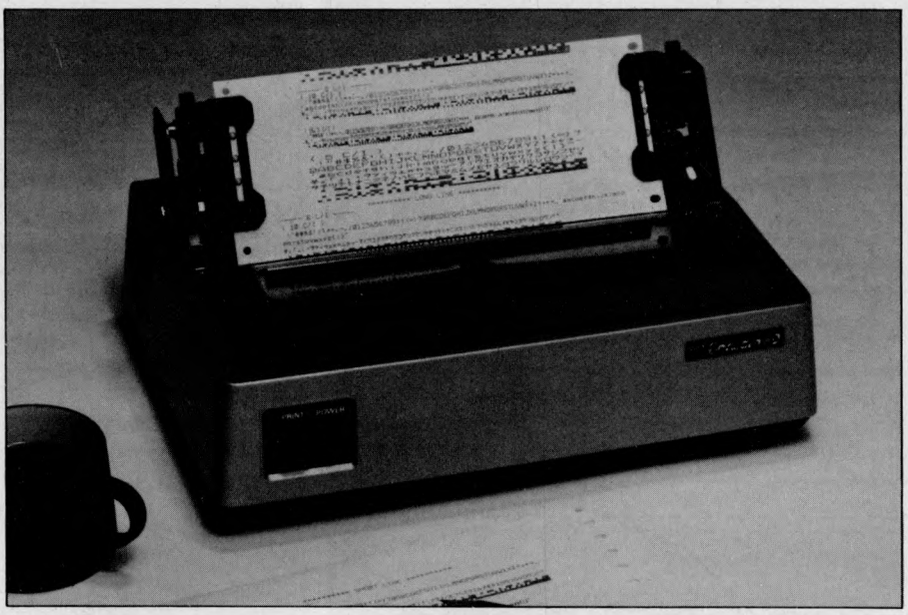

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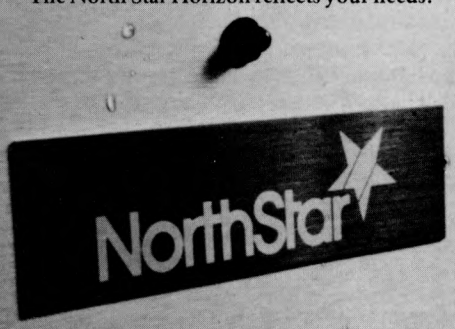

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The October Personal Computer World exclusive pre-release benchtest and review concluded: *"If I want to spend £600 on a personal computer, my choice will be between PET, TRS-80 and MZ-80K. Without question the MZ-80K has the smartest packaging, the fastest BASIC, and marginally better system software"*. Schools have been very impressed with the accuracy of the mathematical functions and they like the way Sharp's extended Basic is loaded on tape – Kobol, Fortran and Pascal program tapes are presently being developed. When available they will make the Sharp ideal for teachers, who will be able to change programming languages by simply loading another tape.

With each order for a Sharp MZ-80K we supply 30 free programs including GAMES: STAR TREK, 3D MAZE, TEN PIN BOWLING, OTHELLO, SKI SLOPE, B52 ATTACK, SPACE FIGHTER, SNAKE ISLAND, STAMP OUT, POKER etc. MATHS: Pythagorean theorem fractions/decimal, graphs, squares Poisson figures, and a special 'Teach tables' program. All these fully utilise the Sharp graphics and Music commands. We also give free with each MZ-80k four very important programs which can only be obtained from us.

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3. HEX POKER: machine code loader which handles eight bytes at a time without the need for spaces between bytes.
4. BYTE SEARCHER: amazing program which finds specified byte contents in any part of the memory. Single byte or up to four sequential bytes can be located and the address displayed.

With the appoval of Mr. Paul Streeter, the manager of Sharp Computers, we have formed the SHARP USERS CLUB. Membership will cost £3 annually but will be free if you purchase your MZ-80K from Knight's. The first edition of the SHARP USER GROUP NEWSLETTER is now available with reports from the Japanese Micro Exhibition, articles showing how to take advantage of the SHARP music commands which allow semitones, and notes from a minim down to a 32nd to be played over any three octaves at seven tempos. We already have members of the Sharp User Group in Germany, Hong Kong, Australia and Japan, thus ensuring that members will hear of the latest Sharp developments on a worldwide basis. We have offers of software from Japan and feel that the Sharp User Club will play an important part in the development and use of the MZ-80K.

During the next few weeks we will be attending exhibitions and giving lectures at conferences and conventions. On 9 March we will be lecturing at the Radio Society of Great Britain's VHF Convention, demonstrating how our Sharp and Nascom computers can be used to send and receive Morse and radio teletype automatically, track communication satellites, and display distance and magnetic bearing to any location in the world. On 15 March, and again on 15 April, we will be at the Radio, Electrical, Television, Retailers Association conference demonstrating how we use the Sharp MZ-80K for diagnostic servicing of television sets. We have developed programs which enable completely unskilled staff to repair television sets and an article on this subject, written by us for 'Dealer Magazine' is reprinted in the Sharp User Group Newsletter. From 8–10 May we will be at the Radio Society Exhibition at Alexandra Palace. We look forward to seeing you at one of these events.

Happy computing,
Graham Knight,
(for A. & G. Knight)

P.S. Almost forgot to say the Sharp MZ-80K costs £520 plus VAT. Delivery is free anywhere in the UK and we include the free programs and Sharp User Club membership detailed above. We also stock the Nascom range and full details of Sharp and Nascom products will be sent to you on receipt of a large s.a.e.
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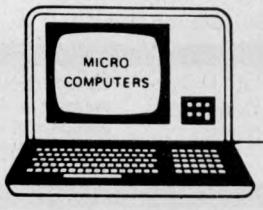

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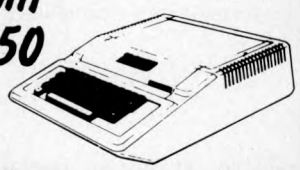

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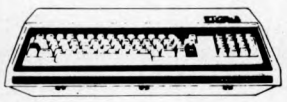

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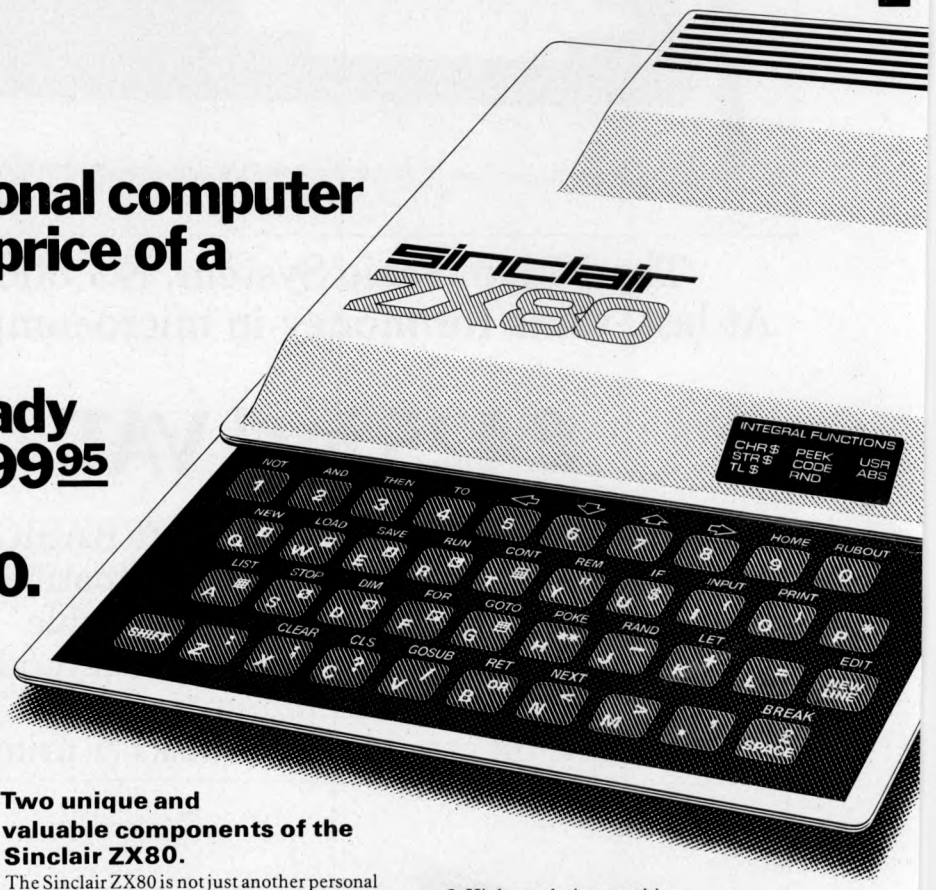

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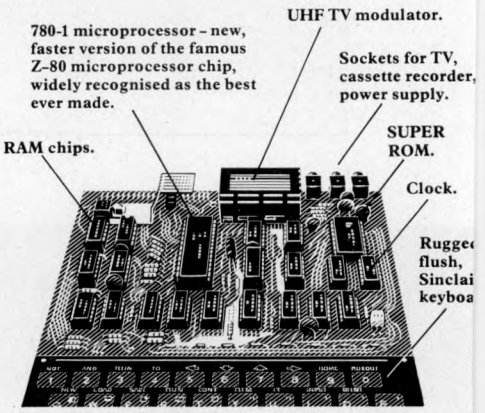

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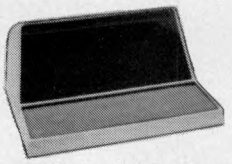

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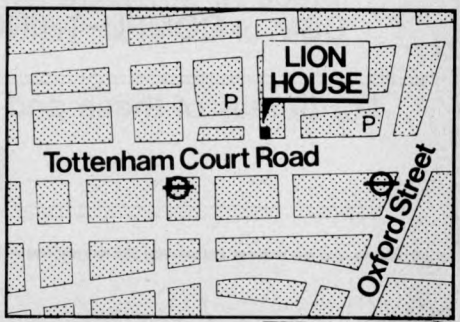

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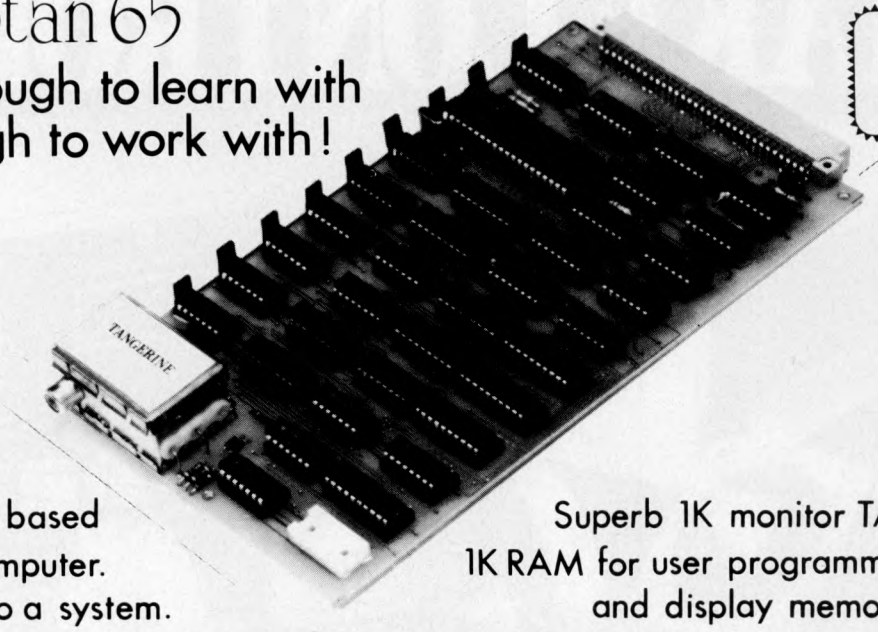

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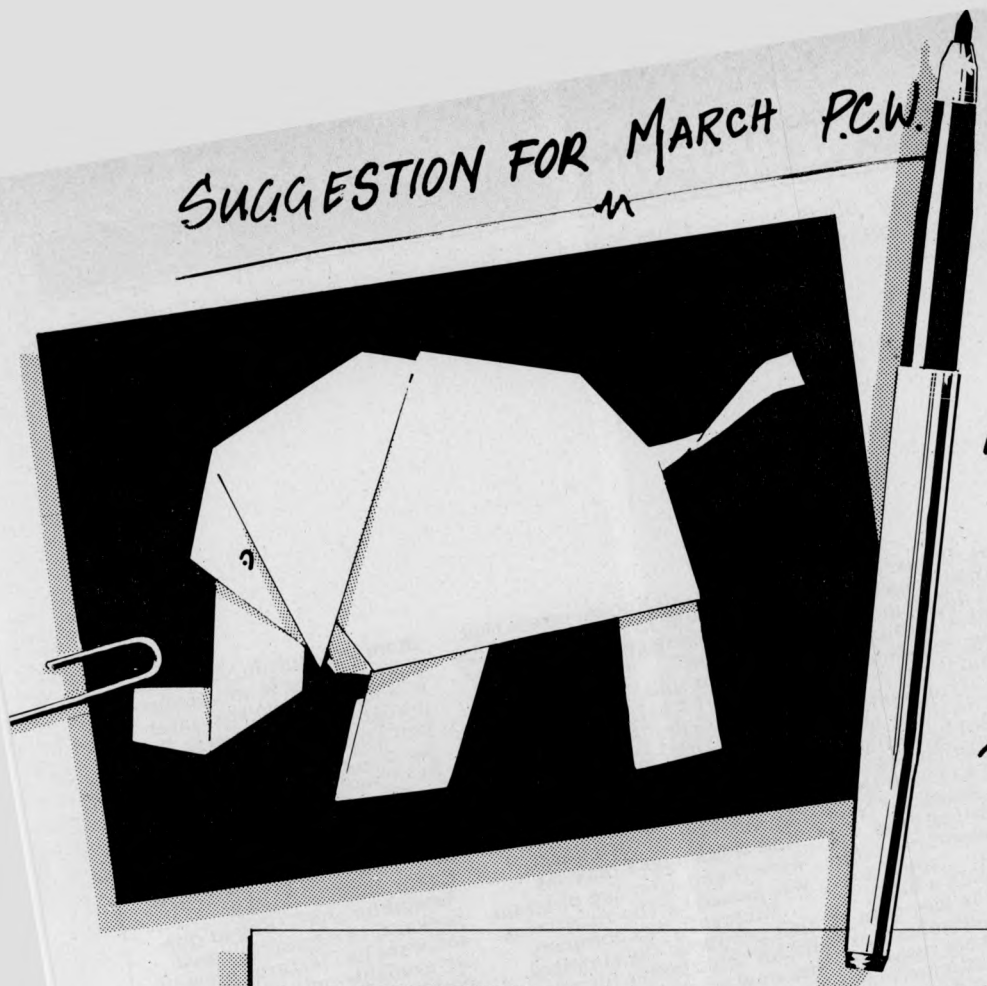

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NEWSPRINT

Newsprint is the place where Guy Kewney *reports the happenings of the micro world — read on for product news, rumour, gossip, prediction, speculation and fearless exposés.*

Cobol up on Tandy

People who do not work with computers tend to dismiss as cynics, those who say: "the one thing you can be sure of in talking about software is that it will have mistakes in it". It is, however, a simple statement of observable fact.

That fact always causes a sinking feeling when a particularly ambitious piece of software is announced: I have to pass on the claims of the vendors with no real idea of how well they have been achieved, but with the certainty that there are serious flaws which will only reveal themselves after many hours use of the program.

This heart searching is prompted by the release of a Cobol compiler from Microsoft, for the Tandy TRS-80.

The best microprocessor Cobol is, without any real doubt, that produced in this country by Paul O'Grady's Micro Focus. It has been tested by American Navy and Government departments who have put it through the most gruelling tests they know of — and it has come through with flying colours, in a way that no other microprocessor Cobol has done.

Yet the tests that the Americans run to prove that Cobol reaches American National Standards Institute level are themselves software. They have flaws. . . some are trivial, errors which a little thought allows the user (the tester) to make suitable compensation, others are disastrous failures of anticipation by the people who devised the tests.

In essence, the tests consist of a long (two million bytes) string of Cobol instructions, some of which are deliberately faulty, some of which are deliberately tricky and some of which generate deliberately large amounts of code that need careful managing. The idea is, these programs are designed to trap all known errors that can occur in Cobol compilers. The important word here is "known".

I am told, by people whom I trust, that the Micro Focus Cobol is now a very good Cobol compiler indeed. The same people assure me that this is because several major "bugs" have been cleaned out of the code. And these bugs I may say were found *after* the program was passed by the Americans.

Microsoft, the company that produced the standard BASIC interpreter for micros, has now adapted that BASIC to run on the TRS-80 model II, as a compiler. It has also adapted its Cobol compiler to run on the same machine.

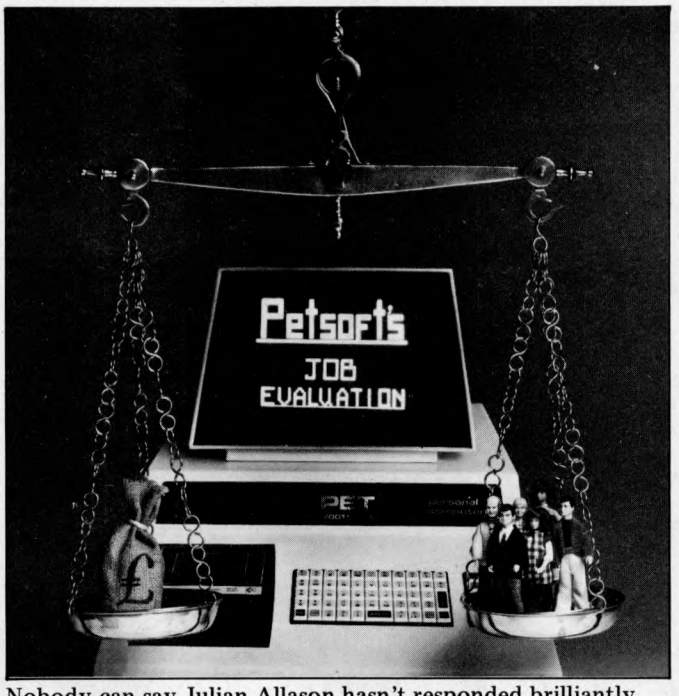
And it has announced a program which does the work of three Tandy programs which is designed to assist the user who writes assembly mnemonics for machine code, rather than high level Cobol or BASIC statements. The Cobol is described as an ANSI-74 implementation featuring complete interactive screen handling capability using ACCEPT and DISPLAY; indexed and relative files, and an optional packed decimal format that significantly "reduces mass storage requirements". (More significantly that happens to be a feature of IBM Cobol, so it should make it easier to borrow IBM Cobol programs.) It includes advanced data manipulation verbs (COMPUTE? INSPECT STRING UNSTRING SEARCH), three dimensional arrays, and a full COPY facility.

The BASIC compiler generates machine code from your favourite BASIC programs. The advantage is that when you load and run this machine code, it goes between three and ten times faster than the original BASIC statements can be processed by an interpreter — also it can be loaded onto a machine that doesn't have an interpreter. The drawback is that even at three to ten times faster than interpreted statements, BASIC programs are abominably slow, and Microsoft's claim that the machine code is "highly optimised" has to be taken in that context. Highly optimised *for BASIC.*

The other snag is that if there is a fault in your program, finding it and changing it is not the snip that interpreted BASIC makes it. But you knew that anyway, and besides, your programs don't have faults.

The assembler mnemonic package is the Editor/Assembler Plus. "In addition to providing every feature of Radio Shack's Editor/Assembler and T-Bug in one package, this cassette based software has features previously available only on large computers, to make working in assembly language easier and faster", says Microsoft. Major new assembler features are listed as "the ability to assemble directly into memory; conditional assembly (you only assemble a section of code if an indicator is set, allowing you to generate different versions of a program) and macro assembly, where a whole sequence of machine code instructions can be generated by one mnemonic.

In America, the Cobol costs $750, the BASIC costs $395, and the Ed/Ass costs $30. BASIC and Ed/Ass will run on the Level I Tandy.



Nobody can say Julian Allason hasn't responded brilliantly to our suggestion that some of the photographs sent in have been more like illustrations of sexual fantasies than a guide to the product on offer. How about this, showing what a £25 job evaluation program for PET is meant to do? It's intended for the company that doesn't know what to offer for a new job inside it: the computer asks questions designed to establish what the management really expect from the new employee, and from that it works out a reasonable salary level. Details on 021 455 8585.

Prestel meets Appletel

Very sensibly, the Post Office is letting Apple II owners use the machine to call up pages from its Prestel data banks. And very sensibly, Apple II distributor Microsense has decided to distribute a product, made by Owl Computers, which will allow the machine to do the job of calling up these pages.

The product is called Appletel, and costs £595. For that money the buyer gets a communications circuit card, modified to Prestel standards; a master disc holding the software and instructions to the owner; and a protective lead to link the Apple II to the Post Office modem, (to protect the Post Office lines, not the Apple) — plus a manual to explain it all.

The user will also need a modem. A modem is a device that turns dots and dashes of binary code into bleeps and bloops of frequency modulated sound — different notes, if you prefer. A Post Office modem is rather a

different beast from a Prestel modem, and as things stand today, I don't know of anybody who will sell a Prestel modem.

Mike Gardner of Owl Computers: "will be pleased to talk about the system in more detail," on 0279 52682 and Microsense in Hemel Hempstead will provide details of local dealers.

First the good news...

Terry Brown (I read) is, at 15, one of the younger members of the South East London microcomputer club, SELMIC, which meets regularly at the Thames Poly in Woolwich. A year ago, knowing nothing about micros, Terry was given a computer kit — the Nascom 1 — as a birthday present. Within four days, with a little help from his friends, Terry got the computer built and working; soon he became involved in programming. After "much dedication and study" he sold his first program, making enough money to buy 40 blank cassettes, and making enough of a splash to be offered stand space at the Online Micro Show in July.

There, Terry sold even more programs, and met the marketing boss of Nascom, Kerr Borland. Kerr now hopes to make Terry's future products into "stars" by marketing them worldwide. South East London Software, a small software business, is Terry Brown's latest venture and he's recently built a Nascom 2, financed entirely from his business success in the last year.

The afore piece of news came direct from Selmic. I didn't have to include it, but it owes its reproduction here to two things. First, if the many clubs around the country want the world to know what they are doing, little reports like this (showing what can be done by stating simply what has been done) are invaluable, and I want to hear more.
Second, it gives me "a platform of nice things about Nascom" on which to stand while I mention the unfortunate lawsuit between Nascom and Mine of Information.

From where I sit, it's hard not to sympathise with both parties. Richard Ross-Langley of MoI, like many who wanted to do things with the Nascom 1, got caught in the touch-and-go early delays as the company juggled a revolutionary product with tight finances, amid astonishing sales; his plans to develop software on the machine were scuppered.

Whether this was the fault of Nascom for being disorganised, or of MoI for relying on the guesswork predictions of an overloaded new company, or again, whether it was just plain bad luck that Ross-Langley, instead of plumping for the 32K byte memory board backed the 8K byte (which never quite got debugged) isn't really the point.

The thing is that lawsuits are bad guides to events — and the events that precede them are often even worse guides to reality. Reality is that companies will get clobbered by angry users and the sound of fists hitting faces will be reported here much more often than the sound of Terry Brown's successful business. Similarly as long as dealers and distributors pretend machines have no faults,those faults will cause rage and disappointment to buyers. It's important to add though that this rage and disappointment is only what *can* happen — not necessarily what *will* happen.

Course notes

PCW's very own book reviewer, Malcolm Peltu, has long been conducting a determined campaign to make human beings pay serious attention to computer technology, and not just run around shouting "Gee Whizz!" while Rome burns.

He will give a two day residential course, costing a miserly £15 (including all meals) at Holly Royde College in April, starting on Friday 18, and finishing on the Saturday.

His subject will be "the social impact of micro electronics" and the organisers at the department of extra mural studies for the University of Manchester, promise that he will show how this technology relates to real world environments, rather than rabbiting on about the number of transistors that can sit on the head of a pin. Enquiries to Mrs L Palethorpe at the Department, Manchester M13 9PL. Phone 061 273 3333.

Post Office taps in Wedge

Want a microcomputer? Ask the Post Office because that corporation is now renting microcomputers to customers of its computer bureau, NDPS (National Data Processing Service.

It's hard to see this information going down quietly in the computing business, even though the first PO steps are small, timid, and have been kept particularly quiet. Too many people will see it as the thin end of a very thick wedge.

The micro business will be delighted, of course. The Post Office is currently buying close to 80% of the production of Casu microcomputers — this being a UK-built micro based on the Z80 chip, using the standard micro skeleton and the S100 bus. And it's providing these — or most of these — to existing customers of the bureau. What a badge of respectability for the personal computer people!

Dust covers for terminals are available from Data Efficiency (as shown) and South Coast Enterprises of Anaheim, California. DE is on 0442 57137: South Coast on (714) 630 3940.

Think, however, of the people who are chewing their nails. Taking politicians first, nobody can seriously claim it to be coincidence that the NDPS, having lost a packet when its computer staff went on strike last year, has now started supplying machines that will not be affected by any future strikes. It may be only prudence — taking some eggs out of the basket and spreading them around — but no labour organiser worth his salary will let the move go unchallenged, since it strikes (sorry) at one of the most promising new industrial muscles unions have found.

Computer retailers next: can they seriously hope to compete with the country-wide Post Office personnel network? At present, all maintenance of Casu systems is the job of Casu, not the PO. For the future, it need only be said that Casu is small, and plans to stay that way; from that, one deduces that other machines will have to be added, and central maintenance introduced.

In the end, even if the PO does not abuse its monopoly position in telecommunications, its sheer size and staff abilities will make it a good bet for biggest micro rental outfit.

After politicians and retailers; bureaux. These people started off the way the PO bureau did — as a side-line operation for companies which wanted their own computers, but didn't have enough work (or money) to justify the move internally. So they sold off spare time to outsiders, sometimes at a profit. All bureaux are now looking the same way as the Post Office in terms of how they expand. More and more are offering a stand alone machine to sit in the user's own premises, for the cost of the software they run on the bureau's central machine already. Few have been so radical as to move into microcomputers, and fewer still have gone as far as NDPS which will actually stop all payroll bureau services at the end of this financial year — in April 1980.

One of the most admirably sensible and public spirited policies of that normally predatory outfit, IBM, is its insistence that no supplier of goods or services provides IBM with more than 40% of that supplier's output. The Post Office has no such scruples, and in fact does the opposite; equipment supplied to the PO is normally not permitted for sale to anyone else. The terrible effect on companies like Plessey and STC, as the PO switches from electro-mechanical exchanges to computerised ones, is well documented. In micros, it has taken the sensible approach of using standard products, so far. Within five years, I'll bet anybody that the Official PO Micro is an exclusive design, good at transmitting or storing messages, and inside which thou shalt not stick thy British Standard Finger. It may all be for the best, but until that is proved we will all live in interesting times.

Z80 gets real database?

Theoretically, it makes a great deal of sense to keep all your computer records in one, enormous, automatically house-kept "database" — with all the customer names in alphabetical order, all the account numbers in numerical order, all the important people in priority order, all the tax fiddles in secrecy order, and all the prices in profitability order. Theoretically, this is possible on a big mainframe computer with a database management system, in a package costing upwards of £30,000.

A new piece of software which theoretically allows all

the apparent benefits of this expensive old software, has been announced by an American company, Micro Data Base Systems of Lafayette, Indiana.

The MDBS product runs on the Zilog Z80 micro, and will shortly be available, on other major central processor chips.

It was launched at an introductory cost of $750, with the promise of hefty price rises: unfortunately the announcement didn't get here until the day before the price rises were to go into effect, and accordingly the marketing coup of a cut-price introduction has been ever so slightly "blown". MDBS has enclosed its apologies, and when I think of something useful to do with them I'll do it!

Meanwhile it's worth recording my total belief that database software is what all micro users of the future are really waiting for. When a good, working foolproof database package hits the market, everybody will want one. "While large mainframe and minicomputer systems have available, sophisticated, data base management tools", says Lafayette blandly, "microcomputers have usually been limited to some variant of an indexed sequential access method file management package".

It's not fair to speak slightingly of a new software product before talking to users. It remains unavoidable that if this sytem does what is claimed to be possible on mainframes, it is doing something that is still more a claim than a reality.

It is apparent from the Lafayette announcement that the company can speak the data base language. To quote: "MDBS provides a full network capability and even generalises some features of the Codasyl approach. For example, instead of restricting a set relationship to be "one of many", MDBS permits "many to many" set relationships. A record type can be both the owner and member of a set relationship. Full database security is maintained by providing read and write access levels for all record types, items, and set relationships".

Well, I've recorded the appearance of the Software, and that's all that anyone can do until some enterprising dealer gets onto PO Box 248, Lafayette, Indiana 47902 and arranges a month's hard use trial.

16-bit Monnex

Not the cheapest 16-bit micro on the market at £1,250, is the Monnex system developed by Systems Reliability for its commercially successful TEL-TAG telephone management and information system.

That price buys a Texas Instruments 9900 micro, 8K bytes of read-and-write memory, 22 programmable lines for data input and output plus two serial communications ports; and a real time clock with two subsidiary timers. Details from Luton 38581.

After amusing ourselves at the Atari's expense last month when the distributor dressed two models in sports clothes to play video games, we relent here to show the Atari 800 (expected to cost under £750). There is still no need to get worked up about it, nice though it may look: demand in the US will exceed supply this year, say the importers. Don't expect to see any in the shops until June at the earliest. Details from 0628 32839.

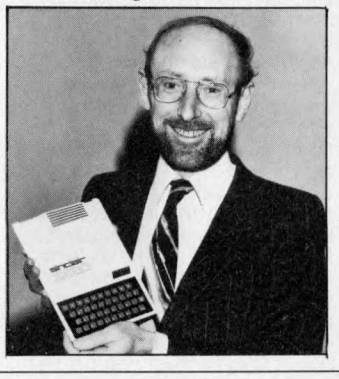
Sinclair surprise cheapie

Clive Sinclair, the inventor of the pocket television ("for deep pockets", as Electronics Weekly once commented) has done it at last.

Exactly what he has done is to produce a personal micro with keyboard and TV interface and BASIC for under £80 in kit form, and I for one don't know how. Its only apparent drawback is the fact that it uses a touch sensitive keyboard. This is great for preventing spilled coffee or beer from getting into the switches and no doubt it keeps costs down that little bit extra, but it does make touch typing impossible; that requires the operator to keep the fingertips on eight of the keys all the time.

Apart from that quibble, it's obviously non-standard in terms of getting programs off other people's cassettes. Sinclair has hinted that his BASIC is greatly compressed and uses a quarter of the memory that a competing BASIC would use — both for itself and for programs that run under it. This saves money, but since nobody else has done it, their programs will need to be rekeyed and slightly modified to run on the Sinclair machine.

I am assured by Sinclair himself that I must have got this information from one of the advertising departments of the eight magazines in which he is advertising the launch of this machine. This is a tremendous relief. It means that, having assured my readers that all the people whose opinions I value are agreed that Sinclair has been very clever in the design of the machine, and that it looks like a bargain, I can almost certainly direct you all to the advertising pages of this journal for details. I know it's there, because Uncle Clive told me so, in a very suspicious tone of voice. . .

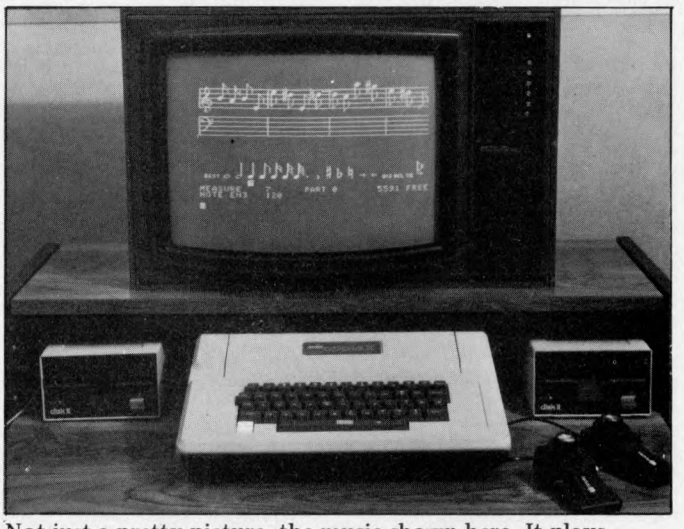


Apple slices prices

With a sense of triumph that can be felt through the small print, Apple distributor Microsense has cut prices on the Apple II. New prices for the machines start at £695 for a black-and-white display version with 16K bytes of memory or £744 for a colour display model. The full glory of a 64K byte Apple II with Pascal, Integer BASIC Applesoft (all software) two disc drives and controller, is now yours for £1780 plus tax.

According to Andre Sousan, president of Eurapple, these price cuts, far from being in response to competition from ITT (or critical comment in PCW) are due to "the level of cost effectiveness that our sales volume in the UK has allowed us to reach".

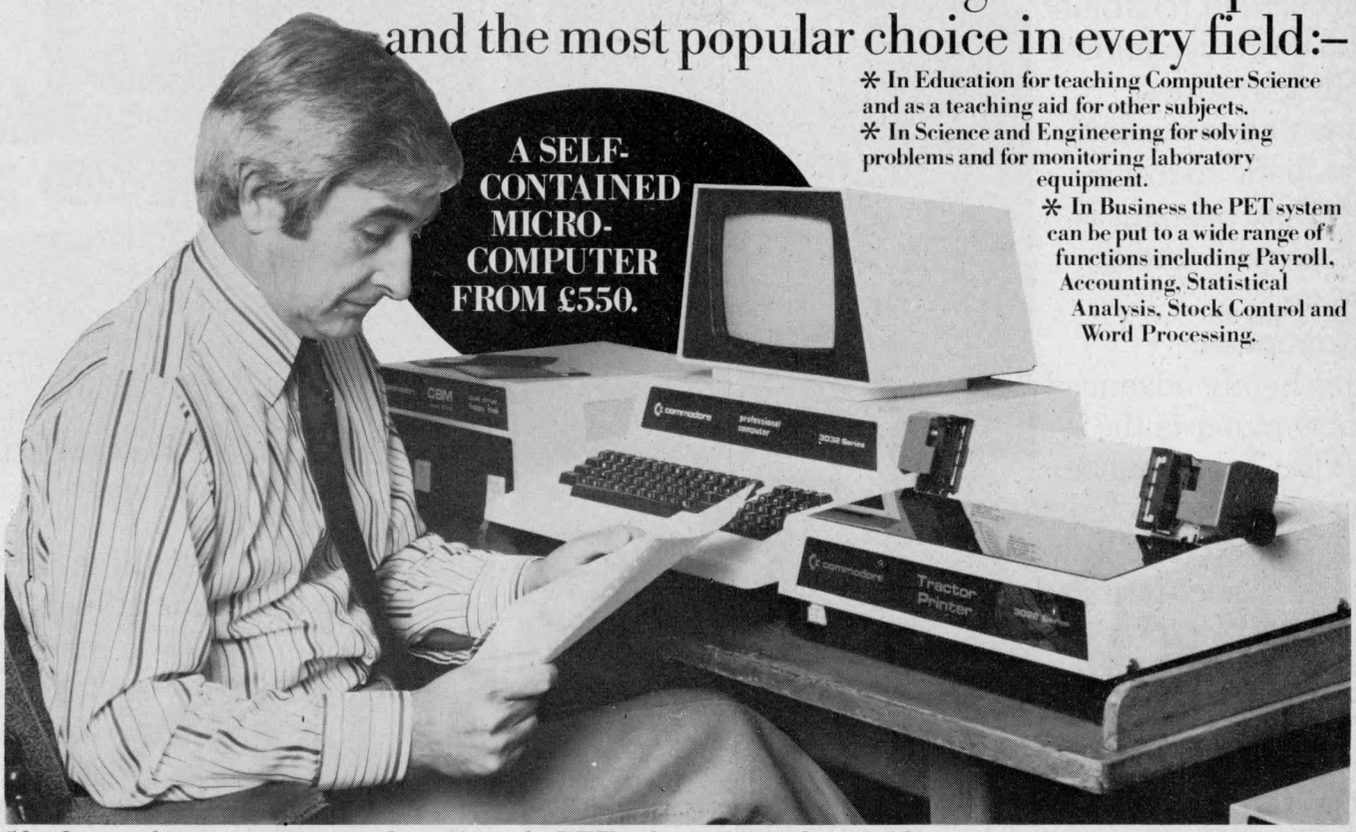
At Microsense, Mike Brewer, chairman, stated: "The Apple II European version now retails in the UK after allowing for necessary



Not just a pretty picture, the music shown here. It plays, through an Apple II synthesizer card now announced in the UK by Microsense at £180 — a much lower price than I was expecting. You can attach up to three of these synthesizer cards, and each will play three notes simultaneously. Unlike the HP-85 programmable BEEP, this will emulate the sound of any instrument you care to copy; I've heard it does a very good harpsicord.

Your Commodore PET System

The Commodore PET is Britain's best selling microcomputer and the most popular choice in every field:–



* In Education for teaching Computer Science and as a teaching aid for other subjects.
* In Science and Engineering for solving problems and for monitoring laboratory equipment.
* In Business the PET system can be put to a wide range of functions including Payroll, Accounting, Statistical Analysis, Stock Control and Word Processing.

Not least of its attractions is the price of a PET – from £550 for a self contained unit, to under £2,500 for the complete system including Floppy Disk Unit and high-speed Printer. Ask your nearest Commodore dealer below for details about Commodore hardware, software and training courses.

Our Dealer* Network

LONDON

Capital Computer Systems, W1. 637 5551
ACE (by Top TV Ltd), SW1. 730 1795
Micro Computer Centre, SW14. 876 6609
Logic Box Ltd, SW1. 222 1122
Sumlock Bondain Ltd, EC1. 250 0505
Da Vinci Computers Ltd, NW4. 202 9630
L & J Computers, NW9. 204 7525
Adda Computers, W1 408 1611
CSS Business Equipment Ltd, E8. 254 9293
Advanced Management, EC2. 638 9319
Metyclean Ltd, SW1. 828 2511
Microcomputation, Southgate. 882 5104
T.L.C. World Trading Ltd, WC2. 839 3894

HOME COUNTIES

Orchard Electronics Ltd, OXON, 0491 35529
D. L. Chittenden Ltd, CHESHAM, 4441
J. R. Ward Computers Ltd, MILTON KEYNES, 562850
Dataview Ltd, COLCHESTER, 78811
South East Computers Ltd, HASTINGS, 426844
Symtec Systems Ltd, SOUTHAMPTON, 38868
Alphascan Ltd, BANBURY, 75606
Super-vision, SOUTHAMPTON, 774023
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DDM, BRENTWOOD, 230480
Stuart R. Dean Ltd, SOUTHEND, 62707
Alpha Business Systems, HERTFORD, 57423
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RUF Computers (UK), BURGESS HILL, 45211
Wego Computers Ltd, CATERHAM, 49235
T. & V. Johnson, CAMBERLEY, 62506
T. & V. Johnson, OXFORD, 721461
Petalect Electronic Services Ltd, WOKING, 23637/21776
Business Electronics, SOUTHAMPTON, 738248
Amplicon Micro Systems Ltd, BRIGHTON, 562163
Bromwall Data Services Ltd, HATFIELD, 60980/64840
MMS Computer Systems, BEDFORD, 40601
Isher-Woods, LUTON, 416202
Sumlock Bondain, NORWICH, 26259
CSE (Computers), READING, 61492
Oxford Computer Systems, WOODSTOCK, 811976

MIDLANDS & STH. HUMBERSIDE

Taylor Wilson Systems Ltd, KNOWLE, 6192
Betos (Systems) Ltd, NOTTINGHAM, 48106
Holbrook Business Systems, DERBY, 368088
Lowe Electronics Limited, MATLOCK, 2817
Davidson-Richards Ltd, DERBY, 366803/4
Arden Data Processing, LEICESTER, 22255
Tekdata Ltd, STOKE-ON-TRENT, 813631
C.S.M. Computer Systems, BIRMINGHAM, 360 6264
Business & Leisure Microcomputers, KENILWORTH, 512127
Caddis Computer Systems Ltd, HINCKLEY, 613544
Allen Computers, GRIMSBY, 40568
CPS (Data Systems) Ltd, BIRMINGHAM, 707 3866
Camden Electronics, BIRMINGHAM, 773 8240
Cliffstock (Computer Systems) Ltd, WOLVERHAMPTON, 24221

YORKSHIRE & NTH. HUMBERSIDE

Microprocessor Services, HULL, 0482 23146
Microware Computers, HULL, 562107
Computer Workshop, LEEDS, 788466
Hallam Computer Systems Ltd, SHEFFIELD, 663125
Ackroyd Typewriters Ltd, BRADFORD, 31835
Datron Micro Centre, SHEFFIELD, 585490
Yorkshire Electronics Service Ltd, MORLEY, 522181
Sheffield Computer Centre, SHEFFIELD, 53519

NORTH EAST

Dyson Instruments, DURHAM, 66937
Currie & Maughan, GATESHEAD, 774540
Wards Office Supplies, GATESHEAD, 605915
Tripont Associated Systems, SUNDERLAND, 73310
Newcastle Computer Services, NEWCASTLE UPON TYNE, (0632) 615325

SOUTH WALES & WEST COUNTRY

Computer and Design, BROADSTONE, 0202 697341
A. C. Systems, EXETER, 71718
Computer Supplies (Swansea), SWANSEA, 290047
Sigma Systems Ltd, CARDIFF, 21515
Devon Computers, PAIGNTON, 526303
Bristol Computer Centre, BRISTOL, 23430
J. A. D. Integrated Services, PLYMOUTH, 62616
Sumlock Tabdown Ltd, BRISTOL, 26685
Radan Computational Ltd, BATH, 318483
T. & V. Johnson Ltd, BRISTOL, 422061

NORTH WEST & NORTH WALES

B. & B. Computers Ltd, BOLTON, 26644
Megapalm Ltd, CARNFORTH, 3801
Tharstern Ltd, BURNLEY, 38481
Fylde Business Machines Ltd, PRESTON, 731901
Preston Computer Centre, PRESTON, 57684
RPL Microsystems, DOUGLAS, 4247/8

LIVERPOOL

Microdigital, LIVERPOOL, 227 2535
Rockliff Brothers Ltd, LIVERPOOL, 521 5830

MANCHESTER

Cytek (UK) Ltd, MANCHESTER, 832 7604
Executive Reprographic Ltd, MANCHESTER, 228 1637
Sumlock Manchester Ltd, DEANSGATE, (0618) 834 4233
Computer Workshop, MANCHESTER, 832 2269
Professional Computer Services Ltd, OLDHAM 061-624 4065
D. Kipping Ltd, SALFORD, 834 6367
Catlands Computers Ltd, 0625 527166

SCOTLAND

Microcentre, EDINBURGH, 225 2022
Thistle Computers, KIRKWALL, 3140
McAllister Business Equipment, EDINBURGH, 336 2402

IRELAND

Softech Ltd, DUBLIN, 784739
Medical and Scientific, LISBURN, 77533

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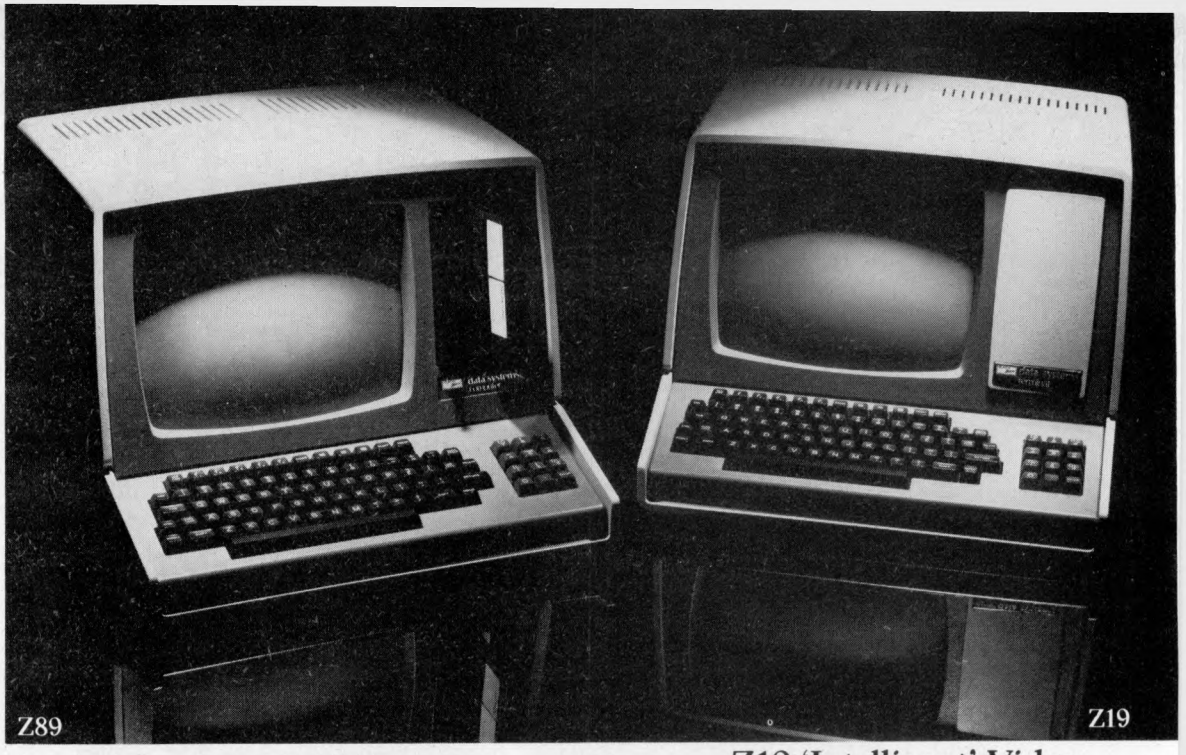
The Professionals

Whether you're a software engineer looking for the best hardware — an educationalist requiring versatility and the ultimate in reliability — or an OEM demanding flexibility, the finest documentation available, and 'realistic' margins — Zenith Data Systems is your automatic choice.



Z89 Series Microcomputer.

This highly advanced Microcomputer is the star of the Zenith range.

Specification includes: Floppy disc storage. 48K RAM. 'Intelligent' video terminal.

Two Z80 Microprocessors. Choice of operating systems including CPM. Standardised communication, RS 232. Prices from £1570

Z11A Series 16-bit computer.

Based on the powerful new LSI-11/2 CPU (LSI — 11/2) it offers you the speed and versatility of a minicomputer at a microcomputer price. With memory* to 32Kwords (64K Bytes). Seven additional I/O positions. PDP 11/03 compatible.

Systems from £4335.

**Memory boards available from £562 per 16K.*

WH14 Serial Printer.

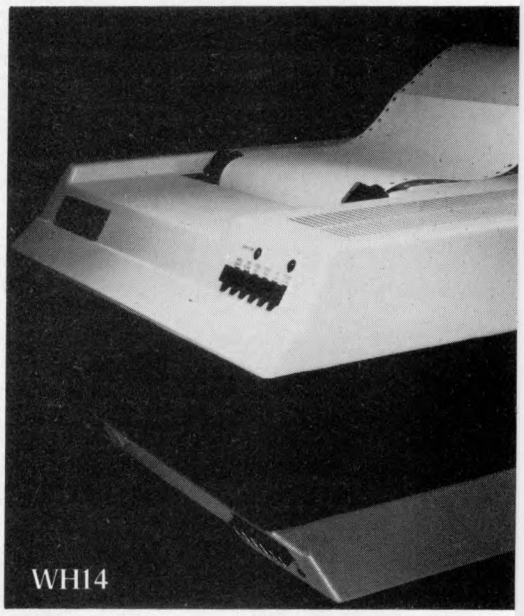
Microprocessor based electronics makes it capable of a wide variety of uses in most computing applications.

It features 5 x 7 dot matrix. Impact print. Operator/software selectable line width — 132, 96 and 80 characters per line. And sprocket paper feed with adjustable spacing.

Price. £510

Z19 'Intelligent' Video Terminal.

Z80 based, it is capable of a multitude of high- speed functions. It has an easy- to-read, high resolution CRT. Heavy duty keyboard. 128 characters. Addressable cursor, relative and direct. Versatile edit functions. And E.I.A. RS 232/c at 110 to 9600 baud. Price. £735



Zenith data systems

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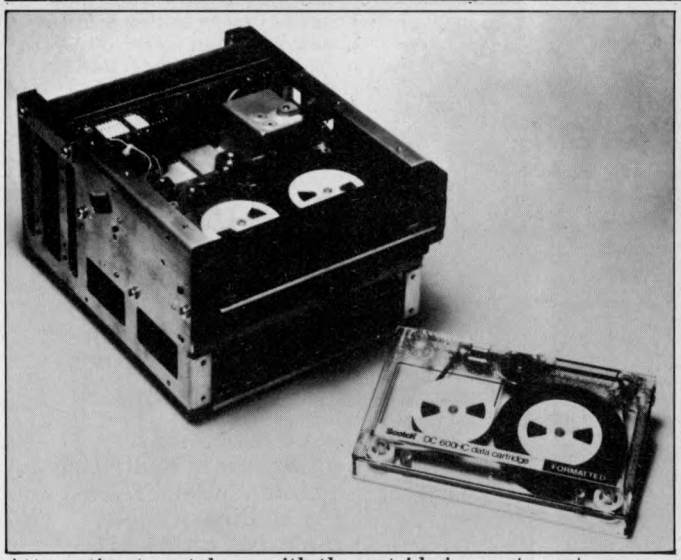
If you'd like more information about any, or all of the Zenith Data Systems range, just contact us at Zenith Data Systems Division, Heath Electronics (U.K.) Limited, Dept (PCW 3), Bristol Road, Gloucester GL2 6EE. Telephone (0452) 29451

All prices are exclusive of VAT and delivery charges.

Generous OEM discounts available.



Attempting to catch up with the outside innovators at Courtest, the 3M Company has announced a disc-like tape cartridge as "the first truly intelligent data cartridge drive system". It differs from Courtest's in offering 16 track recording, and in being rather slower; also in being offered purely as a back-up system for the new mini hard discs, rather than as a systems component functioning in real time. There are other differences too. Details on 0344 58550.

modifications and for freight and duty, at very similar prices to those in the United States". Details on Hemel Hempstead (0442) 41191.

Intel chooses cartridges

Micro maker Intel has upgraded its supersystem, the Intellec development computer, to include a large, 7.3 million character, storage disc.

As would be expected of the market leader, it has adopted a conservative approach, using older, established cartridge discs, rather than the new fangled mini Winchesters. The thinking is unshakeable; people who are developing new systems do not want to cope with too much innovation all at once. Also, new products aren't always readily available. Intel aims the new system at users of its big 16-bit 8086 and of the 8085, who have a large number of programs available to compile, assemble, link and load.

Keen to sell PETS

One of two distributors of the Apple II up to the middle of last year was Keen Computers of Nottingham. The appointment of Microsense as master distributor was a warning to Keen that it could no longer delegate the bulk sales to sub dealers and collect a small percentage, and that it would have to change its ways in the market. As a result, Dr Tim Keen's company has been the subject of considerable anxiety ever since, culminating in unfounded rumours that it was going bust.

More important, Keen was forced to look to expand its market. It has now done so on two fronts. First, it sells the Corvus Winchester mini-disc, and second, it sells the PET.

Keen's announcement observed that to date, the company has marketed the Apple II to education and big business markets. Keen's approach to the Apple has always been a bit up-market — for example, where others tend to supply the computer with a card that broadcasts the display (down a wire) into the aerial socket of a colour television, Keen has preferred to sell it together with a colour monitor, taking the output of the computer direct to the red/green/blue controls of the colour tube.

So when Keen refers to the PET as "the best selling machine in the small business market," it's obvious that he sees it as a useful source of volume sales, as opposed to the more specialised deals done with Apple.

The move should convince people that he has found a replacement for any business lost with the Apple distributorship.

Byte shop sold to Comart

Computer enthusiasts were doubtless relieved to hear that the Byte Shop had been sold to somebody who knew the business, rather than to someone who planned to run it like a soap and soup supermarket. It was bought for over £300,000 by Comart's David Broad — one of the first people to sell American microcomputers in this country. Broad's main anxiety on taking over Byte Shop (1980) was to reassure everybody except South West Technical Products and Ohio Scientific that business would continue as usual.

His own chain of retail outlets — the Comart franchises — are assured that this side of the business will continue to be controlled by John Lamb, "who will have nothing to do with Byte Shop". All former personnel are to be retained, and so are all the shops. The changes are not definite yet, but the fact that the product range would be rationalised was known before Comart took over.

In charge of the rationalisation will be Nottingham Byte Shop manager, John Braga. It is he who will have to decide which machines are to be sold, and which will be dropped. Since Comart handles Cromemco and North Star, it's a safe bet they won't go; and if Nascom keeps deliveries up to scratch,with such a good seller, they should be in there too.

South West Tech Products, however, has moved its market position significantly towards selling minicomputers, rather than mail order or retail micros; Braga is known to be looking carefully at that line.

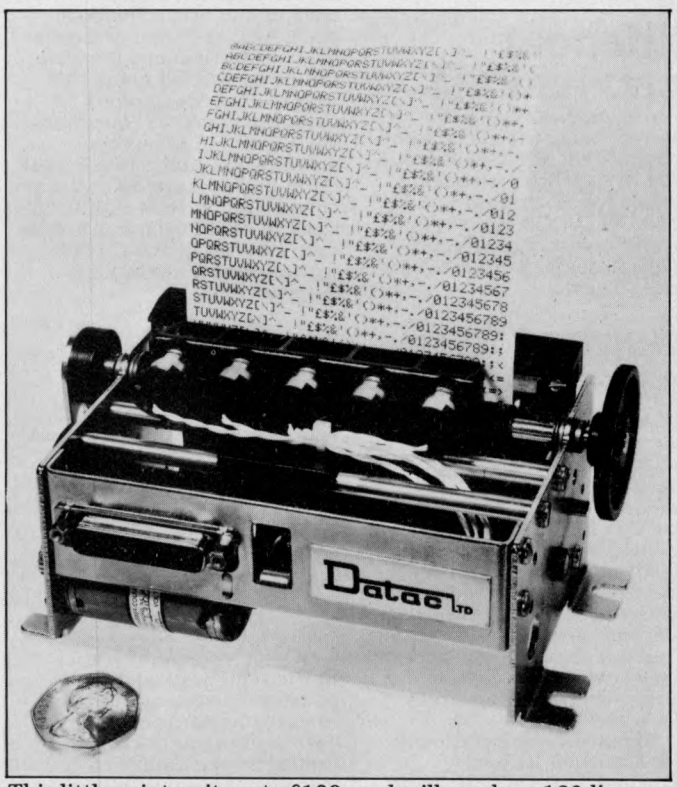
And problems already experienced by Byte Shop in handling Ohio Scientific machines, whether or not they were problems of Byte Shop's own making, have seen the entire stock of machines and parts sold off by the receiver. Contrary to rumour, the PET will definitely not be dropped. "Apart from the money PET makes, we sell so much PET software that we wouldn't like to consider dropping it, even if it caused much more difficulty than it does," said Braga.

The question of what will happen to unsecured creditors of the old Byte Shop is no further advanced than it was when our long analysis appeared last month. The only news is, that, having made "a good sale" of the group, the receiver is now hopeful that they will get 50 pence in the £ — or possibly more.

Hop on the TRS80 bus

When Tandy launched its packaged microsystem, everybody pointed out that it would never have the benefit of being a standard add-on bus machine, like Altair, and that the job of expanding it would, therefore, be costly. Ingenuity will always find a way to prove these predictions wrong. In New Jersey, a company called Hartmann Lang is releasing add-on hardware for the TRS 80, by the devious method of using the official connector socket at the back of the computer, and expanding it to what Hartman calls the STD bus — a 56 pin 8-bit bus supported by "products from numerous manufacturers".

Hartmann-Lang now has available the following products for the TRS 80/STD bus: the bus interface, a 6 slot STD bus mother board,



This little print unit costs £139, and will produce 120 lines of output a minute with its five print heads. It needs drive circuitry, and it is available without this from Datac on 061 941 2361.

a 16 channel ten and twelve bit analogue to digital converter board, a four channel 12-bit digital to analogue board, an eight channel reed relay output board, an eight channel triac board — useful for varying the speed of electric motors or the intensity of lights — plus a range of memory boards, input output ports, and printer interfaces.

Software available includes an intriguing emulator of the 6502 which, if it works, will allow the TRS-80 to run any program written for the Kim or PET family in machine code. There is also a collection of operating utilities, to make loading information from cassette easier, and to help with machine code programming.

For the freaky, there is a monitor program — written in BASIC — which "makes an interesting case study in interaction between machine code and BASIC", comments the company. At least it isn't claimed to be any kind of useful breakthrough.

PET EPROM burner

A hardware and software package which allows PET users to "blow" eraseable read only memory chips has been launched by GR Electronics. This allows the user to load permanent programs into silicon, for insertion into the PET itself, or into other micro based systems that will take the right chip. The chip is the single voltage 2716 EPROM. Details from 0633 67426.

Lifeboat carries mail

A mailing list system for any system using the CP/M operating system has been announced by Lifeboat Associates. It's called Postmaster, and it costs $150. Details of your systems would be needed, since it comes in over 20 diskette formats.

Commodore goes soft

Commodore has given a big boost to writers of PET software by getting them all together in one place, to swap good ideas. It held a meeting early in February, to show its dealers what software had been sent in and approved, and no doubt the result will be that a great many more software products that were available from one or two outlets will suddenly appear from new dealers around Europe.

Meanwhile the company has launched its own Wordpro II word processing software at £75, for the big keyboard PET. With diskettes and printer, Commodore estimates that a working word processing system would cost £2600; one with a daisy wheel printer, giving typewriter quality printout, would cost more, "but would still cost less than £4000".

Prices start at £218 for a new pair of printer ranges from Digitec, through dealer Aviquipo in Maidenhead. Details on 9628 34555.

A model system

Financial modelling facilities for an Apple II now cost £95. That is the retail price of software, called Visicalc, which Personal Computers is selling as "a large financial notesheet that can be moved in any direction, to highlight specific problems". The notesheet accepts the user's financial problems, and then illustrates the overall financial position on the screen, allowing the user to find the answers to complex "what if" questions. Mike Sterland offers the information that Visicalc cost £200,000 to develop — the need to sell at least 2,000 systems to break even must indicate something about what sort of people are buying Apples.

Newbear expands

Newbear Books, a division of the Newbear Computing Store, has opened another branch in Birmingham. It is at the Tivoli Centre, Yardley, next to the Swan landmark. Details from Dave Sperry or Sue Dunn on 021 707 7170.

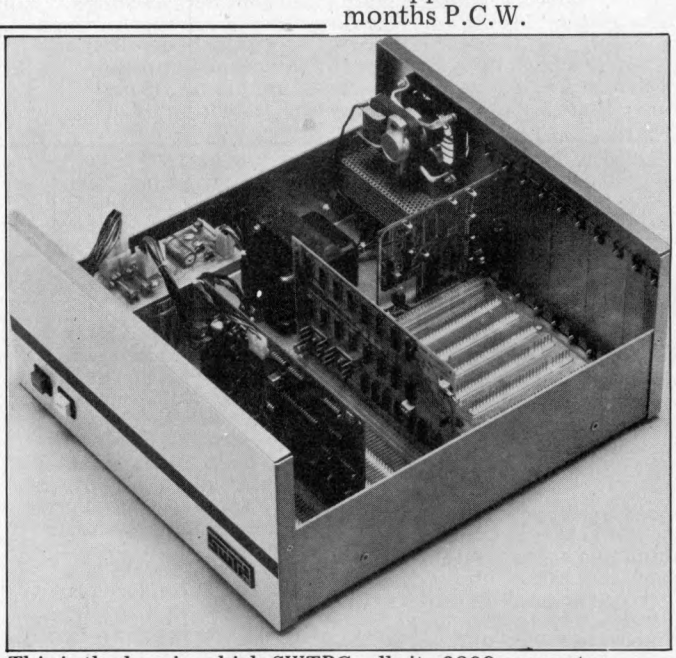
Make a date

In the same way that a marriage bureau allows you to date one of its clients before filling in the licence, Productivity Unlimited management consultants has set up a room where prospective micro users can have an intimate session with their hands on the micro — in a new centre in Gerrard's Cross. Andrew Jackson on 02813 89248 will give details of software available for test on Apple and Microstar computers.

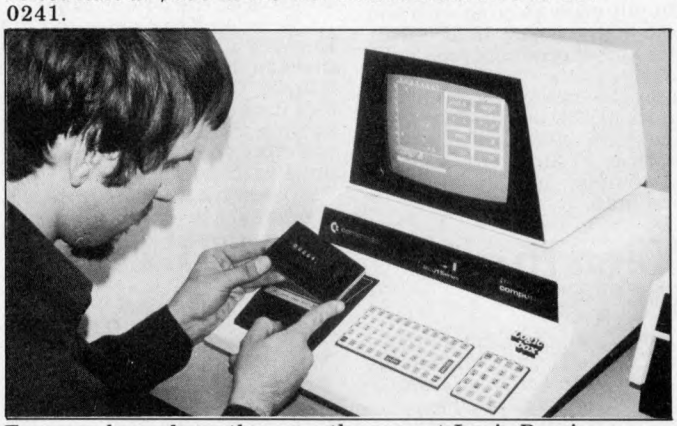
Stop Press

The Third Personal Computer World Show will be held at the Cunard International Hotel in Hammersmith, London on Sept 4, 5 and 6th 1980.

Organizations interested in exhibiting should contact Timothy Collins of Montbuild Ltd on 01-486 1951. Further details will appear in next months P.C.W.



This is the box in which SWTPC sells its 6809 computer. Prices start at $595 in the US. Details there on 512 344 0241.



To prove how clever they are, the guys at Logic Box in London have dreamed up the idea of putting a rev counter on the tape cassette of a PET. And to show how clever they *really* are, they are not going to sell it, or help you design it; you can have the idea of fitting it via a slotted spindle onto one of the tape drive wheels, drilling through the plastic cover — FOR FREE. Logic Box does sell an add-on cassette deck, *with* tape counter and loudspeaker, for the PET, at the PET price — when you get frustrated trying to build your own, you can buy theirs. On 01-222 1122.

Guy Kewney is technology editor of Computing.

The Panasonic

Now you have decided why to get it, a little reflection will tell you where.

To the Customer

By now, all the advantages of buying Panasonic will be clear to you. As a spectacularly powerful, flexible and self-contained machine, the Panasonic's claim to supremacy amongst computers almost goes without saying. But if you knew nothing of DDP Five Star Computing or the range of CAP programs with which DDP support the Panasonic, you could be excused for thinking that where to buy might present a problem.

On the one hand, Five Star Computing is our literal Commitment to Excellence across the whole spectrum of DDP products, services and expertise. To uphold that commitment in the case of the Panasonic we rely, in part, on our wide experience at both ends of the computing scale. In particular, as the largest and longest serving UK distributor of the smaller ITT 2020 and as a 'System Builder' for the big Honeywell Level 6, we believe that we are uniquely suited to solving the problems of the Panasonic operator in the middle of our 'turnkey' computer range. Our confidence is also due, on the other hand, to our Five Star endorsement of the CAP programs for the Panasonic. One of the World's largest software houses, CAP have written such programs specifically for microcomputers like the Panasonic, but in such a way as to give enhanced performance comparable to that achieved on the very largest computers.

For both these reasons, your logical choice is to buy a DDP Panasonic. But if you are still unsure, please contact us and we'll go into the whys and wherefores together.

To the Dealer

To help support the growth of Five Star Computing, we are currently interested in extending our dealer network in the South-East to include more Panasonic outlets. Therefore if you are interested in becoming a DDP Five Star Panasonic Dealer, please contact Nick Yates at DDP now.

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COMMUNICATION

PCW welcomes correspondence from its readers. Be as brief and concise as possible and please add "not for publication" if your comments/questions are to be kept private.
Address letters to: "Communications", Personal Computer World, 14 Rathbone Place, London W1P 1DE.

Cryptic comments

Excellent magazine, Like new format. Superlative show, superlative staff. Catering (restaurant) worse than lousy. Why don't you choose another venue if you must have it in London? Come to that why not move the show around the country? You'll eat better with our Northern hospitality and pay less, and we know better than the rudiments of service (which is more than can be said for a certain West London Hotel). Would you care to review the Superbrain? I'm sending a letter about the TI 59 review — watch out. Pascal series excellent. Why the hell can't you finish a **** article on the next page instead of completing it on some spare corner of some column twenty pages away. Use a word processor and edit out surplus text. Particularly on serious articles which your readers will wish to photocopy. Get the spelling right, and/or employ a proof reader. Happy new year.
J. D. Briggs, Scawthorpe, Doncaster

Comments noted. What surplus text? Noticed the spelling improvement since November? — Ed.

Prize praise

I thought it would come as a pleasant surprise to receive a letter glowing with admiration and praise, but as you didn't send me one, I'll send you one instead.

Needless to say I enjoyed my Christmas and New Year very much, thanks to the generosity of PCW. The Sharp MZ-80K will give me years of fun and interest and the opportunity to experience divorce first hand. I am currently working on a short transparent program for Sharp, PET etc. using TI$ to prompt the programmer every 5 munites or so to "SPEAK TO SPOUSE".

On a more personal note, I should like to thank everybody for making me feel so welcome at the presentation — a most memorable day for me.

If you should want a "users" appraisal of the machine sometime in the future, I should be happy to supply one.

Once again thanks for everything.
Terry Rigby, East Sheen

For those who don't know, Terry won the Sharp MZ-80K as a result of being first out of the hat in our recent readers survey. The machine was donated by Sharp and upgraded and guaranteed by Personal Computers Ltd. — Ed.

Prestel postbox

In December's Newsprint column you expressed surprise that ITT have announced a message keypad for Prestel. In fact the Post Office's prototype Prestel has got a mail box facility to allow users to swap messages. For some reason this has not been implemented in the commercial version for public use. I doubt that this is a Post Office secret since both versions were demonstrated at a local branch meeting of the BCS last year. Why not ask Prestel?
J McIntosh, Liverpool, Lancs

We asked Prestel and they tell us that there are no firm plans to make this facility available. Perhaps it poses too much of a threat to conventional mail. However, there is a form of message swapping service available now, in which details of an order for goods or services may be left for subsequent processing by the supplier — Ed.

Ghanaian gripe

I like the 'new look' PCW, because it gives more facts and information.

The new 'Bench Tests' are far better than what you were doing before. I hope you will do one on the Apple.

The new series 'Computer Answers' and 'The Complete Pascal' are very welcome.

'Bookfare' (Sept & Oct) is a disaster. Please change it quickly. The type of book review that I appreciate is the sort of thing we had in April or February of this year.

And now I am going to request one thing. In fact I will go further and beg you, on bended knees if necessary! Please do not print different articles back to back on consecutive pages. It only annoys and frustrates those of us who cut up PCW and file it for future use. For example, in the October edition the 'Mini-Bench Test on the Sharp MZ-80K' was back to back with 'The Complete Pascal'; I wanted to file both articles, but couldn't. Please space such articles with adverts if necessary.

Now let me underline this last request once more!

By the way, I preferred the type you used on the original PCW.

Thanks for a good magazine.
G.R.Hunt, Tamale, Ghana

Thanks very much for your comments — we welcome both good and bad, as long as they're constructive. As far as your request about articles backing each other is concerned, this would involve putting far more advertisements into the body of the magazine. We feel that this would then make the interesting bits harder to find. I suppose you wouldn't consider buying two copies each month?. . .

All go algol

Pascal is being pushed by many people, as they think it should be the new language for the eighties. Unfortunately, a Pascal system is a very tight squeeze, even on big micros and yet on larger machines it has drawbacks when compared with a language such as Algol 68. I would suggest that Algol 68S, a strict sublanguage of Algol 68, would be a much better choice for micros such as the Z80 or 6809. This would allow users to "upgrade" to full Algol 68 when available with little trouble. Algol 68S is very clear and produces good code without complex optimisation. It has many features not found in Pascal, and is easy to learn.

An example of the language in use would be a solution to the "Pascal Question Mark" in the January 1980 issue:

```
FOR L From a BY 2 TO 19
DO IF L =x
    THEN first thing
    ELSE second thing
    FI
OD
```

This shows clearly what is going on, and should produce efficient code.

The program body of the Sales Ledger in the same issue would be easy to write in Algol 68S. The Algol 68 CASE has an OUT clause to take care of the selections which are not found. Notice also that the INTeger value "selection" is only declared where is is needed:

```
DO menu;
    print ("please type in your selection");
    CASE INT selection;read (selection);
            selection
    IN      list,
            stock code,
            invoice,
            amend,
            total
    OUT     print("goodbye");stop
    ESAC
OD
```

Note that DO. . . . .OD is equivalent to WHILE TRUE DO. . . . .OD. Now an exercise for Pascal users: Write the equivalent of the BASIC code:

```
100 FOR J=A TO B STEP C
110 . . .a. . .
200 IF M>N THEN GOTO 400
210 . . .b. . .
300 NEXT J
400
```

The Algol 68 version would be:

```
FOR j FROM a BY c TO b
WHILE  . . . .a. . . .  ;n>=m
DO          . . . .b. . . . OD
```

P.S. I enclose some ideologically sound stickers to stick round your office!
Raymond Anderson, Nottingham

Thanks for the Algol fan club stickers. The ones that haven't been nicked are now stuck round our ideologically sound office — Ed.

Home help

I should like to commend to your readers Compshop Ltd. Recently I visited their premises at 14 Station Road, New Barnet to see the Compukit UK 101. The staff were very helpful and enthusiastic, answering all my questions and spending as much time with me as I could wish.

Eventually I purchased the Compukit and during assembly telephoned the Compshop several times to ask advice of one sort or another. Always they were very pleasant and helpful. A few small components were found to be missing from the kit; these arrived within about four days of my telephoning the shop!

I believe that a firm who are willing to take trouble over a small customer such as myself, will be equally efficient over a customer spending much larger sums of money.
J.M.H. Taylor, Harrow, Middx.

Apple tip

Although the documentation on the use of the DOS for the APPLE is extremely well presented, well written and lists the various PEEKS and POKES and CALLS relevant to disc use, one point which perhaps is not brought out as clearly as it might have been is how to get from APPLESOFT or PALSOFT into the monitor without the facility of being able to return via the recommended 3D0G, because, for instance, that area is being used for some other machine code programs.

In order to get round this, if, instead of getting into the monitor by pressing RESET, instead you do it by a CALL −155 from the relevant BASIC you'll find that you can return from monitor by just typing FP and hitting the return, DOS intact.

The same process is the one used when controlling the Apple from an EXEC text file. This is where the machine is controlled by a sequence of instructions previously stored in a text file — the APPLE reacts to the instructions read from the text file just as if it had received them from the keyboard.

Richard Lawrence, Harlow, Essex

Frequency fudge

While at the Personal Computer World Show in London, several people asked me if I could let them know how to convert a VDM-1 (S-100 alphanumeric/graphic board from the late lamented Processor Technology) to operate on 50 Hz. These particular people have been notified, but in case there are any PTC "orphans" around, here is what to do.

On the VDM-1, disconnect pin-5 of IC8 from pin 6, and connect it to ground (pin 4). This increases the modulus of the counter to 8 in the VDISP element. This results in four extra character lines on the display. The total is now 312 lines per field, the equivalent of 624 lines per frame (sound familiar?). The field rate is now close enough to 50Hz to reduce the "swimming" effect to less than 0.1 Hz.

If you have trouble centering the display on screen — probably due to standoff time to VSYNC from the bottom (which is still on the 60 Hz standard), increase the value of R34 (located in series with the VPOS control).

Les Solomon, New York

Tandy tunes

I am a young reader of your magazine (11) and I share a TRS-80 with my brother. My other interest apart from programming is music and I would like to add a music function to it. I would like the function to provide three octaves and various types of sound (clarinet and recorder). I would also like to see more TRS-80 level 1 programs in your magazine.

J. P. Chessell, Worthing, Sussex.

The word from Tandy is that they sell a music program called Micromusic. It has a five octave range and can play sharps, flats, whole notes, half notes, quarter notes and eighth notes. You can play the music by either recording it and then playing it back, or by attaching the grey cassette lead to an amplifier. As far as TRS-80 level 1 programs are concerned, well we'd be happy to publish them if readers would care to submit them — Ed.

Nascom notes

I bought your magazine for the first time at the 'Breadboard' exhibition in London, after meeting Don Finlay and seeing his article on Nascom words and music. Unfortunately I cannot find a firm who can supply the DAC 1 and 2 for this circuit. These components are numbered MC1408L8. I would appreciate it if you could let me know where I could buy them and how much they cost. Sorry for the trouble.

D Blackburn-Kane, Chard, Somerset.

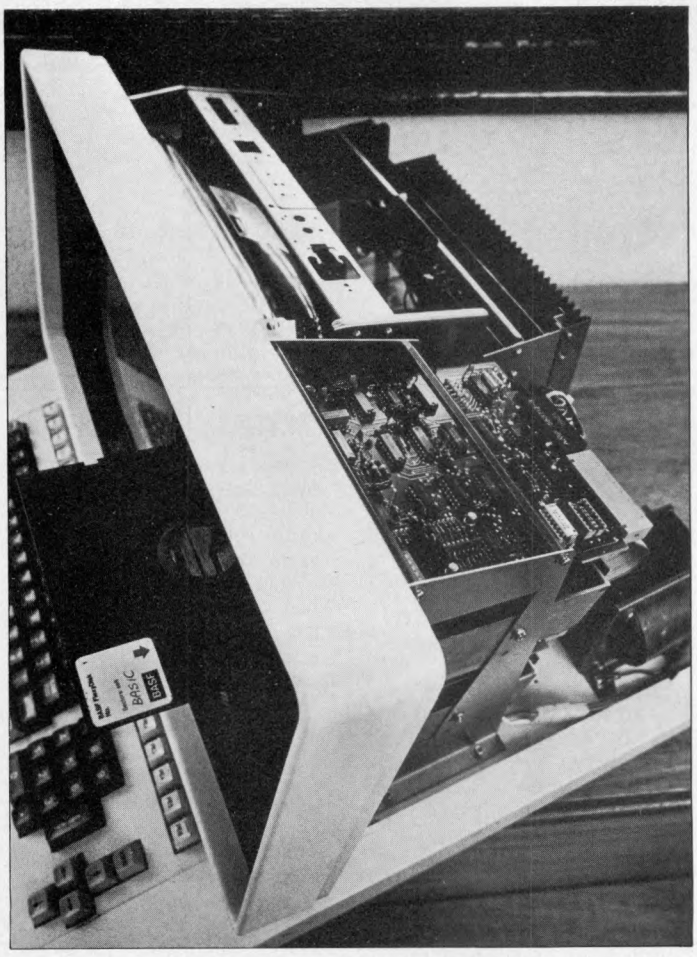
No trouble at all, we called Don Finlay who very kindly supplied the following list:
Crellon Electronics Ltd., Slough, Tel: 06286 4434
Celdis Ltd., Reading, Tel: 0734 585171
ITT Electronic Services, Harlow, Tel: 0279-26777
Jermyn Industries, Sevenoaks, Tel: 732-51174
Macro-Marketing Ltd., Slough, Tel: 06286 63011
He also thinks that some of these firms have a minimum order value, probably around £10. One MC1408L8 should cost £1.88 or thereabouts (last Novembers price) — Ed.

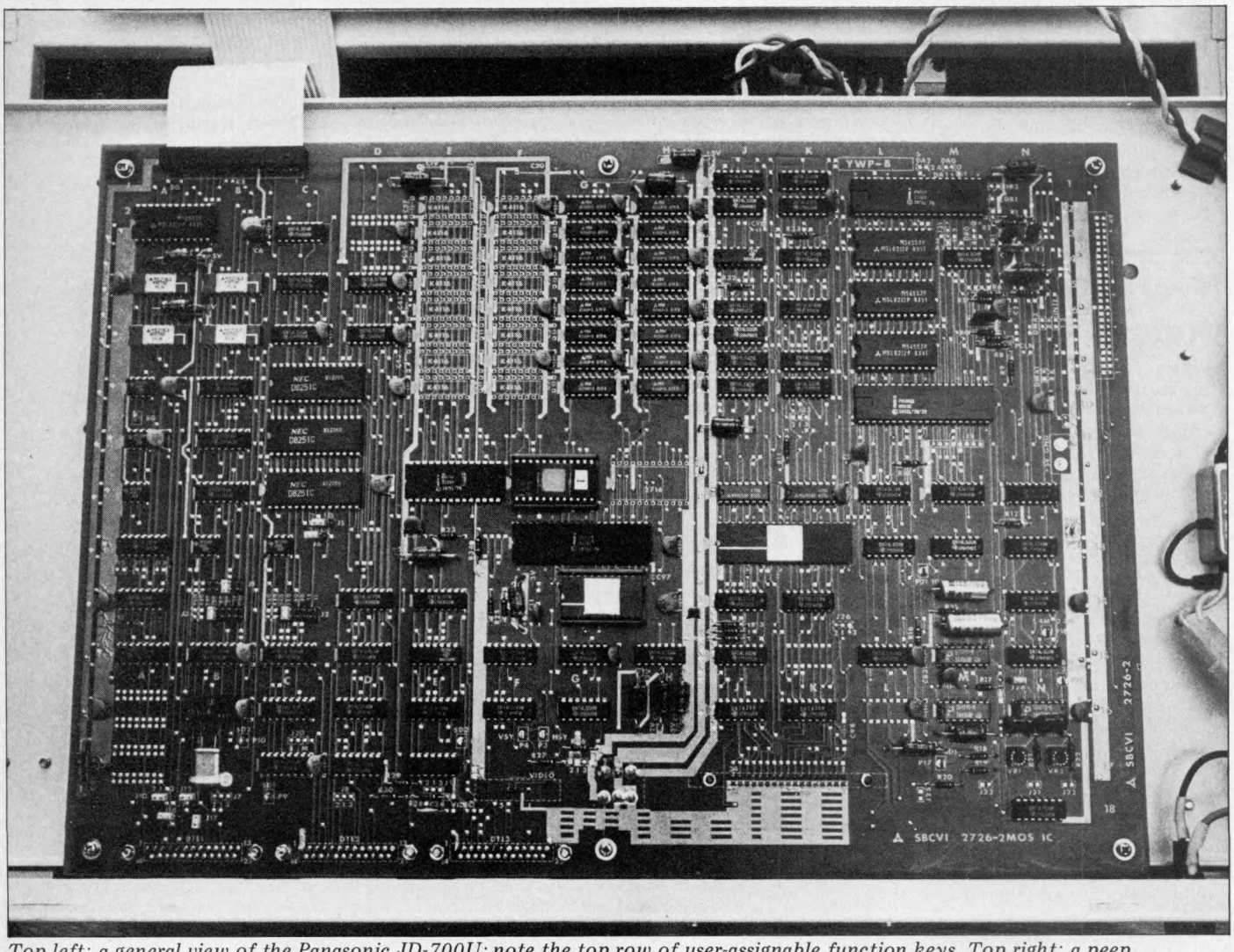
Research request

I am a final year student at Sheffield City Polytechnic, taking a degree course in Computing Science. My final year project is concerned with a study of the use of microcomputers in business applications. If any of your readers in the Sheffield area are using micros in business applications and are willing to help me in my investigations, would they either please write to me or phone Barnsley 45615 to arrange an interview. Any users not in the Sheffield area could help me by sending their address, and I will send them a questionnaire.

Steve Brown, 73 Swanee Road, Kendray, Barnsley, S. Yorks

Feedback





Top left: a general view of the Panasonic JD-700U; note the top row of user-assignable function keys. Top right: a peep inside shows the usual arrangement of disc drive, PSU and CRT. Bottom: revealed, the single board computer, with 8085A, 2MHz CPU, memory and all the circuitry for the disc drives, CRT and three RS232C ports.

BENCH TEST

PANASONIC JD-700U

With its JD series Panasonic has established itself as the first Japanese contender in what looks to be an increasingly competitive market . . . namely small businesses who find the PET and its rivals too limiting yet who aren't ready for the boxes and wires of a bus based machine with separate VDU. As is expected from the Japanese the hardware is well designed and built, although you couldn't say that it actually breaks new ground; neither does the software, which will need considerable development in order to exploit fully the available hardware features. Software enhancements and, of course, pricing are likely to be crucial factors in the battle for this market.

by Sue Eisenbach

Hardware

The Panasonic JD-700U is a single unit personal computer weighing 30kg. Because the peripherals — keyboard, screen and disc drives — are all contained within the cabinet, access is necessary only for maintenance or repair. The white metal case can be removed by unscrewing six retaining screws (the fan also needs to be disconnected). Revealed are the CRT, the disc drives and the power supply. To get to the computer itself, the unit has to be turned over on its side thus allowing access to underneath. Remove the black metal cover plate and the single board computer will be revealed, complete with 8085A, 2MHz CPU, memory and all the circuitry for the disc drives, CRT and 3 RS232C ports.

The review machine came with 32K dynamic RAM (4116s) which can be expanded to 56K. Above this 56K address space is 2K of static RAM for the CRT. The next 2K of address space isn't used, while the top 4K is reserved for PROM. There was a 2K (Intel 2716) PROM containing the bootstrap and a space on the board for an optional 2716 PROM.

The Intel 8257 direct memory access (DMA) controller is used to transfer data between memory and floppies or CRT display; it has the capability of transferring blocks up to 16K bytes between memory and peripheral without CPU intervention. The disc drives are controlled by a FDC 1771 floppy controller and each disc has a formatted capacity of approximately 71.68K bytes held on 32 tracks. Each track is divided into 16 sectors, each of which contains 128 bytes. Data is transferred using DMA in sector units with an average access time of 463ms. Panasonic are proud of the fact that they build the drives themselves.

The screen is 12 inches and provides 24 lines of 80 characters, which can be displayed in normal, highlight, reverse, underline or blink mode. The CRT is controlled by the 8275 programmable CRT controller. The characters are 7 x 12 dot matrices in a 10 x 14 dot matrix field. The screen is p.39 green phosphor and designed to minimise eye strain. Unfortunately, images linger long enough after a line has scrolled up for it to be a distraction.

The keyboard consists of 95 keys divided into five different sections: standard qwerty, numeric keypad, cursor pad, editing keys and function keys. Each key can send four different 8 bit codes (using SHIFT and CONTROL). None of these codes is for graphics, rather there are several key combinations for every character (including lower case letters). Although the cursor pad provides an easy method for moving the cursor around the screen, none of the software provided acknowledges input from these keys. The six editing keys have no appreciable effect on either the screen image or the text being typed in. The input from both the cursor keys and the editing keys can be accepted through machine or assembly language programs and the fifteen function keys are set up for easy use in the BASIC system. Under CP/M the function keys have no effect, but can also be used through machine/assembly language programs. The labels on the function and editing keys (PF1-PF15, PE1-PE6) can easily be replaced with appropriate titles.

There are three RS232C ports easily accessible at the back of the machine. Ports 1 and 3 are for asynchronous transfers while port 2 can be used for either synchronous or asynchronous transfers. For asynchronous transfers speeds can be set (using a shorting plug inside the machine) between 110 and 9600 baud, whereas synchronous transfers can be set between 1200 and 9600 baud. The ports can be accessed through both CP/M and BASIC.

My overall impression of the hardware is that it is robust and thoughtfully designed. The single board computer is clean and isolated from the heat producing power supply, drives and CRT. A design decision was made to use the CPU only for processing. Control of peripherals and memory transfers is delegated to programmable control devices.

Software

Two discs with the system software were supplied — one labelled BASIC, the other CP/M and to use either system the appropriate disc must be placed in the top drive (called 1 in BASIC and A in CP/M). Upon powering up with the BASIC disc in place, BASIC is automatically loaded into main memory and the following message appears on the screen:

```
BASIC Rev. 5.0
[Matsushita version]
Copyright 1977 (c) by Microsoft
8025 Bytes free
Ok
```

Despite the Rev number this is not Microsoft's new version 5 BASIC 80 but rather their previous Extended BASIC with a few extra features.

Four new BASIC commands associated with the function keys are:

1) KEY ASSIGN (string expression) TO PF(n) associates a string with key n.
2) KEY LIST prints key definitions on the CRT.
3) KEY SAVE (filename) saves all key assignments in the designated file.
4) KEY LOAD (filename) fetch all key assignments from the designated file.

The keys have initial assignments that include RUN, EDIT, PRINT etc.

TECHNICAL DATA

CPU	8085A, 2MHz
Memory	32K bytes dynamic, 2K bytes static (CRT), 2K PROM
Keyboard	95 Keys
Screen	12", 24 lines x 80 characters
Casette	N/A
Disc Drives	Twin 5" discs, single density
Printer	N/A
Bus	N/A
Ports	3 RS-232C serial ports
System Software	CP/M
Language	BASIC, 8080 Assembler

In addition to the CP/M Microsoft BASIC disc accessing commands there are several commands that allow the user to have greater control over disc accesses. DSKI$ (D,T,S) reads a string from disc D, track T, sector S while DSKO$ D,T,S(string expression) writes the string expression to the stated sector. For all other accesses the file directory must be in memory. This is achieved by MOUNTing the disc. Before changing discs the first one should be REMOVEd in order to update the disc directory. Files and discs can be SET to provide write protection or read after write checks, while the ATTR$ function returns the current attributes of a file or disc. The DSKF function returns the number of free groups (1 group=8 sectors) on a disc.

The 3 RS232C ports can be accessed directly in BASIC by using PRINT%, PRINT% USING, INPUT%, LINE INPUT%, INIT%, INPUT$ and PORT with appropriate port number. CSRLIN returns the line number of the cursor while LOCATE positions the cursor. FLP$ is used to set the display to normal, blink, highlight, reverse or underline. Unfortunately there is nothing in BASIC for setting up or using the keyboard editing keys.

With the CP/M disc loaded in the top drive, CP/M rather than BASIC, comes up. Panasonic CP/M is a fairly standard minimal system. Minor differences include not implementing MOVCPM (The CP/M system can only be moved into memory by using SYSGEN), enhancing the STAT command and adding a command RSMODE. There are three possible logical peripherals (paper tape reader, paper tape punch and printer) that can be assigned to an RS232 port and STAT enables the user to enquire about what device is attached to each port as well as to alter the attachment. RSMODE allows the user to change information such as parity, character length etc of any of the RS232 ports. Although Digital Research expanded CP/M to allow for easy interface with the RS232 ports, no account was taken of any of the special keys on the console keyboard.

Potential

In small business terms the most useful, non-standard hardware features are the cursor control and programmable function and editing keys. Accompanied by suitably configured software, these can provide an ideal turnkey business computer making powerful editing facilities and entire programs available to an unskilled operator at the touch of a single key. Likewise, a development system could be streamlined by associating system commands with individual keys. Perhaps after general release, some software house will undertake the development of a CP/M implementation which is configured to exploit this powerful and convenient option.

The Panasonic BASIC has some unusual features for business software. Both the extra disc handling features and the easy to use function keys should allow for straightforward development of BASIC business systems that are easier to use and more secure than systems developed in standard Microsoft BASIC.

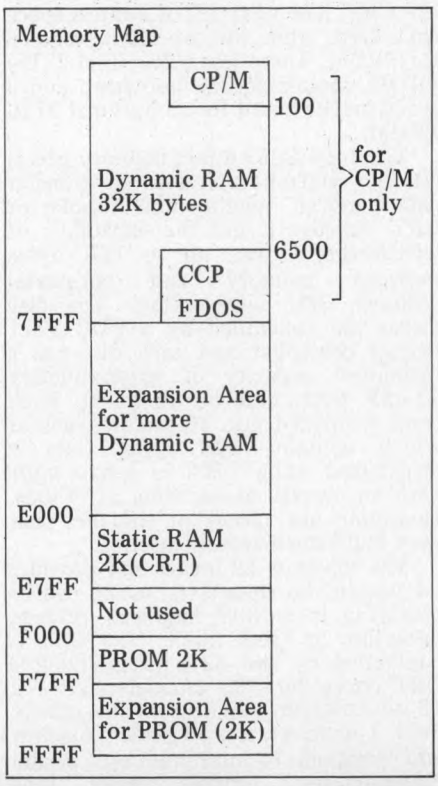
A close look at the Panasonic's comprehensive keyboard. Opposite: when scrolling, the characteristic high screen persistence causes severe "ghosting" of the image.

Looking at the hardware, I think Panasonic are aiming at the word processing market. The special keys, neat appearance, ease of use and RS232 ports make it a nice word processor of word processing terminal in a network, always provided the software is forthcoming.

As a machine for educational purposes the Panasonic has its advantages. In its favour is its compact form and robust casing. It should survive frequent changes in location and much battering. Also having CP/M as its operating system means that the full range of CP/M system software is available.

Against these advantages should be balanced the price, lack of graphics and slow speed. In these times of educational cutbacks it is unlikely that the desirable features of the Panasonic are worth the money. Graphical techniques are useful in both CAL and the teaching of programming, while the benchmarks show that there are faster BASIC systems for users who want to use a machine for data logging or number crunching.

An expensive machine without graphics capabilities with delayed screen



clearing does not have a bright future in the games market.

Expansion

The Panasonic JD range of personal computers is not designed for expansion. There are three serial ports that can be used to add printers and modems or to turn their personal computer into an intelligent terminal of a larger system.

Rather than designing a computer that can be expanded, Panasonic decided to produce a range of similar computers. The review machine was the smallest in this range and the only one that does not come with 56K of RAM as standard. A memory expansion kit should be available soon. The second machine in the range called the JD-740 is similar to the JD-700 except that it has double density, double sided disc (580K bytes capacity). The JD-800 comes with 8" single density single sided discs (512K bytes capacity) while the current top of the range has double density double sided full size discs (2 megabyte capacity). Panasonic are expected to announce a hard disc 900 series computer.

The design philosophy for the hardware fortunately does not carry over to the software. Since Panasonic have put CP/M on their system, the full range of system and application software available under CP/M can be implemented on the Panasonic range of personal computers. CAP Microcobol should be available soon after the launch.

Documentation

Manuals for CP/M, BASIC and technical information were provided with the computer. The standard CP/M manuals are incorporated within the Panasonic CP/M manual as chapters, preceded by a chapter entitled 'A guide to Panasonic CP/M'. This first chapter contains an overview of the system and details of any deviations that Panasonic CP/M exhibits compared with standard CP/M. Altering the rest of the chapters in the appropriate places to include this material would have been a preferable approach. Whereas I've not previously had difficulty locating specific details when using the original collection of CP/M manuals, I found using the single Panasonic manual awkward. Page numbers start from 1 in each chapter and though there is a brief table of contents (useful for finding the order of the chapters but not much more), there is no index.

The BASIC reference manual, an improvement over the CP/M one, is Microsoft's standard manual with additions interspersed for the special Panasonic language features. Unfortunately the detailed table of contents lacks page numbers but there is a good index.

The third manual, calles "OEM Manual JD-700", is written in fairly poor (but understandable) English by Panasonic. It aims to describe the hardware components down to chip level for maintenance and customization purposes. Sufficient information including diagrams and tables is provided for altering such system attributes as screen format or block size for data transfers. Full instruction sets are included for the 8085 and the programmable controllers. The manual is paginated and has an adequate table of contents.

As the cost of getting manuals decently translated, paginated and indexed must be minor compared with that of hardware development, I can only assume that manufacturers underestimate the importance of well presented, easy to use documentation.

PRICES
JD 700 32K £3985
JD 700 56K £4125
JD 740 56K £4500
JD 800 56K £4750
JD 840 56K £5500
The memory expansion kit for the 32K JD 700 is not yet available.

Conclusion

The Panasonic JD 700 is a well designed self contained small business computer and, although much attention has gone into the hardware, the same cannot be said of the software. With CP/M for its operating system, a large range of system and application programs can be transferred to it, but prior to the machine's general release they haven't been put on. As it stands, the user has the choice of either CP/M or Microsoft BASIC. Although the hardware seems most suitable, the software has not been set up for screen editing. However, because the machine is attractive, compact, robust and convenient without much software it will probably end up as the basis for a variety of turnkey business systems where its uncompetitive price can perhaps be disguised in the overall cost.

At a glance

FIRST IMPRESSIONS	
Looks	****
Setting Up	****
Ease of Use	****
HIGH LEVEL LANGUAGES	
BASIC	****
COBOL	N/A
FORTRAN	N/A
PASCAL	N/A
System Software	***
PACKAGES	
Business	****
Education	N/A
Home	N/A
PERFORMANCE	
Processor	***
Cassette	N/A
Disc	***
Peripherals	N/A
EXPANDIBILITY	
Memory	***
Cassette	N/A
Discs	N/A
Bus	N/A
COMPATIBILITY	
Hardware	**
Software	****
DOCUMENTATION	**
VALUE FOR MONEY	**

*****	excellent
****	v. good
***	good
**	fair
*	poor

Benchmarks	
1	2.8
2	9.1
3	24.6
4	24.7
5	26.2
6	43.9
7	69.7
8	11.8

Disc tests	
1	1.7
2	45.8
3	42.1
4	44.1
5	40.4

VIVA LAS VEGAS!

Where is the future in microcomputing? Julian Allason of Petsoft reports on a voyage of discovery that led him, via the giant Consumer Electronics Fair in Las Vegas, to the dustbins and back yards of Palo Alto

Holding the Consumer Electronics Fair in Las Vegas must have seemed like a good idea at the time. Four days later as 55,000 excited electronics retailers flew off home, Las Vegans were less sure. In Mob circles enquiries were said to be afoot into just whose bright idea it had been to invite so many computer experts into the casinos in the first place.

Nevada's fledgling anti-noise lobby found themselves in some disarray also. Vegas is hardly a haven of peace and tranquility at the best of times, but the CES had raised noise pollution to astonishing new levels.

Not all of the din was man-made. Visitors to the cavernously vast convention centre were assailed by the uninflected babble of myriad synthetic voices.

It has to be admitted that whilst artificial speech is perfectly comprehensible, the present level of development leaves a good deal to be desired from an aesthetic point of view. Quasar's talking calculator was described as resembling a dalek with a Swedish accent. Not surprisingly Texas Instrument's Language Translator had a certain cowboy drawl, the voice patterns having been modelled on those of a Dallas disc jockey.

The Translator is rather impressive, pronouncing and displaying over three hundred phrases and 3,000 words in Spanish, French, German and English, according to which module is plugged in. The handheld device is now on sale in the United States at $300 including earplug and mains adaptor. Sharp's talking calculator had speech recognition as well, responding to twenty-two words and three different voices.

Randy Robots

A passing robot motioned towards Sanyo's talkative calculator and confided that it had once been out with one of them; "All talk and no action." it complained.

It seems that just about everything will be having its say in the not too distant future. One company had a refrigerator which noisily advised against "snacking" after midnight. Even the normally sedate Toshiba showed voice-activated hi-fi.

The distinguished software consultant Gregory Yob described his nightmare of pulling up at a red light and having the car stereo argue with the instrument console. When Windert Inc. release their $99 talking watch, no doubt it will join in too.

Peripheral Paradise

Surprisingly it was in computer corner that visitors gained a brief respite from the clamour of synthetic voices. Relative peace reigned as Apple demonstrated their new Graphics Tablet. A shape traced on the 11″ x 11″ Mylar overlay is converted to digital values and the image displayed on the Apple's video monitor. It can also be stored on disc for later processing.

Resolution was 167 points to the inch and scaling user selectable. A reducer function allowed the composition of quite detailed figures. Other functions could be activated by touching a number of menu boxes at the top of the tablet. I found the system surprisingly fast considering that the control program and functions are written in BASIC.

The Graphics Tablet is to retail at $795 complete with interface card, connecting cable, ROM firmware and software on disc. Minimum system requirements are 48K of RAM, Applesoft BASIC and disk II.

And cheap too

A much less expensive accessory was the Presto Digitizer which enables PET, Apple, and Atari computers to recognize hand printed letters and graphics characters. Developed by Dr. David Thornburg of Innovision Inc., the digitizer consists of a copper tablet divided into seven oblong shapes. As each character is inscribed on the surface the stylus passes over them in a different order. The handwritten characters are converted to digital values and passed to the screen where they appear as alphanumeric or graphics characters. U.K. release of the Presto Digitizer is imminent and retail price is expected to be around the £40 mark.

Hot Computers

Considerable trade interest was expressed in Ohio Scientific's Challenger 4P colour computer. For a remarkable $698 American customers are being offered a cassette based system with 8K BASIC in ROM and 8K bytes of RAM to plug into their TV sets. The 4P I saw featured 16 colours in both alphabetics and graphics, 32 rows by 64 columns of upper and lower case with an effective screen resolution of 256 x 512 points.

For prospective British purchasers the hook, as ever, is that the computer has been designed around the American 525 line NTSC colour TV system. An Ohio salesman claimed that the company had a 625-line PAL version in the works. In this connection it is perhaps worth noting that neither Texas nor Atari have succeeded in bringing out

European versions at time of writing, and Ohio may encounter similar difficulties.

Needless to say the Challenger 4P has a 200-20KHz programmable tone generator for voice (and music) generation. The provision for I/O is generous, including as it does two 10-keypad interfaces, two 8-axis joystick interfaces, a printer interface (which was not wired to a connector), and an AC remote control interface. Expansion up into 32K of RAM and two mini floppy drives is allowed for. The speed was impressive and claimed at three times that of the Tandy TRS-80.

HP Source

The real blockbuster was the launch of Hewlett Packard's desk top micro — the HP 85. This ultra compact computer incorporates a 5″ 32 column by 16 line screen matching thermal printer and a tape cartridge drive. The whole package weighed no more than 20lbs and measured a modest 18x6½x16½ inches, approximately.

Hewlett Packard will probably not be thanked for introducing a new tape format. However, the cartridges store up to 195K bytes of program or 210 of data which may be accessed and loaded at "high speed" via a tape directory. In practice it took nearly half a minute to locate and load a 2K program. However, floppy discs and other peripherals are promised for the future.

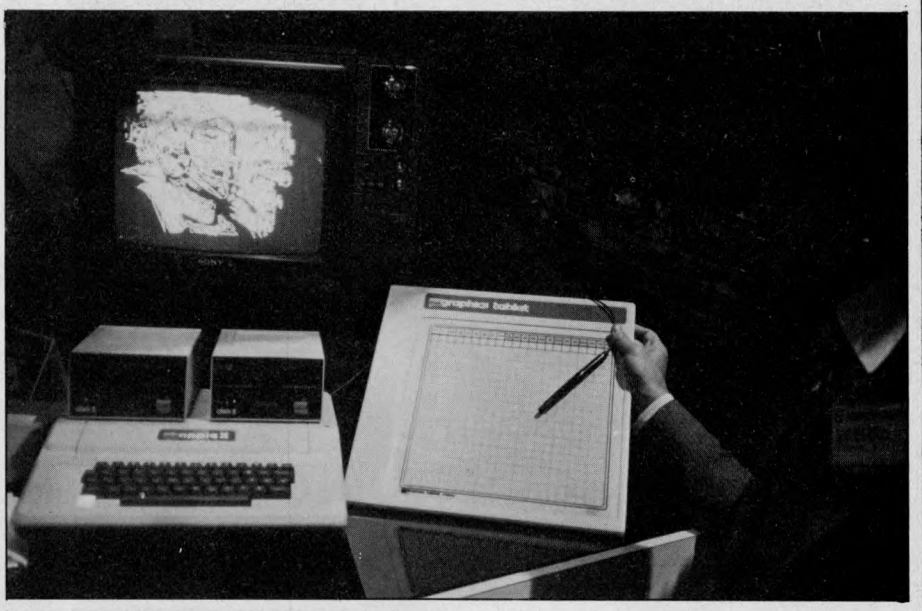
For a hefty £1950 you get a system based on H P's own 8-bit CPU, with 16K bytes of RAM, expandable to 32K. Cartridges retail at £9 each. As might be expected from Hewlett Packard the BASIC is fast and very extensive with 42 predefined functions and 12-digit accuracy. Notable were the flexible high resolution graphics handling and a useful software security feature capable of protecting programs and data from listing, editing or copying. In graphics mode 256 x 192 points can be addressed on the screen or printer. Two buffers store last text and last graphics displays making it possible to switch between the two without loss of data. This is a *very* carefully thought-out computer. Biggest minus is that assembly language programming is not possible. A new PET it is not.

Peek~a~Boo

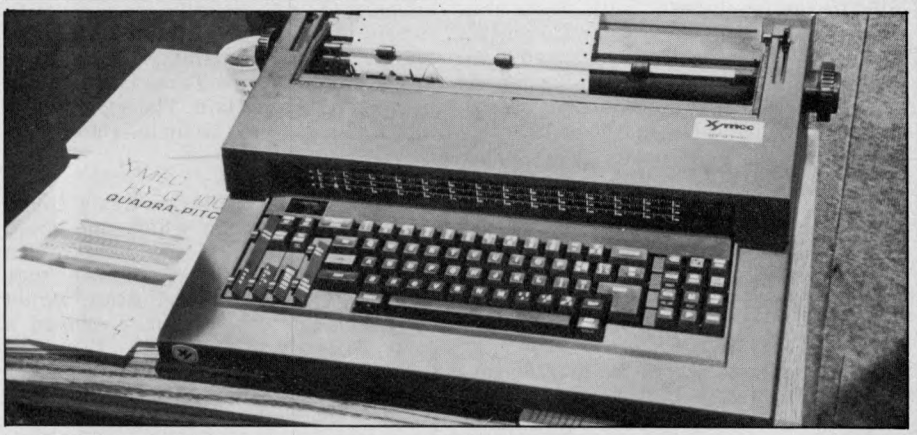
Most of the other microcomputer manufacturers maintained surprisingly low profiles, Tandy to the point of invisibility. Commodore teased everyone with a 'now-you-see-it, now-you-don't' display of its superb new large screen model. Already dubbed the 'Super-PET' by PRINTOUT magazine, it has a 12″ 80 column screen and an improved BASIC. Although no formal announcement was made, dealers seemed confident that the new range would at the very least maintain Commodore's global number two position.

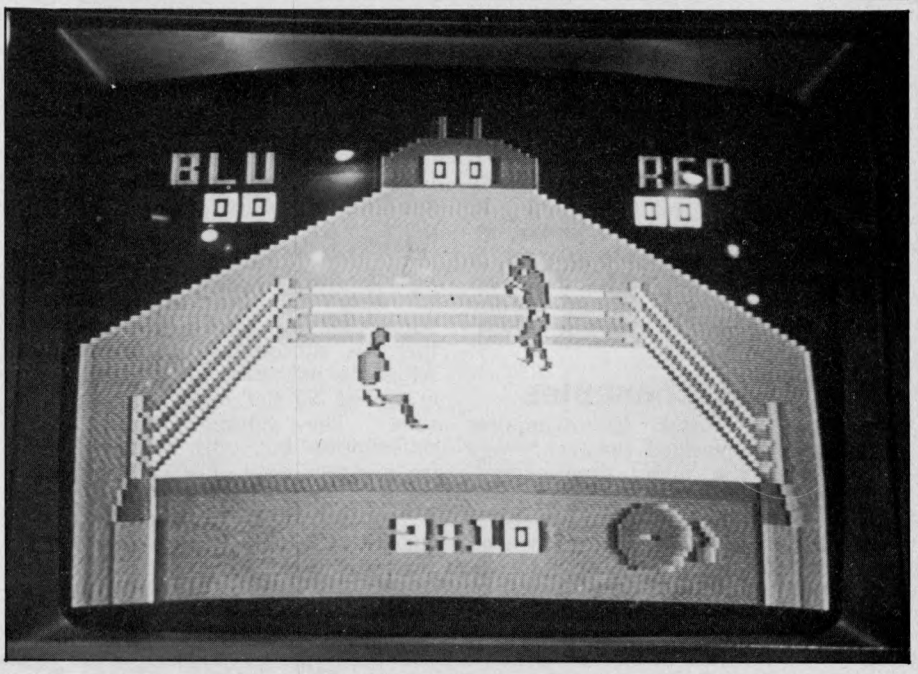
With the remaining micro houses like TI and Atari showing only new disc drives and modems for introduction at 'some time in 1980' the silence was deafening.

The impression conveyed to dealers was that the era of hyperactive development was over. The market was now safely in the hands of the big boys, with



Above: Apple's new Graphics Tablet — fast response and useful facilities. Left. Julian and friend! Below: Xymec printer — prettiest peripheral, but is it really an Olivetti? Bottom: Boxing clever with Mattel — best colour graphics yet.





Left: Commodore's acoustic modem will let PETs converse over long distance telephone. Below: Common Sense security system — PET monitors alarm and displays security zones on screen.

most of the pioneers gone to the wall. From now on, the argument ran, controlled marketing strategy would be the order of the day. These at least were the conclusions reached by many CES visitors as they played the slot machines in the airpost departure lounge.

Palo Alto Pilgrimage

If such really was the case, then it was a mighty reversal indeed. Both Apple and TRS-80 were born in garages. Could the situation really have changed so radically in two and a half years? A quick visit to the backyards and garages of Silicon Valley seemed called for.

Almost all of the innovators of the microcomputer world have outposts in that narrow spur of land which protects San Francisco from the Pacific Ocean. Five days on the peninsula convinced me that the era of rapid development is far from over.

Super Stringy

Developments to watch for include the Stringy Floppy, a budget priced high speed data storage system that will make the cassette drive obsolete. Using inexpensive tape 'wafers' like a miniature cartridge, which can store up to 150K bytes, the Stringy Floppy is as reliable as mini-floppy disc, nearly as fast, and a third the price. Manufactured by Exation Inc., a version configured for the SWTPC 6800 is already on sale, and I was shown a prototype running on the PET at an independent laboratory. With Microsoft developing a specially extended BASIC to handle data files and fast access, the Stringy Floppy looks set to make a major breakthrough.

Look Ma, no phonemes

One of the major Microcomputer manufacturers revealed the technology it currently has under development. Inevitably, one of the projects related to speech synthesis, in this case, of a somewhat higher order than had been demonstrated in Las Vegas. As each key on the keyboard was depressed it identified itself orally. For those who desire never to have to study phonetics the system is a revelation. Words typed on the screen in normal English are rendered into clear inflected English.

This is achieved by referencing each word entered to a disc based dictionary of some 700 oft-used words. Instructions are then given to the synthesiser to enable it to generate the correct phonemes. If the word entered is not found in the dictionary it is enunciated phonetically according to certain key rules of pronunciation. This phoneme programmability approach is in direct contrast to Texas Instrument's digital storage method. The advantage is that it allows words to be inflected.

Tender Touch

Another prototype device was a touch sensitive screen upon which one could draw using a finger. It would also return the X, Y co-ordinates of the spot touched. One useful application would be direct menu selection. I played a game of touch Tic Tac Toe and promptly lost to the computer.

Throughout the visit to the Bay Area, I was asked: "Are you on the Source?" At first I took the reference to be to one of the quasi-religious California cults which spring up every few weeks. The Source turned out to be one of the two major communications networks now linking microcomputer users throughout the U.S. with large mainframe computers and with each other.

More Source

For the astonishingly low hook-up fee of only $9 the other network, MicroNET, will grant a microcomputer user his subscription to the system. After this once-only charge, access costs a modest $5 per hour for connection time. The Source has a $100 subscription but only $2.75 an hour for connect time. The only accessory required is a standard 300 baud modem.

MicroNET has local rate telephone charges from major cities and reduced charges from over 100 others. Subscribers get 128K bytes of free storage on the mainframe and can use the system during the off peak hours of 6pm to 5am and all day weekends and holidays.

The microcomputer owner can use the powerful mainframe processors in BASIC, Fortran, Pascal, APL and a number of other languages. The software includes personal, business, educational and games programs, including networking multi-player games. Software can also be purchased and down loaded to your personal computer. All charges are debited directly to the subscribers credit card account.

Micromail

Perhaps the greatest potential lies in the field of electronic mail. MicroNET subscribers can send messages or software to other users. Tom Williams, editor of the Intelligent Machines Journal, told me that he is already receiving stories via The Source. A UFO reporting service is also operating.

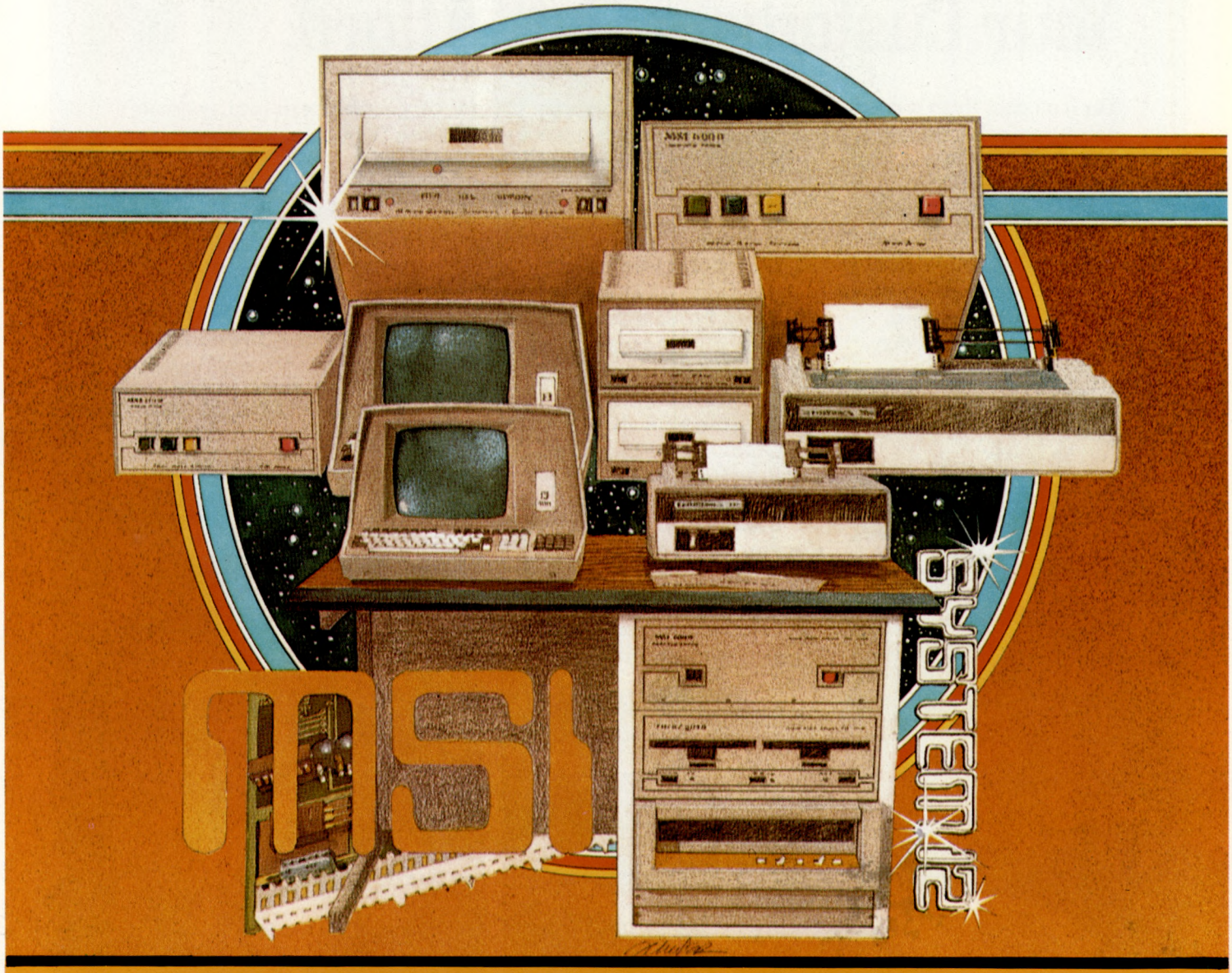
Source subscribers also have a nationwide toll-free computer based answering system available to them. They can send or receive electronic mail messages when a terminal is not available. Users simply dial a toll-free number from anywhere within the U.S. and dictate 'Voicegram' messages over the telephone. These can be retrieved from any terminal, communicating word processor or microcomputer, using one of these communications networks.

Voicegrams can be up to 100 words long and are forwarded within an average of 15 minutes for a cost of $1.25 plus the normal connect time charge.

The Future

The sudden arrival of electronic mail has produced some amusing side effects. The U.S. Post Office is currently locked in litigation with the Federal Communications Commission in a battle for jurisdiction. While the bureaucrats squabble the networks grow. Micro-networking is an idea whose time has come. Now it is just a matter of time before it makes a satellite assisted leap across the Atlantic.

All Systems Are Not Created Equal



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WHISTLE UP A COLOUR ON YOUR APPLE II/ITT 2020

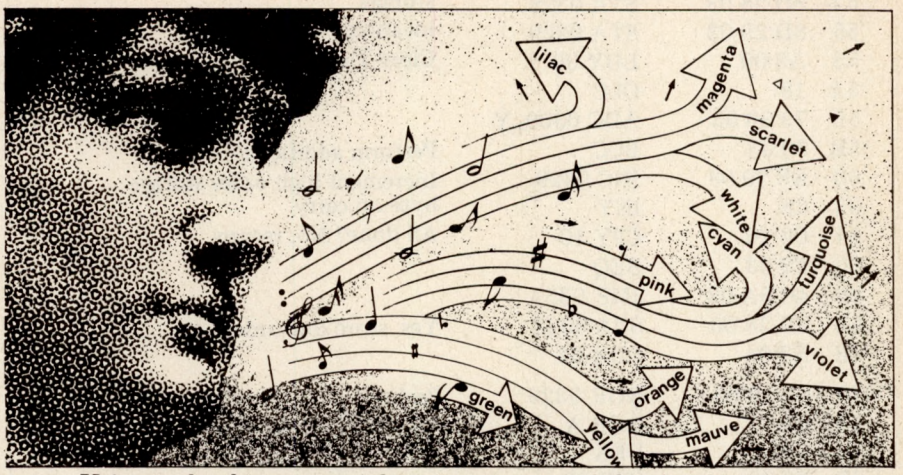

Illustration by N. E. One

Using only the cassette data input port of the Apple system (plus a microphone/pre-amp.) the software described here provides a technique to generate effects or alter program direction as a result of the user whistling at different frequencies. R. W. Lawrence BSc explains. . .

Cassette input port

Unlike some microcomputer systems available at present which allow the transfer of data to and from a cassette recorder, the Apple II and ITT 2020 depend virtually entirely on software for analysing the output from the cassette when reading data, and generating a suitable signal for it when writing data. This means that the data is available to the processor in virtually the same form as it is recorded on the tape, with only a Schmitt in between to "clean" it up a bit; it's not buffered off from it by a p.l.l. or frequency comparator. This means that one can perform various functions on the signal fed into the data input (which of course, doesn't necessarily have to have come from a cassette recorder. This is, however, probably the best way to start as it will already be hooked up).

Period measurement

By deriving a means to measure the frequency or period at this point, the value obtained can be used by other programs for control or effect . . . or anything else.

In this case the result determines the colour of a pattern displayed in the lo. res. graphics mode. The number of other applications of the technique are only limited by the user's imagination.

Whistling is chosen as the best input (when using a microphone) as it gives a purer waveform than, for instance, voice input. Hence results are more reliable (see later, however).

Software

The technique produces a number proportional to the period of the incoming signal by starting a counter at a 1 to 0 transition and stopping it as soon as a 0 to 1 transition is encountered.

One sample of the period measurement would probably do on its own if the signal to be measured were clean (a pure sinewave or squarewave for example), but there are bound to be various discontinuities or extraneous noises involved too and these will almost inevitably cause errors.

To get round these problems not just one, but sixteen samples are taken and the results stored in memory.

Averaging

In the next stage all the sixteen samples are added together, the result being stored in memory (two bytes). This value is then divided by sixteen to yield the average value of all the samples. This has a far greater chance of being representative of the actual period than the value obtained from a single measurement.

Initially this part of the program was done in BASIC with only the period measurements in machine code; but the BASIC section proved too slow for most applications and so the averaging is now included in the machine code section.

The sixteen samples are stored in memory locations 0300-030F. Locations 0310-0325 contain the subroutine which actually carries out the period measurement, whilst locations 0350-037F is the averaging program. The control program (0330-0348) calls up the above two subroutines, and also determines the number of samples to be taken and where they are stored.

Locations 0328 and 0329 hold the low and high order bytes of the sum of the samples, and the final average value is stored in location 038F. This can be examined when in BASIC by PEEKing (911).

Source code

The programs are fairly self-explanatory. The division by sixteen is performed by a right shift operation done four times, from location 0329 through the accumulator. Since none of the period samples taken could be greater than 225_{10}, it follows that the average must be less than this too — hence the result must fit into the accumulator.

Basic program

This program puts the colour display up on the screen, and after calling up the machine code program, varies the colour of the display depending on the

```
Listing
0300
  01
  02                                  Storage locations
  03                                  for period measurements
  04
  |
  |
  OF  A
0310  A9 01     LDA 01                Initialise flags and counter
  12  A2 00     LDX 00
  14  2C 60 C0  BITC060
  17  30 FB     BMI                   Zero yet? No, test again
  19  E8        INX                   Yes: Increment X
  1A  2C 60 C0  BIT C060              One yet? No? Go back and
                                      inc. X
  1D  30 03     BMI                   Yes: Go on
  1F  4C 19 03  JMP 0319
  22  8A        TXA                   Transfer X to A and store
  23  91 FA     STA (FA), Y           final count in relevant
  25  60        RTS                   location. Return.

0330  A9 00     LDA 00
  32  85 FA     STA                   Set up pointer
  34  A9 03     LDA 03
  36  85 FB     STA
```

```
  38  A0 00        LDY 00          Zero counter for no. of
                                   samples
  3A  20 10 03     JSR 0310        Call subr. for period measurement
  3D  C8           INCY
  3E  C0 10        CPY 10          16(10) samples taken yet?
  40  F0 03        BEQ             No, repeat. Yes, finished.
  42  FC 2A 03     JMP 033A
  45  20 50 03     JSR 0350        Call averaging subr.
0348  60           RTS             Return to Basic prog.

0350  A9 00        LDA 00          Clear
  52  8D 28 03     STA 0328        storage
  55  8D 29 03     STA 0329        locations.
  58  A0 00        LDY 00          Clear Y reg.
  5A  18           CLC
  5B  79 00 03     ADC 0300, Y
  5E  90 03        BCC             Perform additions
  60  EE 29 03     INC 0329        Increment high order storage
  63  C8           INY             byte on carry
  64  C0 10        CPY 10          All done? No, return
  66  F0 03        BEQ
  68  4C 5A 03     JMP 035A
  6B  8D 28 03     STA 0328        Yes, store low order byte
  6E  A2 04        LDX 04

0370  6E 29 03     ROR 0329        Perform ÷ 16(10) process by 4
  73  6A           ROR A           right shift operations
  74  CA           DEX             through accumulator
  75  E0 00        CPX 00
  77  F0 03        BEQ             4 completed? No, return
  79  4C 70 03     JMP 0370
  7C  7D 8F 03     STA 038F        Yes, store result
  7F  60           RTS             Return
```

Basic program listing

```
200  GR
205  CALL 816: W = PEEK (911)
220  IF W < 11  THEN W = 11
230  IF W > 110 THEN W = 110
240  COLOR = INT ((W — 3)/108 * 15)
242  R = RND(1): IF R> 0.5 GOTO 245
243  FOR N=1 TO 19 STEP 2: HLIN(20—N), (20+N) AT
     (20+N): VLIN(20—N), (20+N) AT (20+N): HLIN (20—N),
     (20+N) AT (20—N): VLIN(20—N), (20+N) AT (20—N)
     : NEXT
244  GOTO 205
245  FOR N = 19 TO 1 STEP —2: HLIN (20—N), (20+N)
     AT (20+N): VLIN(20—N), (20+N) AT (20+N): HLIN
     (20—N), (20+N) AT (20—N): VLIN(20—N), (20+N)
     AT (20—N): NEXT
250  GOTO 205
```

Generator listing in M/C code

```
038F                                 Location for pitch data
0390  A9 08        LDA 08           Load A with duration
  92  8D 30 C0     STA C030         Toggle Speaker
  95  88           DEY
  96  D0 04        BNE              Decrement X until zero and
  98  E9 01        SBC 01           toggle speaker each time
  9A  F0 11        BEQ              round. Decrement Y too, but
  9C  CA           DEX              only decrement A by 1 after
  9D  D0 F6        BNE              255(10) Y decrements.
  9F  AE 8F 03     LDX 038F
  A2  48           PHA              Variable delay in pitch loop
  A3  A9 03        LDA 03           to tune final o/p frequ. to
  A5  E9 01        SBC 01           match that coming in
  A7  D0 FC        BNE
  A9  68           PLA
  AA  4C 92 03     JMP 0392
  AD  4C 30 03     JMP 0330         Back to main prog.
```

frequency of the incoming signal.

The system assumes the signal has a frequency range from about 400Hz to about 2KHz, this being considered a reasonable range to whistle over. Any measurement yielding values that are outside this preset range are "clipped" into it by lines 220 and 230. Line 240 normalises the measurement into an integer between 1 and 15: ready to set the colour of the pattern to one of the fifteen possible on the system.

Line 242 makes the display slightly more interesting by randomly selecting the "tunnel in" (line 245), or the "tunnel out" (line 243) subroutine. These two subroutines change the colour of about ten concentric squares, the only difference between them being the STEP value which selects motion inwards if —2, and outwards is +2.

Looping

As it stands, the processor remains in a loop in the machine code program awaiting any input to the cassette input port. Whilst in this loop it cannot accept data entered from the keyboard — or anywhere else — only, in fact, from the cassette input. Control can be returned to the keyboard via the usual RESET; control C. If desired this can be remedied by putting in a "look at keyboard to see if the key has been depressed" type of programme between lines 0314 and 0317, and jumping out of the loop if it has. This was omitted to keep the number of machine cycles within the loop to a minimum and thus allow the highest possible frequencies to be measured.

Other applications

The technique has been used successfully in other applications (the one described here was really by way of an example) such as in a software frequency of the incoming signal against time; and, if suitably modified, in speech analysis and synthesis.

A reciprocal machine code program could be added. This would form a generator (using the internal speaker) producing tones of the same frequency as those measured by the above arrangement when presented with the same data. Thus the Apple could "whistle" along with you — albeit rather roughly as it would have to stop every so often to see what you're whistling.

A suitable machine code generator program is also given. It's a modified form of the one listed in the Apple II Reference manual, except that the duration is preset (byte in location 0391) and also a "tuning" factor is added to make sure it "whistles" what it "hears" (using the terms euphemistically). Lines 03A2 — 03A9 perform the latter. Increase the value at 03A4 to flatten the generated frequency for a given input, and reduce it to sharpen the generated frequency.

Linking up

The generator program can be linked in to the analyser program as follows: Line 0348 changes from 60 (RTS) to:
0348 4C 90 03 (JMP 0390).

P.S: If you can't whistle, you'll just have to learn to hum sinusoidally.

Personal Computer World

Here follows, a sectionalised breakdown of the contents of the earlier editions of Personal Computer World magazine — from Volume 1, Number 1 through to and including Volume 2, number 4.

Next month we shall list all the remaining editions in the 2nd Volume. From then on we shall be publishing a list, cumulative issue by issue, for our current 3rd Volume. *Please Note: The following issues of PCW have completely sold out: Volume 1 Nos.4, 5, 9 & 12.*

Any one issue 70p; Any two issues £1.20; Any three issues £1.60; Any four issues £2.00. All additional issues @ 40p each. Binders @ 2.95. All prices include post and packing. Cheque or P.O. payable to Sportscene Publishers Ltd., 14 Rathbone Place, London W1P 1DE. Please allow up to 3 weeks for delivery and don't forget to state clearly your name and full address with your order.
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COMPUTER ANSWERS

Each month Sheridan Williams and his panel of consultants answer readers questions. Topics may be hardware — from kits to mainframes, or software — from differential equations and statistics to file handling or sorting; the choice is yours. Send your questions direct to Sheridan Williams at 35 St Julians Road, St. Albans Herts.

Either/or

I am presently trying to decide which of two computers to purchase, either the Apple II or the Compucolor II.

As you most probably will already have realised, I am looking for a computer with good colour graphics and a good information store (floppy system). Could I have a list of pros and cons on both computers?

Do you know if Apple is working on a Mk III and when it will be released? And, finally, could you please tell me the difference between the Apple II and the ITT 2020?
Mr. M Randall, Bury St. Edmunds, Suffolk.

As you imply, when choosing between the Apple II and the Compucolor II it's very much a question of pros and cons rather than a "best buy". The balance is going to depend on which features are of most importance to you.

As you already know, Apple II and Compucolor II are the only two real contenders in their class for colour graphics. Both also aim at being general purpose microcomputers, and both have floppy disc drives available.

So how to choose between them? That, I think depends on where you wish to place the emphasis — colour graphics, or general purpose computing ability. Look at some of the differences between the two machines:

Once you have added a disc drive to Apple you have upwards of 110K bytes on-line, and a flexible system which will let you add other drives. Compucolor comes with a built-in single drive, but it gives less than 52K bytes of storage. A second identical drive can be added, but that's all.

Apple can readily be interfaced to a wide variety of peripherals, not so Compucolor. Apple is about 50% faster. Apple can LIST from one specified line number to another — Compucolor can only do a complete LIST from beginning to end. There is a lot of software available in this country for Apple — not much (as yet anyway) for Compucolor. And there is a surprising range of firmware for Apple — from light pens to speech input and output.

Compucolor displays 32 lines of 64 characters — Apple only 24 lines of 40 characters. Compucolor has consistent colours. There are places on the screen with Apple where a line of a specified colour just does not appear! The trouble seems to be that Apple uses a colour TV set for its display, and the compromises involved with the UK television system are not entirely happy. Compucolor comes with its own built-in colour monitor, and is largely free of these problems.

So there, in my opinion, you have it apart from the fact that for a single drive system with 32K of memory, Compucolor could be up to £200 cheaper. It's all a question of where your preferences lie — if colour graphics is the most important, I'd think long and hard about a Compucolor — if you want versatility, Apple certainly scores. Do try to see both in action before choosing.

The closest we are right now to an Apple III is the Apple II EUROPLUS, and its main difference from the Apple II is an "Autostart" ROM. This enables the computer to start RUNning a program as soon as you turn it on and includes improved edit facilities.

Turning now to the differences between Apple II EUROPLUS and ITT 2020, the extended BASICs (available in ROM) seem to differ mainly in their handling of high resolution graphics. This shows up most with the plot grid which is 280 x 192 on the Apple, but 360 x 192 on the 2020. While a plot of, say, 50 x 50 on the Apple is square, on the 2020 it's a rectangle. The colours on the 2020 are somewhat purer and richer and the machine does not have Autostart, although it will accept an Apple Autostart card. It has, however, overcome the problem of the closeness of the RETURN and RESET keys on the Apple. On the 2020 you have to hold down CONTROL before RESET will work. Costs for the two machines are very similar.

Once again, I would urge you to see the machines in action, side by side, if at all possible.

Apart from the August 1978 review of Apple II in PCW, you will find more on Apple II in the January 1979 issue, and a "Bench Test" of Compucolor II in the September 1979 issue.
P. McIlmoyle.

Vetting a pet

I wish to buy a secondhand PET (no discs or printer but with as much memory as possible). How do I test it to ensure that I am not buying a load of rubbish? The tests would have to be carried out at the current owner's home and should take no more than 30 minutes.

I have used PETs before and found some software bugs I would like to eliminate (e.g. pressing return only, after an INPUT request and the system crashes). Having extensive assembler, operating system and compiler experience, I feel this is within my capabilities. Is there a simple and practical guide to micro hardware for people with only software experience? Also is there anywhere I can obtain listings of the system software and BASIC interpreter?
T. Edwards, Chalfont St. Giles, Bucks.

The Commodore PET is an excellent buy as a "switch on and go" microcomputer, and there is no reason to suppose that a secondhand one will be a waste of money. The critical stage of any electronic equipment is the first few months of its life. Generally, any faults will become apparent during this period. The PET is reasonably trouble free after this term.

There are a number of points to look for when buying a secondhand machine. The cassette drive is the most likely part to give trouble. This can be a simple fault — such as a dirty or poorly aligned tape head — or, more seriously, there may be problems with the power supply. The power supply is not very well regulated on the PET and the earth not very secure, which gives problems reading tapes. Faults of this nature can usually be seen as a wobble on the screen. The easiest way to test the tape unit is to load a few program and data tapes; if they load without error, you can assume it's working correctly. You should check that the RAMs are okay; there are a number of tapes available which will test them and these should be obtainable from any Commodore dealer. It's important that you don't just rely on the FRE(X) function to test the memory as it's not always indicative of a functioning memory.

The external ports are a little more difficult to test. It is possible to check them by "poking" the PIA output registers and measuring the voltage on the output connections, but if you don't intend to add a printer or discs, there's no need to bother.

There *are* a number of bugs in the PET software, some of which are cured by the new ROM machines, but usually it's far better to learn to live with them, rather than overcome them with machine code routines. Remember that BASIC is in ROM and is not easily changeable.

"Looks like PET expansion to me!"

COMPUTER ANSWERS

Incidentally, the one you mention doesn't actually crash the system, it just reverts to BASIC from program control; it's also very easily cured by ensuring that the cursor is positioned over a character (e.g. INPUT "sp sp sp ↖ crl crl crl";X$). Here, sp = space and crl = cursor left.

There are a number of publications, some available from Commodore whch will assist in using the system software for advanced programming, and also for the hardware. A trip to a technical bookshop or a glance through the book suppliers in PCW will be worthwhile as there are a large number of publications available dedicated to the 6502 IC (the microprocessor used in the PET).
Mark Wratten.

Pointing the way

I have a program that will put a straight line through a set of points and allow me to make a prediction based on that straight line. For example, given the population of the world over the last 100 years, I could predict the future population with a fair amount of accuracy. Suppose that the set of points is nowhere near a straight line, what do I do? Is there a way of putting a curve through the given points?
T. Williams, Croydon, Surrey.

Yes, there is, it's called curve fitting, and a curve is put through the set of points so as to give the best fit; it's not an *exact* fit as there will always be a small amount of error. Provided that there are not too many transcription errors, what follows should be useful. Ask someone with at least A level maths to help as it would take many pages to put the following formulae into words. I have replied personally to the writer, but if other people are interested I'll turn this into an article for future publication — please write and let me know. To fit a *straight* line of the form y=ax+b.

$\Sigma y = a\Sigma x + nb$
where n is the number of pairs of points

$\Sigma xy = a\Sigma x^2 + b\Sigma x$
now solve for a,b and c in the equation $y=ax^2+bx+c$

To fit a quadratic you would use
$\Sigma y = a\Sigma x^2 + b\Sigma x + nc$
$\Sigma xy = a\Sigma x^3 + b\Sigma x^2 + c\Sigma x$
$\Sigma x^2 y = a\Sigma x^4 + b\Sigma x^3 + c\Sigma x^2$
now solve for a,b and c in the equation $y=ax^2+bx+c$

You can easily extend this to cubics and quartics etc.

Many sets of points are not suited to a polynomial though, so try this function:

$y = a\,f(x) + b\,g(x)$

Use
$a\Sigma f(x).f(x) + b\Sigma f(x).g(x) = \Sigma y.f(x)$
$a\Sigma f(x).g(x) + b\Sigma g(x).g(x) = \Sigma y.g(x)$

Examples of functions are:
$y=ae^x+be^{-x}$
$y=a \sin x + b \sin x$
putting $f(x)=x$ and $g(x)=1$ will give a straight line fit.

Of course you now have a problem solving the resulting simultaneous equations, but there are many programs around that will do that.
S.W.

UK okay?

I am thinking of buying a UK 101 as a hobby computer. Would you recommend this computer for a "first" and which book on BASIC would you suggest bearing in mind the use to which it would be put?
PCW Reader, Harrow, Middx.

A personal computer can start from a chip set or with a ready to run complete boxed system, plus you can buy in at almost any level in between. It's largely a choice of how many problems you pay the manufacturer to solve, and how many you take on yourself.

Buying a kit solves the vital problems of design and layout, but leaves you the assembly and test work. This size of computer has 1,000 or more soldered joints and they all have to be good. If you can't make a perfect joint almost in your sleep, practise on something much less complex first. When it's all together, double check for components the wrong way round before applying power. The checkout procedure will test each section of the machine and localise any hardware faults. In the unlikely event of an elusive fault, you will have to pay the supplier a small service charge to find and fix it for you. The buoyant state of the kit market suggests that few have trouble with kit assembly.

Complete details of the Compukit UK101 were published in *Practical Electronics*, August-November '79. Its advantage over cheaper kits includes the "industry standard" Microsoft BASIC, a powerful learning and program development tool, and compatibility with proven Ohio Scientific memory expansion and floppy disc for when you outgrow the maximum 8K on board. One of the best introductory BASIC books is *Illustrating BASIC* by Donald Alcock, but once you have learnt your way around the language, you should brush up your programming style with the *Little Book of BASIC Style* by John Nevison or *BASIC with Style* by Nagin / Ledgard.
Len Warner, Kelek Systems Ltd.

PAYROLL

Compiled and edited by Mike Knight of Mike Rose Micros

What is the most important administrative system in your company? Ask that question of any business manager and you will get a variety of answers. Ask that question of an employee and he will almost certainly say "The Payroll"! One of my earliest recollections in the computer industry just over twenty years ago is of a very emotional wages clerk talking to the data processing manager saying: "He (sob) didn't say what was wrong (sob) with his payslip (sob) he just punched me on the nose (howl)!!"

There are some business functions where mistakes can be rectified by actions taken sometimes many months later, Payroll is NOT one of these.

Objectives

The objective of payroll is to pay employees the amount due on time and to meet statutory requirements.

Most people think of payroll as an automatic choice for computerisation. However, bearing in mind my warning illustration above, I think it is one major application which MUST give benefits if it is going to be computerised. What benefits you may ask?

Well firstly payroll has specific deadlines so will it fit in with any other applications which you are either considering or have already implemented on your microcomputer? In many businesses everything has to stop for payroll so you may find that payday means no despatch notes for example.

If you do go ahead will it cost less in time, money or effort than your present system?

Will it provide you with the same information or more than you have at present and will you get this information before you get it now?

Will you be able to get rid of any equipment you use for payroll or will it save you bureau charges? Finally will the system allow for expansion?

Functional requirements

Having determined that payroll will benefit our business we can set down what we would expect from our package.

1 We must be able to create new employee records, amend existing ones (including department transfers) and delete or mark leavers.

2 We must be able to input all variable information on hours worked at various rates together with bonus calculation information.

3 We must produce payslips and we may wish to produce a coinage analysis if cash payments are to be made.

4 We should be able to do all up to gross calculations automatically including bonus calculations.

5 We should be able to do all gross to nett calculations and must be able to calculate Tax and National Insurance.

6 We must be able to analyse both payments and deductions of varying types.

7 We must be able to cater for any variation of pay cycle, particularly weekly and monthly.

8 It should make no difference whether pay is calculated by hourly rates or if salaries are paid.

9 Finally year end requirements should be catered for automatically.

Evaluations

VLASAK PAYROLL

This system was written by Vlasak Electronics Ltd, of Marlow, Bucks (06284 74789) and is available direct from them or from any of their countrywide dealers. The minimum hardware required is a 48K Apple II, two disc drives and a 132 column printer, which costs approximately £3300. The package is written in BASIC (Applesoft) and the cost includes personalisation. If required, customisation would be undertaken and charged according to the amount of work involved. A user manual is provided which gives some systems details and a good explanation of the operation of the system. If the package is purchased together with the hardware then an installation and training service is provided. If any "bugs" were found they would be repaired free but any corruption of either the program disc or data files by misoperation would involve a charge for repair or replacement. Linkages are provided to Vlasak's Sales, Purchase, Nominal and Stock systems.

WISBECH PAYROLL

This package was written by Wisebech Computer Services Ltd., of Wisbech, Cambs (0945 64146) and is based on their successful "WISPAY" system for the IBM 370. It is available from their dealers throughout the country. There are 34 programs within the package written in BASIC and linked by a main menu and six sub-menus. The package is heavily parameterised and as such has not required either personalisation or additional customisation (as yet). It has been available since August 1979 and there are 8 users who pay a quarterly lease dependent on the number of employees. The cost per employee varies from 10p per week up to 50 employees down to 5p per week for over 250 employees. There is an installation and training charge of £50+ expenses and an annual maintenance charge of £100. The charges include an on site installation and training service, automatic updating of both statutory changes and system enhacements, automatic correction of bugs or defects found and a day to day telephone backup service. The minimum hardware required is a 32K North Star Horizon with two discs, VDU and printer and costs £3700. The documentation provided is a user manual which contains both systems and operations information and, although printed on a computer, is supplied in a presentation binder with each page in a plastic "page cover". The content is excellent and I am certain their users have no difficulty in running the system. (If any of the users are reading this article perhaps they would like to write and let us know what they think.)

INTEX PAYROLL-200

This package was written by Intex Datalog Ltd of Stockton-on-Tees, Cleveland (0642 781193) and is designed to run on a 32K PET with dual floppy discs and a printer. The package costs £50 and is supplied with an operating manual which has obviously been produced with the first time user in mind. The illustrations are of the screens the user would see on his VDU and a full explanation is given of every function. A customisation service is provided on request.

Tasks and volumes

TASKS	VLASAK	WISBECH	INTEX	MICROSOLVE	ARMSTRONG	TRIDATA
Create new employee record	*	*	*	*	*	*
Amend existing employee	*	*	*	*	*	*
Delete employee	*	*	*			
Transfer employee		*				
Pay cycle — weekly	*	*	*	*	*	*
— 2 weekly				*		*
— 3 weekly						*
— 4 weekly						*
— monthly	*	*	*	*	*	*
Pay type — hourly	*	*		*	*	*
— weekly	*	*	*	*	*	*
— monthly	*	*	*	*	*	*
Print — payslips	*	*	*	*	*	*
— payment analysis	*	*	*	*	*	*
— NI "		*		*	*	
— Tax "		*		*	*	
— Coinage "	*	*	*	*	*	*
— Employee list	*	*	*			
— Bank "		*				*
— Year end tax returns		*		*		*
— Unused employee numbers						*
Pay means — Cash	*	*	*	*	*	*
— Credit transfer		*				*
— Cheque		*				
Pensions	*	*			*	
Holiday pay		*	*	*		*
Sick pay		*	*	*		
Employee enquiry						*
VOLUMES AND COSTS						
No. of hourly rates	4	15	3	2	1	5
Payment elements	5	15		3		
Deduction elements	5	15		3		5
No. of employees	200/ disc	300/ disc	200	200/ disc	150	400/ disc
Cost of hardware £	3300	3700		2429		3334
software £		lease		400	(200)	218
TOTAL £				2829	4000	3552

MICROSOLVE PAYROLL

This package was written by Microsolve Computer Services Ltd of Edgware, Middlesex (01-951 0218) and is available directly from them. The package consists of ten programs linked by main menu options or called direct by other programs. It is written in Applesoft BASIC and personalisation of the Payslip layout is included in the cost of the package. Customisation is undertaken on request and, to date, users who have taken advantage of this service have paid approximately £100 to £150. The package was first made available in Sep/Oct 1979 and the minimum hardware configuration is a 48K Apple, two disc drives and a printer costing £2429. An on site installation and training service is provided together with a telephone backup included in the cost of the package. Bugs are corrected free of charge and, if the user inadvertently corrupted his data, advice is given to correct the problem. A detailed operating manual is supplied with the system which contains not only the operating instructions but a good overview including contents of files used.

ARMSTRONG PAYROLL

This package was written by Armstrong Computer Services of Telford, Salop (095283 373) and is normally sold as a complete system together with the minimum hardware — 48K Apple II, Apple II disc drive, serial printer and 9" VDU, at a total cost of £4000. This price includes a tailoring service and full support, including an updating service for tax changes. The package may also be bought as standard at £200 without the tailoring service.

TRIDATA PAYROLL

This package was written by Tridata Micros Ltd of Birmingham (021-622 6085) and is available direct from them, from all Tandy stores or from Tridata dealers. The package consists of 15 programs linked via the menu and is written in BASIC. It was first made available in November 1979 and there are 67 users. The minimum hardware is a Tandy TRS 80 with 32K, two disc drives and a printer and costs £3334. The package is supplied with a user instruction manual which gives not only full operating instructions but many helpful hints for the first time user with no computer experience. A telephone backup service is provided for installation but no training is offered currently (no installation problems have yet been encountered). A normal warranty and update service is provided at 15% of the price and there are linkages to the Tridata nominal ledger.

OTHER SYSTEMS KNOWN BUT NOT EVALUATED

Grama-Winter London 01-636 8210
A. J. Harding Bexhill 0424-220391
Computastore Manchester 061-832 4761
Databank Loughborough 0509-217671
Microsense Hemel Hempstead 0442 41191
Commodore London 01-388 5702
Keen Computers Nottingham 0602-583254
Arden Data Processing Leicester 0533-22255
Sumlock Bondain London 01-250 0505
Graffcom Systems Ltd London 01-734 8862
ACT Microcomputer Systems 021-455 8686
Algobel Computers Ltd 021-233 2407
Katanna Management Services Ltd 0245 76127
Landsler Software 01-399 2476
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in single disk and dual disk configurations with
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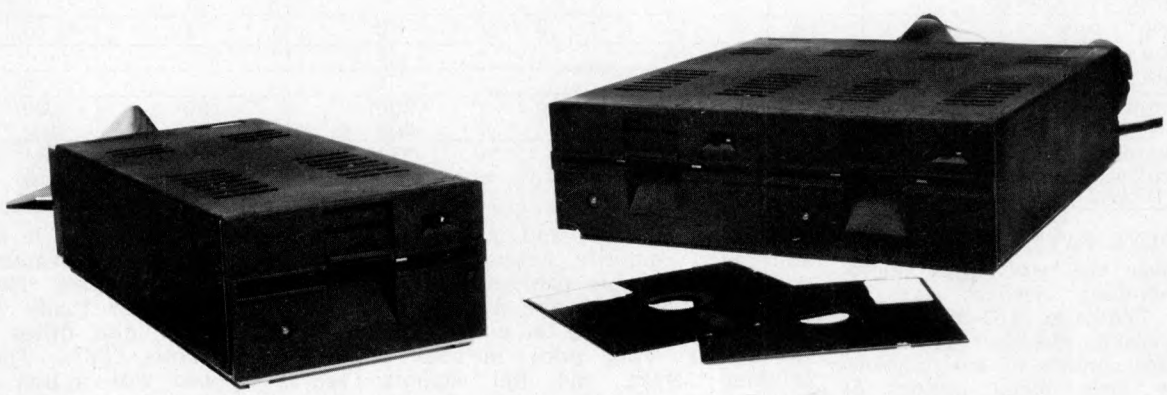

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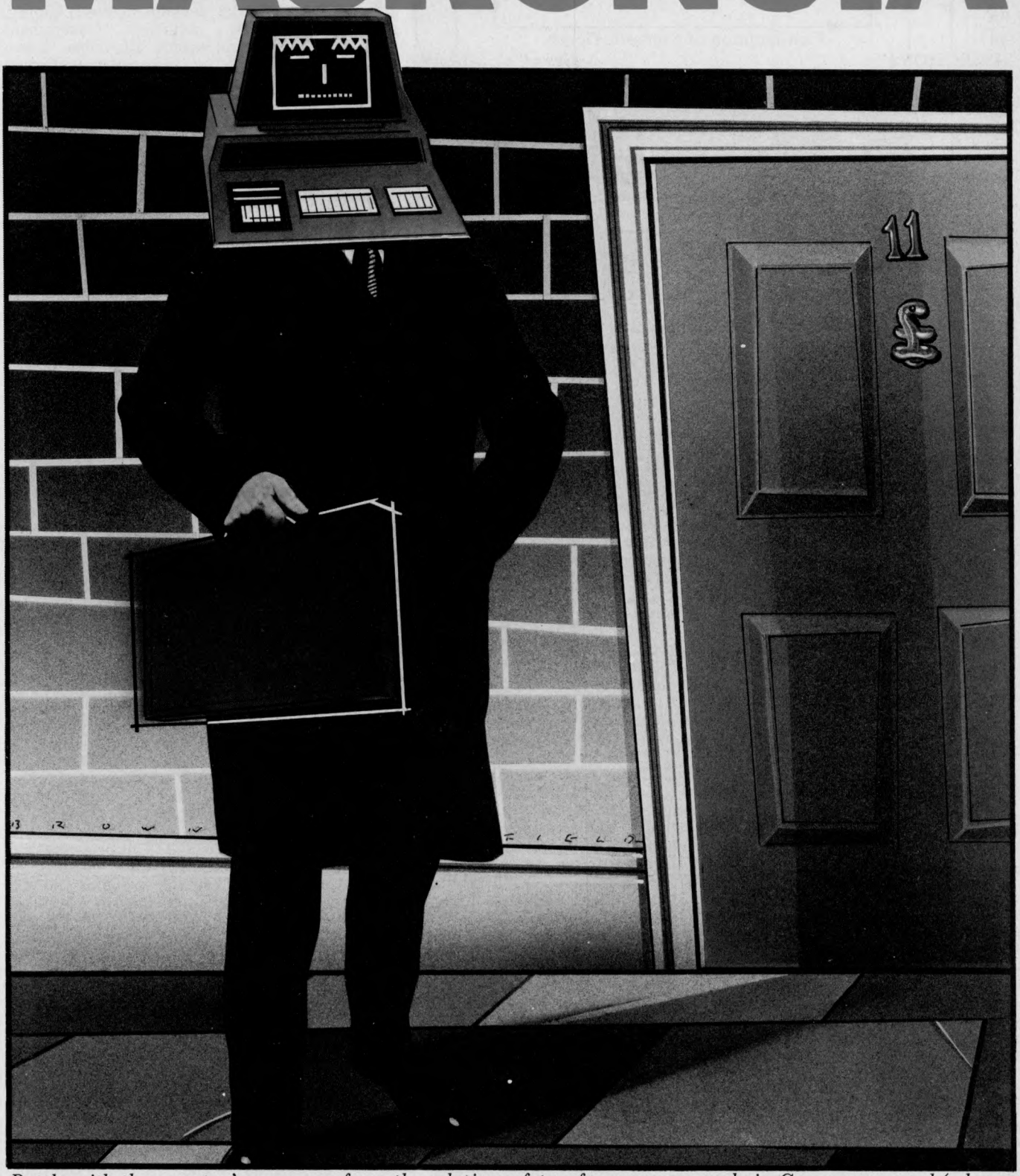


Battle with the country's economy from the relative safety of your own armchair. Can you succeed (where all others seem to be failing) at conquering the evil consequences of our bourgeois capitalist existence? Economist, Graham Addis, sets out the rules . . . the programs are in PET BASIC.

You always did think that you could do better at running the country than the Chancellor of the Exchequer (whatever his political leanings!). Well here's your chance, and the computer lets you have eight years in office to prove it! I've made the model a lot simpler than the real thing, (though it does bear some relationship to the UK economy), so you shouldn't have any difficulty. The trouble is that no two economists can ever agree about how the economy actually works, so the program models two different theories and you can choose the one you prefer. Doubtless economists will argue with the particular set of assumptions built into the models, but then economists always will.

THE KEYNESIAN MODEL.

John Maynard Keynes, the great economist of the 1930s who showed post-war Governments how to solve the problem of unemployment, gives his name to the first model. He taught that the economy is like a bath tub with water (money) flowing in

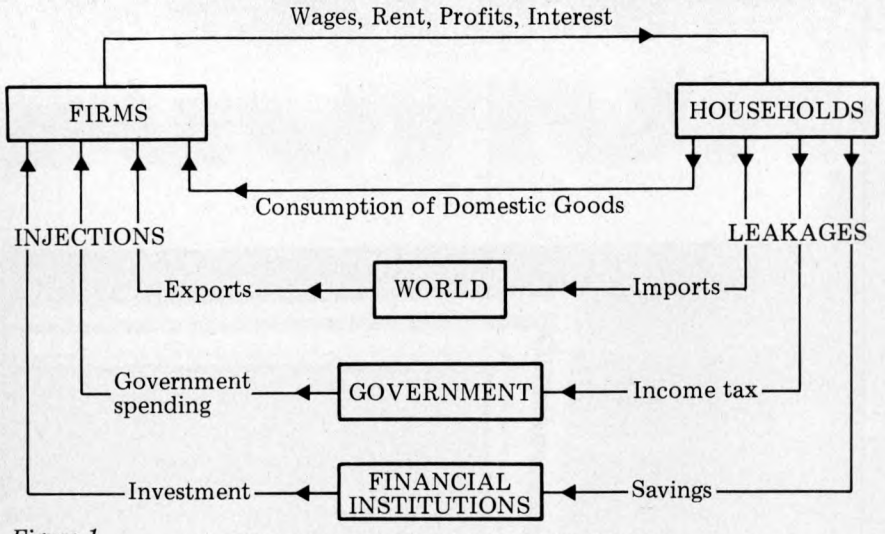


Figure 1 THE CIRCULAR FLOW OF INCOME

through the taps and leaking out through the plughole. As you will remember from your schoolday maths, if the water flows into the bath faster than it flows out, the water in the bath rises; you can control the level of the water (the level of National Income) by controlling the flow of water through the tap ("injections") and through the plughole ("leakages"). If the "water" level falls too low, you have 1930s-style unemployment, if it rises too high and slops on the floor, you have 1970s-style inflation.

The economy is of course rather more complicated than this and there are in fact several injections and several leakages, as can be seen more clearly in Figure 1, which shows the flow of Income round the economy. First break up the economy into "sectors": *firms* where goods and services are made, *households* where they are consumed, and *financial institutions* like Banks, the Stock Market, Insurance and Pension funds which channel our savings and lend our money to firms to build new factories; *the World*, to which we export and from which we import, and finally *the Government*, which controls (or at least tries to) the whole thing.

Follow the flow through with me. Firms pay out wages, salaries, dividends etc., to households which receive them as Income (the sum total paid out in one year is known as National Income). Quite a lot of that Income "leaks" out of the economy as Savings, Tax, and expenditure on Imports. Only a part of our Income is actually spent on British goods and services, and if that was the end of the story, the "bath" would soon be empty. However other sectors buy British goods and so "inject" money into the economy. Foreigners buy our exports, the Government buys hospitals and pays dustmen, and firms build new factories and buy new machinery (this is called "Investment" by economists).

The Government has control of one injection and one leakage: Government spending and taxation, and these form the main "weapons" of the Keynesian Government.

2) THE MONETARIST MODEL.

Despised by Keynes, and popularised by Milton Friedman, monetarist theories have made a remarkable come-back in the last few years, as Keynesian policies seem to become ever less successful; indeed Margaret Thatcher is now a firm believer in Monetarism.

The theory rests on a remarkably simple equation, a tautology:
MV=PT.
To explain it, imagine a desert island and a small community of shipwrecked sailors, with one hundred £1 notes saved from the wreck. The stock, or supply of money (M) on the island, is £100.

Suppose that each week £100 is paid out in wages, and spent, then in one year each pound will have been spent 52 times. The "Velocity of circulation" (V) is 52, and £5,200 worth of goods and services have been bought in that year.

That £5,200 could have bought 52 goods at £100, or 200 goods at £26 and so on. So we see that price (P) times the number of transactions (T) must always, by definition, equal the number of pounds spent (MV).

What happens if we change M? Clearly if M rises to 200, then either V must fall to 26, or P or T must rise, or more likely some combination of all three. Now monetarists generally assume that V is pretty well constant, and that any increase in M (money supply) must therefore lead either to an equivalent rise in the number of goods sold, or more likely in their price, and monetarists can produce statistics from the last 80 years to prove it. What makes the theory complicated is that the effects are not instantaneous, but occur after a time lag, typically of 18-24 months. Their recipe for long term success is to slow the rate of growth of the money supply to around 2-3% (the average rate at which the economy has grown in the last 20 years) arguing that this must, eventually, squeeze out inflation although at the price of some short term (how short?) unemployment.

THE AIMS OF GOVERNMENT AND HOW TO ACHIEVE THEM.

So the Keynesians believe that the economy can be controlled by altering levels of Government spending and rates of Tax, while the Monetarists believe that controlling the growth of the money supply is the only effective way to manage the country. Both however agree on what they are trying to achieve. Both want (don't we all) to bring inflation and unemployment down to some low figure (around 3% for each perhaps) while increasing the rate at which the economy, and so our standard of living, can grow (all the while ensuring that the Balance of Payments stays firmly in the black). And that is not easy, as you will soon discover.

To control inflation, you reduce the level of total demand in the economy, either by reducing Government spending and raising Tax rates, if you are a Keynesian, or by reducing the rate of growth of the money supply, if you are a Monetarist. Keynesians believe that inflation is made worse by excessive wage settlements and so introduce Incomes policies; Monetarists know that higher wages can only be paid by printing more money and say that therefore an Incomes policy is irrelevant.

To reduce unemployment you reverse your anti-inflation policies.

To increase the rate of economic growth you need higher Investment (more new factories), and this is determined partly by the rate of interest (and as we are only too painfully aware, cutting back money supply growth makes borrowing money very expensive), and partly by the level of Government spending (money that the Government borrows from us to pay for its own expenditure cannot be borrowed by Industry). You may also find that Investment is temporarily reduced one year if there is a shortage of essential raw materials or labour, and boosted the next as the shortfall is made good.

To correct a Balance of Payments deficit, you can deflate, devalue, or impose import restrictions. Deflation means reducing the level of National Income so that we have less money to spend, and so less to spend on imports. Devaluation means lowering the exchange rate of Sterling, to make our exports cheaper and our imports less competitive, but at the price of higher inflation. Import quotas reduce the level of imports and some argue that they are the only means by which we can lower unemployment without running up massive Balance of Payments deficits.

It all sounds pretty complicated, but you will understand it all better as you play the game. The interrelationships in the model are fairly complex and you may be surprised at some of the things that happen, but if you don't like the look of one set of policies you can easily go back and try that year over again with different policies. There are in fact no implementation lags in executing Government policy decisions and it is deemed that all policy changes take effect as from January 1st in the current year. Why not run through eight years twice with the same policies, once with the Keynesian model, and once with the Monetarist model and compare the results?

Maybe at the end of it you will understand some of Sir Geoffrey Howe's problems better than you did before. If you do really well, why not let Sir Geoffrey know? He might recommend you as the next Chancellor!

RUNNING THE PROGRAM.

As it stands, the program needs less than 8K Bytes of store, and should run happily on most machines with a reasonable BASIC interpreter or compiler. Although written for a PET, machine dependent commands have been avoided wherever possible. To

reduce the size of the program, cut out all the REM statements and shorten or remove the comments. If you are really short of space, consider removing one or other of the main models.

The program has been deliberately written in modular form so that amending parts of the model should be relatively simple if you should want to build in different assumptions, or extend the program.

POLICY WEAPONS.

Five policy weapons are available to you:

1 The Level of Government Spending (in £ million at constant 1980 prices). You cannot change the level by more than 10% in any one year because it takes time to plan cuts and put them into effect, and even more time before planned new roads etc. can be constructed.

2 The rate of Income Tax as a %. A realistic rate is between 20% and 60%. For simplicity it was decided to leave out VAT.

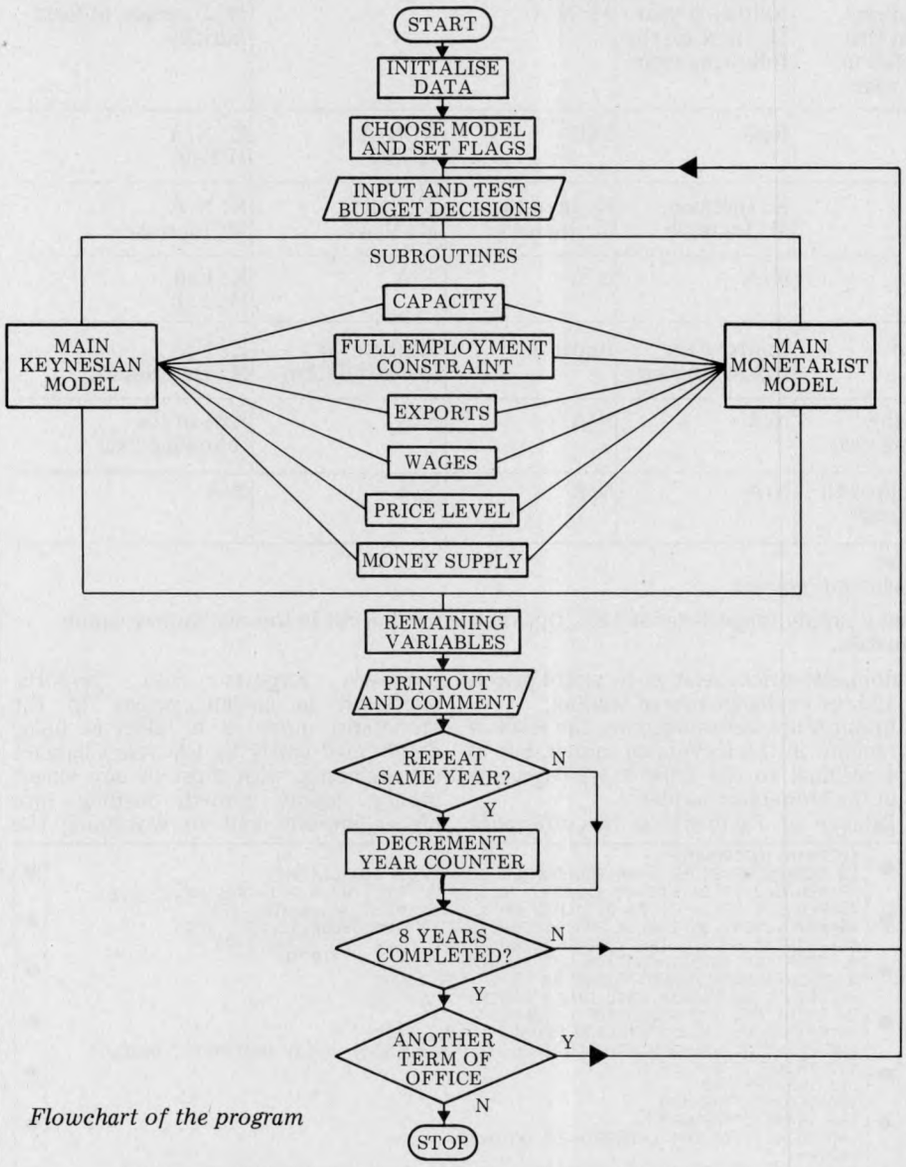
3 The rate of growth of the Money Supply. Again for simplicity, the model assumes that you can achieve your target rate of growth. In practice this is very unlikely to be true, because the money supply is affected not only by the level of Government spending and taxation, but also by the Balance of Payments, and the activities of the High Street banks.

4 Import Quotas (as a % reduction). You can impose quotas on all imports up to a maximum of 50%, which will reduce the level of imports below what it would otherwise have been. Other countries do not retaliate.

5 Incomes policy. You may, if you wish to, set a "norm" for wage increases, which you ask the Trade Unions to accept. You will not find them all that cooperative!

You may run the economy for eight years. During that period you should aim to keep inflation in single figures, unemployment below a million, growth of the economy of better than the historical figure of 2½% and a Balance of Payments deficit of no more than £500 million in any year.

At the end of each year you will be offered the option of rerunning that year with different policies, and at the end of your term in Office you will be offered a second term of Office, starting back in 1980 again. Have fun!



Flowchart of the program

THE ASSUMPTIONS IMPLICIT IN THE EQUATIONS

The form of the equations is mostly conventional to Economics, although the parameters were chosen to make the model relatively stable, rather than to make it conform closely to reality. Even so the model may become unstable if Government policy is subject to violent changes.

The capacity of the economy is determined by the Investment/Income ratio, the rate of growth rising by 1% for every 5% increase in that ratio. Historically it has been growing at

The EQUATIONS USED IN THE MODEL

$Q(t)=(I(t-1)/Y(t-1))^{.2} \times Q(t-1) \times 1.45$

$I(t)= 1.03 \times I(t-1) \times R(t-1)^{-.1} \times 1.23$

$X(t)= 17324 \times 1.02^{t} \times (E(t)/2 \times P1(t-1)/(2.71 \times 1.05^{t}))^{-1.5}$

K: $P1(t)=(((U(t)/.26-2)^{-1.4} \times 9+2)/100+1) \times P1(t-1) \times W2(t-1)^{.2} \times (1.05^{t} \times 2/E(t))^{.3}/2.58$

M: $P1(t)= C(t-1)^{.3} \times .83 \times .5 \times M(t)/q(t) \times .3 \times M(t-1)/Q(t-1) \times .2 \times M(t-2)/Q(t-2)$

K: $Y(t)= (I(t)+G(t)+D(t-1)+X(t)-6156+7740.9-1460)/K9$ where $K9=(.1 \times (1-T(t))+T(t)+.35+.35 \times (1-A(t)))$

M: $Y(t)=10 \times (X(t)+G(t)+I(t))^{.25} \times (M(t)/P1(t))^{.2} \times (M(t-1)/P1(t-1))^{.33} \times 2.02$ $C(t)=Y(t)/Q(t)/1.08 \times 100$

K: $U(t)=((Y(t)/Q(t)/.96)^{-25}+2) \times .26$

$U(t)=(1-(Y(t)/Q(t)/.96)^{1.42}) \times 260$

M: $U(t)= U(t)+(W2(t) \times 460/W(t))^{10} \times .26$

K: $F(t)= (Y(t) \times .35 + D(t-1)+7740) \times (1-A(t))$

M: $F(t)= X(t)-B(t)/P1(t)$

$B1(t)= .6+.8 \times B1(t-1)-.16 \times (M(t)/M(t-1))/Y(t)/P1(t)/100$

K: $B(t)=X(t) \times P1(t) - F(t) \times 2.85 \times 1.05^{t} \times (2/E(t))$

M: $B(t)= Y(t) \times P1(t) \times B1(t)/100$

$W2(t)= 1360/52 \times 1.03^{t} \times P1(t-1)$

$W(t)= .08 \times M(t)^{.8} \times M(t-1)^{.2} \times C(t-1)^{.5}$

$R(t) = Y(t) \times P1(t)/.9/ABS(M(t)+0(t))^{2} +2$

$O(t)= T(t) \times Y(t) - 1460 - G(t)$

POLICY MATRIX — summarising the effects of policy changes, all other things remaining constant.

Policy change / Effect on:	Increase in Government spending	Increase in rate of Income tax	Fall in rate of Exchange	Imposition of Import quota	Incomes Policy	*Increase in real Money Supply (M/P1)
National Income	K: Increase M: Increase	K: Fall M: No direct effect in first year — fall in second year	K: Increase the following year M: Increase the following year	K: Increase M: N/A	N/A	K:N/A M: Increase, at least initially
Unemployment	Fall	Rise	Rise	Fall	K: N/A M:Fall	K: N/A M:Fall
Inflation	K: Increase M: Increase	K: Fall M: Fall	K: Increase M: Increase	K: Increase M: Increase	K: Fall M: N/A	K: N/A M: Increase
Rate of Interest	Increase	Fall	N/A	N/A	N/A	K: Fall M: Fall
Balance of Payments	Deteriorate	Improve	Improve the following year	Improve	Improve via lower inflation	K: N/A M: Deteriorate
Investment	Fall in the following year	Rise in the following year	N/A	N/A	N/A	Rise in the following year
Capacity	Rate of growth will fall	Rate of growth will increase	N/A	N/A	N/A	N/A

K: Keynesian Model — M: Monetarist Model
N/A — Not applicable or the effects are small and indirect.

*If inflation is running at 18% and the money supply target is set at 12%, this is effectively a *cut* in the real money supply, and should be interpreted as such on this matrix.

around 2.5% p.a.

Investment grows at 3% p.a. but the rate of growth is reduced by 0.1% for every 1% increase in the rate of interest.

The Price Level is a complicated function, expressed as an Index, a percentage of some base year. In the Keynesian model it is a non-linear equation determined by the level of unemployment, the level of average wages, and the price of imports (itself affected by world prices growing at 5% p.a., and the exchange rate of Sterling). Every 1% rise in wages, raises the Price Index by .2%, every 1% increase in import prices raises it by .3%.

In the Monetarist model the Price level is determined by the level of capacity utilisation, and the ratio of the money supply to capacity, lagged over three years. For every 1% of excess money supply growth over capacity growth, the Price Index grows eventually by 1%.

Income in the Keynesian model is determined by the level of injections and the rates of the various leakages. In the Monetarist model National Income is determined partly by the level of injections, and partly by the level of money supply (adjusted for inflation). Clearly an increase in the money supply will initially increase Income, through the unlagged term, but the effect on the price level will tend to depress Income in the following year.

Unemployment — two non-linear equations are used, but essentially unployment is determined by the ratio of Income to Capacity. In the Monetarist model unemployment is increased if wage rates increase faster than the money available to pay those wages.

Exports are determined partly by the growth in world trade (2% p.a.), and partly by their dollar price, which is affected both by our own level of domestic prices relative to world prices, and the exchange rate of sterling.

Imports are determined by the level of Income in the Keynesian model, but as a residual to the Balance of Payments in the Monetarist model.

Balance of Payments is the difference between Exports and Imports, expressed in current prices. In the Monetarist model it is taken as being determined partly by last year's balance of payments, with most of any excess money supply growth feeding into higher imports and so worsening the

```
10 PRINT"MACRONOIA"
20 REM***COPYRIGHT 1980:BROADWATER ECONOMICS SIMULATIONS
70 READG(2),T(2),E(2),A(2),M3(2),I(2),Y(2),Y(1),Q(2),Q(1),R(2),P(2),U(2)
75 READZ(2),B(2),P1(2),D(2),M(2),M(1),C(2),W2(2),K3,B1(2),K6,K7
80 DATA12500,.35,2,0,.1,9241,50289,49272,54100,53000,12,16,1.102
85 DATA2.8,-871,3.14,0,55000,50000,86,78,17324,-.57,7740,1460
91 PRINT"IN 1979 INFLATION WAS RUNNING AT 16%"
92 PRINT"UNEMPLOYMENT STOOD AT";U(2);"MILLION"
93 PRINT"THE GROWTH RATE WAS A PALTRY";Z(2);"%"
94 PRINT"AND THE BALANCEOF PAYMENTS"
95 PRINT"WAS";B(2);"MILLION POUNDS IN THE RED"
100 PRINT"DO YOU WANT TO RUN THIS AS A KEYNESIAN  OR A MONETARIST MODEL?"
112 PRINT"TYPE K OR M";
115 INPUTA$:K=0
120 IFA$="K"THEN150
130 IFA$="M"THEN200
140 PRINT"I DO NOT UNDERSTAND":GOTO100
150 K=1
200 FORJ=3TO10:PRINT"ENTER BUDGET DECISIONS FOR THE YEAR";1977+J:PRINT
210 PRINT"LEVEL OF GOVERNMENT EXPENDITURE"
211 PRINT"(LAST YEAR WAS";G(J-1);")":INPUTG(J)
220 IFABS(G(J)-G(J-1))<.1*G(J-1)THEN240
230 PRINT"CHANGE IN GOVERNMENT EXPENDITURE EXCEEDS"
231 PRINT"PRACTICAL LIMITS":GOTO210
240 PRINT"AVERAGE RATEOF DIRECT TAX %(LAST YEAR"
241 PRINT"WAS";T(J-1)*100;")":INPUTT(J)
250 T(J)=T(J)/100:IF(T(J)-.2)*(.6-T(J))>0THEN270
260 PRINT"TAX RATE IS OUTSIDE POLITICALLY"
261 PRINT"ACCEPTABLE LIMITS":GOTO240
270 PRINT"EXCHANGE RATE OF STERLING(LAST YEAR"
271 PRINT"WAS$";E(J-1);")":INPUTE(J)
280 IF(E(J)-1)*(3-E(J))>0THEN300
290 PRINT"EXCHANGE RATE IS OUTSIDE POLITICALLY"
291 PRINT"ACCEPTABLE LIMITS":GOTO270
300 PRINT"IMPORT QUOTA-% REDUCTION IN IMPORTS(LAST YEAR WAS";A(J-1)*100;")"
301 INPUTA(J):A(J)=A(J)/100
310 IFA(J)<.5THEN320
315 PRINT"QUOTA IS UNACCEPTABLY HIGH":GOTO300
320 PRINT"DO YOU WANT AN INCOMES POLICY?(TYPE Y OR N)":INPUTA$
330 IFA$="N"THEN390
340 IFA$<>"Y"THEN360
341 K2=K2+1:IFK2<3THEN370
350 PRINT"UNIONS WILL NOT TOLERATE A FURTHER";
351 PRINT"YEAR OF WAGE RESTRAINT":GOTO390
360 PRINT"I DO NOT UNDERSTAND":GOTO320
370 PRINT"GOVERNMENT NORM FOR PAY INCREASES"
371 INPUTK1
375 IFK1>=0THEN400
380 PRINT"UNIONS INSIST THAT PAY NORM BE POSITIVE   ":GOTO370
390 K2=0
400 PRINT"MONEY SUPPLY GROWTH TARGET-ENTER %:(LAST YEAR ";
405 PRINT"WAS";M3(J-1)*100;")"
406 INPUTM3(J):M3(J)=M3(J)/100:IF(.5-M3(N))>0THEN430
```

```
420 PRINT"GROWTH TARGET UNREALISTIC":GOTO440
430 IF K=0THEN800
440 REM***KEYNESIAN MODEL***************
454 GOSUB1000
460 GOSUB1100
465 K9=(.1*(1-T(J))+T(J)+.35*(1-A(J)))
470 Y(J)=(I(J)-6156+G(J)+X(J)+D(J-1)+K6*.9-K7)/K9:K8=Y(J)
480 GOSUB1050
483 GOSUB1200
485 GOSUB1300
490 IFQ(J)>=(Y(J)/.95)THENGOTO510
500 Y(J)=Q(J)*.95
510 F(J)=(Y(J)*.35+D(J-1)+K7)*(1-A(J)):C1(J)=(Y(J)*(1-T(J))+K6)*.9-6156
530 B(J)=X(J)*P1(J)-F(J)*2.85*1.05↑J*2/E(J)
550 GOSUB1500
560 GOTO900
795 REM***MONETARIST MODEL***************
800 GOSUB1500
810 GOSUB1000
820 K4=.5*M(J)/Q(J)+.3*M(J-1)/Q(J-1)+.2*M(J-2)/Q(J-2)
830 GOSUB1300
840 GOSUB1100
850 Y(J)=10*(X(J)+G(J)+I(J))↑.25*(M(J)/P1(J))↑.2*(M(J-1)/P1(J-1))↑.33*2.02
860 C(J)=Y(J)/Q(J)*100/1.08
865 IFQ(J)>=(Y(J)/.95)THEN868
866 Y(J)=Q(J)*.95
868 GOSUB1200
870 GOSUB1050
871 U(J)=U(J)+(W2(J)*460/W(J))↑10*.26
875 B1(J)=.6+.8*B1(J-1)-.16*(M(J)-M(J-1))/Y(J)/P1(J)*100
880 B(J)=Y(J)*P1(J)*B1(J)/100
890 F(J)=X(J)-B(J)/P1(J)
895 B(J)=B(J)+A(J)*F(J):F(J)=F(J)*(1-A(J))
900 R(J)=(Y(J)*P1(J)/.9/(ABS(M(J)+O(J))))↑2+2
905 D(J)=(K8-Y(J))*K9/2:K5=I(J)-D(J)
910 O(J)=(T(J)*Y(J)-G(J)-K6)*P1(J)
920 Z(J)=(Y(J)/Y(J-1)-1)*100
930 GOSUB1600
935 PRINT"IF YOU WANT TO RERUN YEAR";1977+J;"PRESS Y -";
940 PRINT"TO CONTINUE WITH YEAR";1978+J;"PRESS ANY KEY";
950 INPUTA$:IFA$<>"Y"THEN980
960 J=J-1
980 NEXTJ
990 GOSUB1800
991 STOP
995 REM***CAPACITY**********************
1000 Q(J)=(I(J-1)/Y(J-1))↑.2*1.45*Q(J-1):I(J)=1.03*I(J-1)*R(J-1)↑(-.1)*1.23
1010 RETURN
1049 REM***FULL EMPLOYMENT BARRIER*******
1050 IFY(J)<.85*Q(J)THEN1070
1060 U(J)=((Y(J)/Q(J)/.96)↑(-25)+2)*.26:GOTO1080
1070 U(J)=(1-(Y(J)/Q(J)/.96)↑1.42)*260
1080 RETURN
1095 REM***EXPORTS**********************
1100 X(J)=K3*1.02↑J*((E(J-1)/2)*(P1(J-1)/2.71/1.05↑J))↑(-1.5)
1110 RETURN
1195 REM***WAGES**********************
1200 IFK2=0THEN1250
1220 IFK2=2THEN1240
1230 W2(J)=W2(J-1)*((100+K1*1.2)/100):GOTO1255
1240 W2(J)=W2(J-1)*((100+K1*1.5)/100):GOTO1255
1250 W2(J)=(1360/52)*1.03↑J*P1(J-1)
1255 IFK=0THEN1270
1260 RETURN
1270 W(J)=.08*M(J)↑.8*M(J-1)↑.2*C(J-1)↑0.5:W1(J)=W2(J)/P1(J)*52
1280 RETURN
1295 REM***PRICE LEVEL*******************
1300 IFK=0THEN1340
1320 P1(J)=(((U(J)/.26-2)↑(-1.4)*9+2)/100+1)*P1(J-1)*W2(J-1)↑.2
1321 P1(J)=P1(J)*(1.05↑J*2/E(J))↑.3/2.58:GOTO1350
1340 P1(J)=K4*C(J-1)↑.3*.83
1350 P(J)=(P1(J)/P1(J-1)-1)*100
1360 RETURN
1495 REM***MONEY SUPPLY******************
1500 M(J)=M(J-1)*(1+M3(J))
1510 RETURN
1595 REM***PRINTOUT**********************
1600 PRINT"","YEAR";1977+J
1610 PRINT"INFLATION",INT(P(J)*10)/10;"%","GROWTH",INT(Z(J)*10)/10;"%"
1620 PRINT"UNEMPLOYMENT",INT(U(J)*1000)/1000;"MILLION"
1630 PRINT"BALANCE OF PAYMENTS",INT(B(J));"MILLION POUNDS
1642 PRINT"PRESS ANY KEY TO CONTINUE"
1643 INPUTA$:IFA$<>"Y"THEN1645
1645 PRINT"","","CONSTANT PRICES"
1650 PRINT"NATIONAL INCOME $M","",INT(Y(J))
1660 PRINT"INVESTMENT $M","",INT(K5)
1665 PRINT"FALL IN STOCKS $M","",INT(D(J))
1670 PRINT"RATE OF INTEREST %","",INT(R(J)*10)/10
1680 PRINT"PRICE INDEX 1963=100",INT(P1(J)*100)/100
1690 PRINT"EXPORTS $M","",INT(X(J))
1700 PRINT"IMPORTS $M","",INT(F(J))
1705 PRINT"","","CURRENT PRICES"
1710 PRINT"MONEY SUPPLY $M","",INT(M(J))
1720 PRINT"BUDGET $M","","",INT(O(J))
1730 PRINT"AVERAGE WEEKLY WAGE $",INT(W2(J)*100)/100
1740 IFU(J)<1THEN1750
1745 PRINT"UNIONS ARE UNHAPPY ABOUT THE LEVEL OF"
1746 PRINT"UNEMPLOYMENT*****************************";
1750 IFP(J)<10THEN1760
1755 PRINT"VOTERS ARE WORRIED ABOUT THE RATE OF"
1756 PRINT"INFLATION*********************************";
1760 IFB(J)>(-1000)THEN1770
1765 PRINT"BALANCE OF PAYMENTS DEFICIT IS"
1766 PRINT"UNACCEPTABLY HIGH*************************";
1770 IFZ(J)>2THEN1780
1775 PRINT"AT THIS RATE OF GROWTH YOUR COUNTRY"
1776 PRINT"WILL SOON BE THE POOREST IN EUROPE!*****"
1780 RETURN
1800 PRINT"YOUR TERM OF OFFICE IS NOW COMPLETE"
1810 N1=0:N2=0:N3=0:N4=0
1890 PRINT"WANT TO TRY YOUR HAND AGAIN?"
1895 PRINT"TYPE Y OR N)";
1900 IFA$="Y" THEN10
1910 RETURN
```

balance of payments position.

Average weekly wages normally keep pace with the previous years inflation (Trade Unions are always trying to make good this years fall in living standards), with a target of a 3% p.a. improvement in living standards. Government Incomes policy will reduce the rise in money wages, but when the incomes policy comes off, Unions will attempt to catch up all the ground lost.

The total wage bill. In the monetarist model the total amount of money paid out in wages is determined partly by the money supply over two years) and partly by the level of unemployment — Trade Unions can generally get bigger wage settlements when there is Full Employment.

The Rate of Interest is deemed to be a function of the ratio of National Income in current prices to the Money supply (adjusted for the Budget deficit). If the money supply grows more slowly than the rate of inflation and the level of Income, then interest rates will rise. The larger the Budget deficit the higher will interest rates have to rise in order to persuade people to lend money to the Government.

The Budget Deficit is simply the difference between total tax revenue and Government spending, expressed in current prices.

LIST OF THE VARIABLES USED

Arrays

A(J)	% Quota in Imports
B(J)	@ Balance of Payments
B1(J)	Intermediate B of P variable
C(J)	% Capacity Utilisation
C1(J)	* Consumption expenditure
D(J)	*Unplanned reduction in stocks
E(J)	Exchange rate of Sterling against the Dollar.
F(J)	*Imports
G(J)	*Government Expenditure
I(J)	*Planned Investment
M(J)	@ Money Supply
M3(J)	% Money supply growth target
O(J)	@ Budget surplus/deficit
P(J)	% Inflation rate
P1(J)	Price Index
Q(J)	*Capacity of the economy
R(J)	% Rate of Interest
T(J)	% Average Income tax rate
U(J)	Millions unemployed
W(J)	@ Total wage bill
W2(J)	@ Average weekly wage
X(J)	* Exports
Y(J)	*National Income
Z(J)	% growth rate of Income

*1970 constant prices
@ Current prices.

Simple variables.

J	Time Subscript
K	Model flag
K1	Government Pay norm
K2	Incomes policy counter
K3	Base export value
K4	Intermediate price variable
K5	Actual Investment
K6	Tax intercept value
K7	Import intercept value
K8	Planned Income
K9	Intermediate Income variable

has a long history — one has but to recall "the world the steam engine made", the era of the motor car, the atomic age . . . Nearly all commentary on microelectronics has been conducted within this frame: the silicon chip was "discovered"; it was found to have "incredible" powers; it developed at "breathtaking" pace; it will continue to so develop and the technology will change us all. The social implications are as follows . . . blah, blah, blah.

The problem is not so much that the predictions are frequently miles off target or that they are so easy to make and often so absurd that they can scarcely be taken seriously. More important, the very procedure which underlines futurism is itself wrong. To talk in a way which assumes that technology is here today and hence social implications follow tomorrow is a facile caricature of the complexity of social organisation and social change. Not only is the linear equation, technology = new products = social implications miles off the mark, perhaps even more misleading is that this approach separates technology out from society at the start of its futurology, only to reintroduce it later as a cause of social change.

Technology cannot be separated out from society in this way. An adequate analysis must start from the principle that technology is *always* integrally tied to society and to really understand its growth, its ties with social contexts have to be seen. Thus a sociologist would try to grasp the rapid growth of the micro by locating the technology in the social context of the cold war, the arms race, the battle for space, a growing demand for improvements in communications in an increasingly international world, the expansion of key multinational corporations, massive injections of investment by American governments, the R and D budgets of giant companies like IBM, etc etc.

Here the sociologist would be resisting the current assumption that technology arrives from out of the blue to deliver a number of consequent social effects. Reconstructing the history of the chip would demystify today's technological "revolution" by pointing out the "social origins" of the micro. Its "discovery" by the British public becomes comprehensible in the light of the special circumstances of its growth.

At present, the science fiction selling of the micro makes it almost impossible for mere mortals to query its uses — simply because it seems so "scientific", "unworldly" and "miraculous". Showing that the growth of technology is explicable in terms of social processes allows the public of today an opportunity to genuinely debate the role of recent developments. Only at that point can they start to question what technology this and future societies should and could have.

In order to get away from science fiction and into the realms of reality, as the excellent Malcolm Peltu has been stressing for some time, we have to stop talking about this abstraction, the "microelectronics revolution" and start discussing the particular products.

One aspect of the mass scale development of microelectronic devices in the domestic sphere is the enhanced television — certainly a product that's been produced to respond to (and of course in turn influence) social situations. The following illustration will I hope show the way in which the social context and technology are integrally related.

Coming through the TV pipeline are remote control, teletext, viewdata, video games, home computers, etc. The reason that these devices are being produced is that 97% of British homes already have television and the new products are designed to build upon this basis. But there is more to this than merely noting that high ownership (and/or rental) of TV is a prerequisite for the introduction of new technologies. Another social factor of importance is that building on television's penetration is necessary, not least because of the negative, even intimidating image many people have of computers. Thus if corporations can produce goods which appear to merely extend TV while they in fact incorporate computing facilities, then more sales will result. The most

continued on p87

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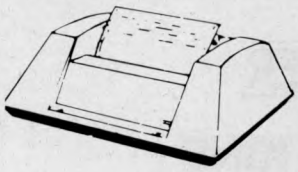

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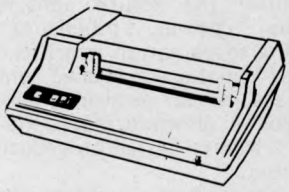

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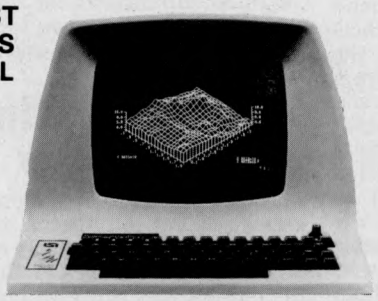

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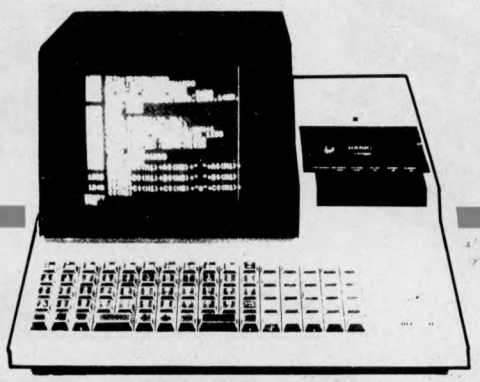

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CHAPTER 7 PROCEDURES AND FUNCTIONS

Throughout this series we have used procedures *to break programming problems into collections of interlinked but self-contained modules. This chapter seeks to examine the different means of interlinking such modules and thereby to analyse the different roles which they play in* modular *program design.*

Introduction

If something has to be done several times within a program, perhaps under different conditions or within different contexts, it can either be coded over and over again, whenever it is required or it can be coded once only and initiated from those points in the rest of the program where it is needed. In consequence, even the most elementary assembly languages usually provide some method of dividing a program into modules (or *subroutines)* and of interrupting the normal linear program flow by a subroutine call to some piece of code remote from that section currently being executed. However, it is one thing for a programmer to use such a facility as a convenience, when the occasion arises, and entirely another deliberately to design a program as a hierarchy of interdependent subroutines each with a specific if limited role within the whole program task.

The advantages of this approach to program writing emerge from a consideration of the process of producing and running a program in general. Firstly the task is hierarchically divided and subdivided into successively more detailed modules each of which has a well-defined, yet limited goal. If the goal is well-defined, the subroutine will be easy to code correctly. If the goal is limited, the subroutine will be more likely to produce the correct results and in addition makes the logical structure of the whole program simpler. Secondly, execution errors will pinpoint the subroutines within which they occur so that debugging a program fragmented in this manner is reduced to debugging one or two offending subroutines. Thirdly, features of the program which depend on special machine, peripheral or operating system characteristics are likely to be concentrated into a few subroutines which can be adapted to another computer environment without disturbing the rest of the program. Likewise, when transferring to a machine with limited memory, *overlaying* (i.e. the splitting of a program so that only a portion is resident in memory at any given time) is greatly assisted if the program is modular.

Finally, designing programs in this way imposes a discipline on the programmer which reflects itself in a logical and consistent approach to programming problems. This means that programs are easier to read and understand by other people. In *block-structued languages* which are designed to exploit this philosophy (and of which PASCAL is a member) the program consists of a number of procedures, within which may be *nested* other procedures, all controlled from the main program block. Variables declared within a procedure are local to the procedure and have no value outside the scope of that procedure.

Several important points arise from a consideration of the technical mechanisms necessary to achieve a satisfactory transfer of control from procedure to procedure. It is fairly simple to call a procedure — the procedure name is associated with the address of the first statement of the procedure so that, when the procedure is called, this address can be loaded into the program counter and processing can continue. However, getting back to the calling point when the procedure has finished is more difficult since the actual execution of the procedure will have altered the "state" of the processor.

For instance, the address of the statement immediately *following* that which initiated the procedure has to be loaded into the program counter for processing to continue after the called procedure has finished. However, the procedure could have been called from anywhere within the program and cannot "know" in advance what point control is supposed to return to. Therefore, during the execution of the called procedure, the *return address* must be stored somewhere out of reach of the current procedure but available immediately it has finished. Likewise any other special conditions which hold at the moment of the procedure call (e.g. the contents of some or all of the processor registers) must be preserved before the procedure is called and must be reinstated at the point of return.

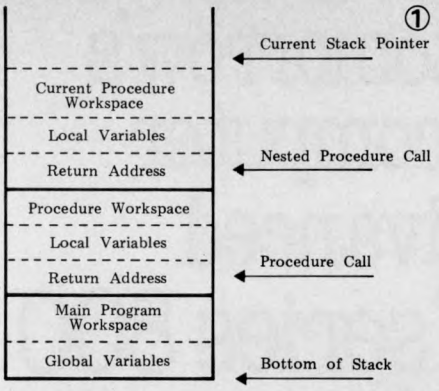
In order to guarantee the preservation of this information, most modern processor architectures and language implementations provide the processor with a *run-time stack* for use as immediate *working space* during program execution. The essential feature of the stack is that only the latest element *pushed* onto the stack is accessible to the processor and anything further down the stack is consequently "safe" from interference. The processor communicates with the stack through a *stack pointer* which contains the first free address above the top (i.e. latest) element on the stack. The processor can access the last element by *popping* it off the stack (and decrementing the stack pointer) or can push another element onto the stack (and increment the stack pointer).

Every operation which uses the stack must ensure that everything pushed onto the stack is popped off before it finishes. In this way when a procedure exits, it will leave the stack in exactly the state in which it found it. If the return address therefore was pushed onto the stack *before* the procedure was called, it can now be popped off, loaded into the program counter and processing can continue. The region of the stack *above* the return address becomes the current procedure's private working space within which the local variables can be established and intermediate results can be stored. The diagram in Box 1 shows a representation of a stack when a nested procedure is being executed.

The current procedure can access any varaibles currently in the stack although when it exits its own local variables will be popped off the stack and hence lost.

Procedures that perform a job

The fact that the current procedure can access any variable on the stack and not just its own local variables is something of a mixed blessing. On the plus side, the current procedure will often require data from procedures further down the stack and it is convenient, in assignment statements and the like, to be able to refer to these variables in a straightforward way. On the minus side however, the further down the stack these variables are declared, the more searching and manipulation is required for each access. In addition, an assignment made to one of these non-local variables will stand even after the current procedure exits. This is known



as a *side-effect* and is all very well if deliberately done by the programmer but a difficult error to trace if it happens inadvertently.

As a consequence it is necessary to make a distinction between those procedures which are required to produce a result and those which merely perform a job. A simple example of this latter category, with which we shall be concerned in this section, might be a procedure to print a line of dashes across a line-printer page. Such a procedure appears in Box 2 where PRINTLINE will produce the desired output when called from some other part of the program, as shown. The local variable I counts the number of dashes — 120 are printed out, this being the width of a typical line-printer page. However, some line-printers are 132 characters wide while matrix printers may have 40, 64, 72 and 80 character line widths, so if PRINTLINE were to be part of a package designed to run on a variety of systems, something would have to be done to customize (or personalize) the package to an individual user's system.

One approach whould be to go through the code changing every occurrence of 120 to the desired value. This, of course, is time consuming, prone to errors of omission and not a serious option, particularly when an alternative is simply to create an integer variable (say LINEWIDTH) which the user is asked to set at the beginning of the program. All output can thence be customized to the terminal merely by *referencing* LINEWIDTH (e.g. line 6, Box 2 would read:

FOR I : = 1 TO LINEWIDTH DO).

Since LINEWIDTH is a global variable it appears at the bottom of the stack and so is accessible to any procedure which is subsequently called. Provided the procedure only *uses* such non-local variables and doesn't change their values, this is a reasonably satisfactory way of allowing a procedure to communicate with external data.

Suppose, however, that one wished to write a procedure to produce a histogram, the data for which was stored in an array HEIGHT [1 .. 10]. Box 3 shows two methods of programming such a procedure. In program SIDEFFECT, procedure LINEOUT1 references the global array elements HEIGHT [I] and the global integer I. Consequently, each time HEIGHT [I] is needed, a search must be made, down to the bottom of the stack, first to find the value of I and then to get the contents of HEIGHT [I]. This must occur for ten iterations. In a large program where the arrays, procedures and hence the

②

```
 1:    --
 2:    --
 3:    PROCEDURE PRINTLINE;
 4:    VAR I:INTEGER;
 5:    BEGIN
 6:        FOR I:=1 TO 120 DO
 7:          WRITE('-');
 8:        WRITELN
 9:    END;
10:    BEGIN (*MAIN PROGRAM*)
11:    --
12:    --
13:    --
14:    IF LINENUM<60 THEN PRINTEXT
15:                  ELSE PRINTLINE;
16:    --
17:    --
18:    --
```

③

```
 1:    PROGRAM SIDEFFECT;
 2:    VAR HEIGHT:ARRAY[1..10] OF INTEGER;
 3:        I:INTEGER;
 4:    --
 5:    --
 6:    (*PROCEDURE TO FILL HEIGHT*)
 7:    --
 8:    --
 9:    PROCEDURE LINEOUT1;
10:    BEGIN
11:        WHILE HEIGHT[I]>0 DO
12:        BEGIN
13:            WRITE('H');
14:            HEIGHT[I]:=HEIGHT[I]-1
15:        END;
16:        WRITELN
17:    END;
18:    --
19:    --
20:    BEGIN (* MAIN PROGRAM *)
21:    --
22:    --
23:        WRITELN('RESULTS HISTOGRAM:');
24:        FOR I:=1 TO 10 DO
25:        BEGIN
26:            IF I<10 THEN WRITE(' ');
27            WRITE(I,'    !');
28:            LINEOUT1
29:        END;
30:    --
   ***-----------------------------------***
31:    PROGRAM CALLBYVALUE;
32:    VAR HEIGHT:ARRAY[1..10] OF INTEGER;
33:        I:INTEGER;
34:    --
35:    --
36:    (*PROCEDURE TO FILL HEIGHT*)
37:    --
38:    --
39:    PROCEDURE LINEOUT2(J:INTEGER);
40:    BEGIN
41:        WHILE J>0 DO12:          BEGIN
42:            WRITE('H');
43:            J=J-1
44:        END;
45:        WRITELN
46:    END;
47:    --
48:    --
49:    BEGIN (* MAIN PROGRAM *)
50:    --
```

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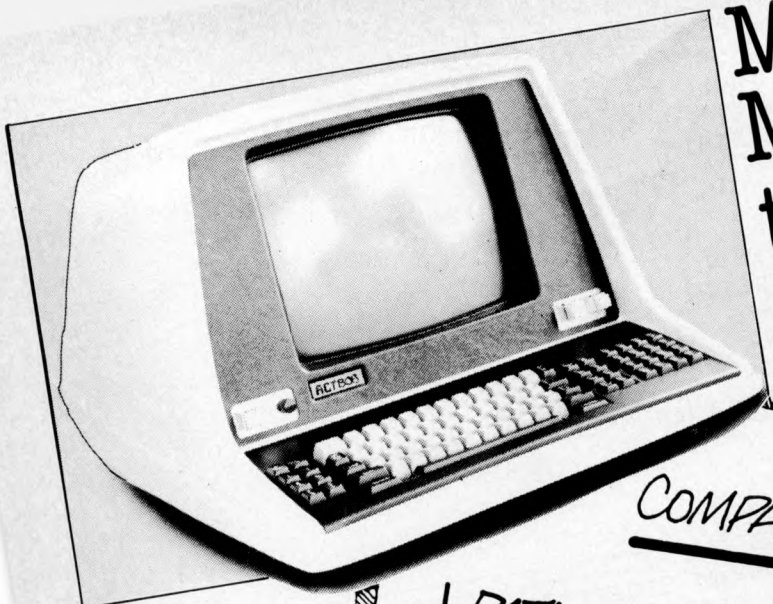

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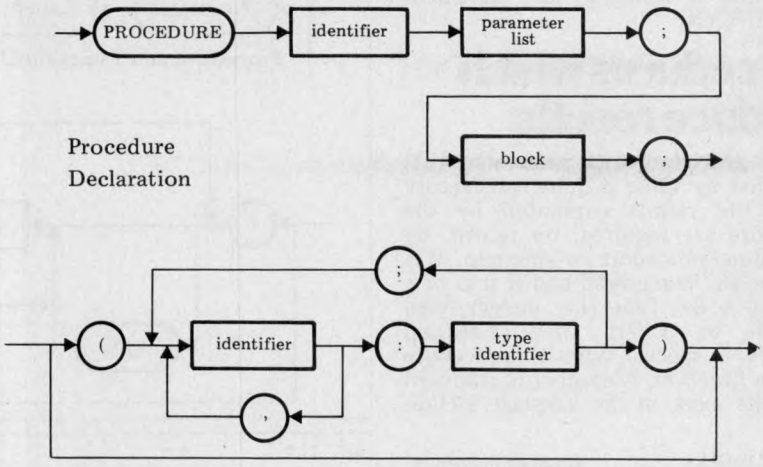
```
51:     --
52:         WRITELN('RESULTS HISTOGRAM');
53:         FOR I:=1 TO 10 DO
54:         BEGIN
55:             IF I<10 THEN WRITE(' ');
56:             WRITE(I,'    !');
57:             LINEOUT2(HEIGHT[I])
58:         END;
59:     --
60:     --
```

Box 3 (continued)

④



⑤

```
 1:     --
 2:     VAR EVEN:BOOLEAN;
 3:     PROCEDURE PROCEVEN(VAL:INTEGER);
 4:     BEGIN
 5:         EVEN:=2*(VAL DIV 2)=VAL
 6:     END;
 7:     --
 8:     --
 9:     BEGIN (* MAIN PROGRAM *)
10:     --
11:     --
12:         PROCEVEN(VAL);
13:         IF EVEN THEN ....
14:     --
15:     --
***-----------------------------------------***
16:     --
17:     FUNCTION EVEN(VAL:INTEGER):BOOLEAN;
18:     BEGIN
19:         EVEN:=2*(VAL DIV 2)=VAL
20:     END;
21:     --
22:     --
23:     BEGIN (* MAIN PROGRAM *)
24:     --
25:     --
26:         IF EVEN(VAL) THEN...
27:     --
28:     --
```

stack itself can be expected to be much larger, the inefficiency of this method becomes amplified.

The second verion of the program in Box 3 is intended to show how specific values may be *passed* to a procedure when it is called. This implies that the called procedure will make its own local copy of the value in its own work space at the top of the stack. Thus the call LINEOUT2 (HEIGHT [I]) in line 57 passes the *actual parameter* value (i.e. the contents of HEIGHT [I]) to produce LINEOUT2 which uses the local *formal parameter* J to reference that value. Every time J is accessed it can be found at the top of the stack so the search is shorter than the corresponding search in program SIDEFFECT. LINEOUT2 alters the value of J as it proceeds but this change does not affect HEIGHT [I] since, when LINEOUT2

exits all its work space (including the current value of J) is returned to the free space above the top of the stack.

This technique of passing useful external values to a procedure for use in its own work space is known as a *call-by-value*. The formal definition is shown in the syntax diagram in Box 4. Note that formal parameters may be of any type and that more than one may be passed.

Exercise: Write a procedure which will cause the line printer to skip 'm' lines and which is called by the statement NEWLINE (N)

Procedures which produce results

Using a procedure with parameters that are called by value is quite satisfactory unless the results computed by the procedure are required, on return, by the calling procedure or program. If a *single* result is required and if it is of a *standard* scalar type (i.e. integer, real, Boolean or Char) then PASCAL provides a special type of procedure called a *function*. A number of standard functions exist in the language including:

EOLN, ODD(X)	— Boolean functions
TRUNC(X), ROUND(X)	— integer functions
SIN(X), SQRT(X)	— real functions
CHR(X)	— char functions

The syntax diagram for user-defined fuctions is given in Box 6.

For other procedures, the procedure call is a complete statement consisting of the procedure identifier followed by the list of actual parameters. Since the result returned by a function is a single standard type, the function call can be made implicitly by using the function name directly in the statement within which the returned result is required. Thus

```
REPEAT
  —
  —
UNTIL EOLN
```

where EOLN represents a function call returning a result of TRUE or FALSE; and

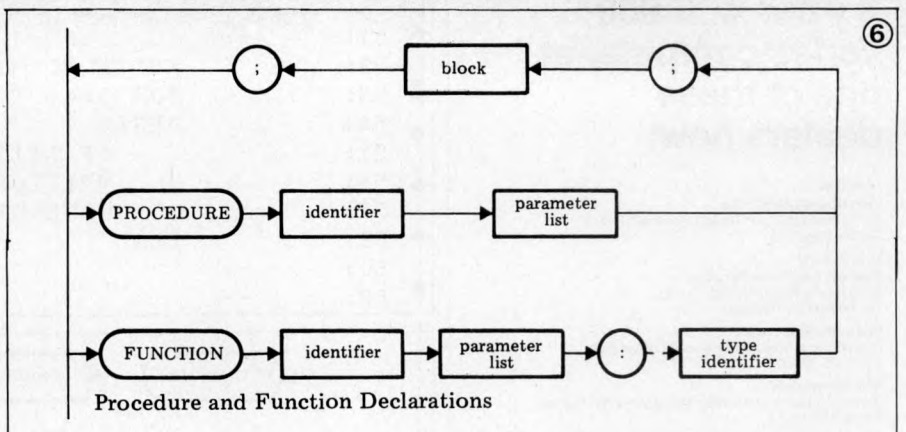
```
WRITE(SIN(X))
```

where the SIN function returns the result which is printed out. User-defined functions can be referenced in exactly the same way and the standard functions can even be overridden within a program by a user-defined function of the same name.

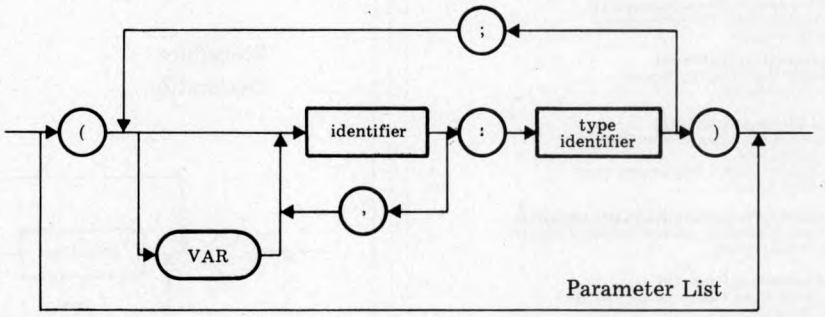
Compare the two segments of code in Box 5, which represent different approaches to the same task — to determine whether a given integer is even or not. When PROCEVEN isused a global Boolean variable EVEN must be declared. This is set to TRUE or FALSE within PROCEVEN depending on the nature of the indicated integer. In the second case, the *function* EVEN is set to TRUE or FALSE. This is made possible in line 17 where the function *itself* is declared as a Boolean (see also the syntax diagram in Box 6). In both cases the integer VAL is passed and in both cases an assignment is made to the identifier EVEN. This is an important feature of functions — an assignment must be made to the function identifier before control returns to the calling procedure. Finally, the concise nature of the function call (line 26) should be compared with the more unwieldy version in lines 12 and 13.

Functions, for all their attractions,

⑥



Procedure and Function Declarations



Parameter List

⑦

```
 1:      --
 2:      VAR A,B:REAL;
 3:          MATRIX:ARRAY[1..50] OF REAL;
 3:      PROCEDURE BADSWAP;
 4:      VAR TEMP:REAL;
 5:      BEGIN
 6:          TEMP:=A;
 7:          A:=B;
 8:          B:=TEMP
 9:      END;
10:
11:      BEGIN (* MAIN PROGRAM *)
12:      --
13:      --
14:          A:=MATRIX[I];
15:          B:=MATRIX[K];
16:          BADSWAP;
17:          MATRIX[I]:=A;
18:          MATRIX[K]:=B;
19:      --
20:      --
    ****------------------------****
21:      --
22:      VAR MATRIX:ARRAY[1..50] OF REAL;
23:
24:      PROCEDURE SWAP(VAR A,B:REAL);
25:      VAR TEMP:REAL;
26:      BEGIN
27:          TEMP:=A;
28:          A:=B;
29:          B:=TEMP
30:      END;
31:
32:      BEGIN (: MAIN PROGRAM :)
33:      --
34:      --
35:          SWAP(MATRIX[I],MATRIX[K]);
36:      --
37:      --
```

can still only return single scalar values, so PASCAL provides a different means of returning multiple scalar values on structured data types (arrays, records, etc). While the ordinary type of procedure call is employed, the call-by-value mechanism can only pass data to the procedure. A second mechanism exists whereby variables declared in the formal parameter list are marked for return to the calling procedure. The method of so marking parameters consists of preceding each variable name (or sequence of variable names) to be returned with the reserved word VAR, as shown in the syntax diagram in Box 6. These are consequently known as *variable* parameters in contrast to the *value* parameters defined in the previous section. The calling mechnism is often referred to as a *call-by-name.*

The action taken by the compiler to achieve this two-way passing of data is quite complex. Provision must be made so that references to the formal parameter in the current procedure can be connected back to the actual parameter in the stack area of the calling procedure. Although the compiler must make these arrangments, the connections are made at run-time since the compiler does not always "know" where the actual parameter is. The classic example of this circumstance occurs when the actual parameter is an array element. Which particular array element is passed depends on the array indices whose values are not known to the compiler. Before the called procedure is activated therefore, the required array element must be identified and connected with the formal parameter name at the top of the stack.

As an example of a procedure using the *call-by-name* approach, compare the two segments of code in Box 7. Both are designed to achieve the exchange (or swapping) of the values of two reals. Procedure BADSWAP achieves this by side-effect and requires two global reals A and B to be declared in the main program. If any other reals (apart from A and B) need to be swapped, then their values must be assigned to A and B before BADSWAP is called and retrieved once control has returned to the calling procedure (lines 14 to 18). In contrast, procedure SWAP contains the variable parameters A and B and any two reals in the calling procedure (lines 14 to 18). In contrast, procedure SWAP contains the variable parameters A and B and any two reals in the calling procedure can be passed and returned directly (line 35). Note that there is no reference to the variables A and B in the calling procedure declaration which implies that procedure SWAP could be inserted into any number of different programs without demanding that any external code be changed.

In this fashion it is possible for a programmer to build up a library of useful procedures which can operate independently of the calling program provided that there is a direct type correspondence between the actual and the formal parameters to avoid having to think about the precise role of each variable in the procedure. However, while this approach may be easier it is not usually more efficient due to the connection activity required to link formal and actual parameters. An exception to this condition occurs when a large data structure is required in a called procedure. The time (and space) taken in creating a fresh copy at the top of the stack will often outweigh the time lost in searching out those elements required in the procedure.

String handling

The next chapter will be concerned with the development of a text formatting program in the course of which a large amount of string manipulation is going to be required. In preparation for this program, Box 8 contains a set of functions and procedures which provide basic string handling facilities. The UCSD PASCAL system provides a similar set of functions and procedures to facilitiate this kind of programming. UCSD has had to define an extra data type the STRING (= PACKED ARRAY [1 .. 80] OF CHAR) so that the function calling (and returning) mechanism will work. Since we are concerned in this series merely with using PASCAL compilers and not writing them, we must be content with a more pedestrian set of procedures.

In particular we have had to write procedures instead of UCSD string func-

continued on page 101

PROGRAMMING - THE SIMPLE APPROACH

Mervyn Axson leads you gently through the minefield of writing your first "real" programs in BASIC. Suitable for businessmen as well as hobbyists, you need only a nodding acquaintance with the language and access to a machine in order to start.

The operations to be performed in most business programs are very simple, so the programming should also be simple. You may doubt the truth of this if you look at a listing of a program, for at first sight it probably appears to be very complicated. If, however, you examine it bit by bit, you will find that it really is quite simple. I'll be tackling the problem in the reverse way, by writing a very basic program, and then refining it step by step to show how it ends up looking complicated. And by the way, although the program will be written in PET's version of BASIC, it can easily be modified to suit other machines.

A problem common to many businesses is that of quoting credit terms to prospective customers. Let us suppose that we require a minimum deposit of 10% and that the credit charges are at the rate of 12½% per annum calculated on the balance remaining after payment of the deposit. The query is: "What are the terms for good costing £399.95 over 18 months?". The calculations are not difficult, although perhaps tedious.

Now we have to consider how to write the computer program to carry out these operations for us. Actually, the simple answer is that we have already done so, for these are all valid BASIC statements! We only have to add line numbers and allow for inputting Sum, Interest Rate and Period, and outputting Deposit and Monthly repayment. Our completed program reads:

```
10 INPUT S
20 INPUT I
30 INPUT P
40 D = S/10
50 B = S — D
60 C = B * (I/100 * (P/12))
70 A = B + C
80 R = A/P
90 PRINT D
100 PRINT R
```

Note that this short and simple program is complete in itself and will give the required answers for any values that you wish to input. You could stop here, since most of the refinements to be added are largely cosmetic in that they do not improve on the basic function, but merely give a better appearance to the output, or make the program easier to use. Of course, in business, these factors can be very important.

What happens if we load the program into PET and then type RUN? PET responds with a "?" so type in the sum (followed by pressing the RETURN key, of course). Another "?" appears, and you type in the interest rate, and finally in response to a third "?" you type in the period. PET now displays the answers, and the screen looks like this:

```
RUN
? 399.95
? 12.5
? 18
  39.995
  23.7470313
```

We would of course mentally round the 39.995 to 40.00 and 23.7470313 to 23.75, but we can easily make PET do it for us. INT(X*100+.5)/100 will round X to 2 decimal places. In this program we only need to use this twice, but in others we have to use it many times so to save typing we can use the DEF statement:

```
5 DEF FNA(X) = INT(X*100+.5)/100
```

and then

```
90 PRINT FNA(D)
100 PRINT FNA(R)
```

will produce the required result.

It would be helpful if PET told us what input it wanted rather than just printing "?". INPUT statements allow us to do this. If we amend line 10 to:

```
10 INPUT "COST OF GOODS" ; S
```

PET will now print:

```
COST OF GOODS?
```

Lines 20 and 30 can also be modified similarly, and lines 90 and 100 can be altered to:

```
90 PRINT "DEPOSIT";FNA(D)
100 PRINT P; "MONTHLY PAYMENTS
    OF";FNA(R)
```

The output will now be:

```
DEPOSIT 40
18 MONTHLY PAYMENTS OF 23.75
```

This is beginning to look better, but there is still a lot that can be done to improve it. Showing the Deposit as 40 rather than 40.00 is annoying to say the least. BASIC does this to all numbers, dropping zeros that are not significant. Typing PRINT 40.10 will produce 40.1 and PRINT 00123 results in 123. There is a fairly simple way round this problem, although it looks complicated! We convert our simple number to a string which can then be "formatted" to produce the desired result and then printed. We will probably need to use this many times in a lot of business programs, so we can write the program section as a subroutine which we can call up whenever required.
This is:

```
10000 Z$ = STR$(Z)
10010 L = LEN(Z$)—2
10020 IF L = 0 THEN 10060
10030 IF MID$(Z$,L,1) =
      "." THEN 10090
10040 L = L+1
10050 IF MID$(Z$,L,1) =
      "." THEN 10080
10060 Z$ = Z$ +".00"
```

Deposit = £399.95 divided by 10 = £40.00
Balance = £399.95 minus £40.00 = £359.95
Charges = Balance multiplied by interest rate multiplied by period.
Interest rate = 12½% p.a. the period = 18 months.
The rate to be applied = 12½% * 1.5 = 18¾%
So charges = £359.95 multiplied by 18.75/100 = £67.49
Amount to be repaid = balance plus charges = £359. 95 plus £67.49 = £427.44.
Divide this last figure by 18 to find the monthly payment which is £23.75.

So for the general case we can say:	or, just using initials:
Deposit = Sum/10	D = S/10
Balance = Sum — Deposit	B = S — D
Charges = Balance * (Interest * Period/12)	C=B * (I/100 * (P/12))
Amount to be repaid = Balance + Charges	A = B + C
Repayments = Amount to be repaid/Period.	R = A/P

```
10070 GOTO 10090
10080 Z$ = Z$+"0"
10090 RETURN
```

The number to be printed is returned as Z$, but before we amend the program, there is one further point in formatting. The result would be clearer if the amounts were set out thus:

```
DEPOSIT                          40.00
18 MONTHLY PAYMENTS OF           23.75
```

Whilst in this case a simple TAB(30) instruction would be satisfactory, it would not if the deposit was 10.00 and payments 9.95:

```
DEPOSIT                          10.00
18 MONTHLY PAYMENTS OF            9.95
```

There is a very simple way to align the numbers. They are in string form so LEN(Z$) works out how long they are and TAB (30 − LEN(ZS)) will ensure that they are lined up.

Now the program reads:

```
88 Z = FNA(D)
89 GOSUB 10000
90 PRINT "DEPOSIT";
   TAB(30—LEN(Z$));Z$
98 Z = FNA(R)
99 GOSUB 10000
100 PRINT P;"MONTHLY PAYMENTS
    OF";TAB(30—LEN(Z$));Z$
```

We now have a fairly presentable result on PET's VDU. A few PRINT statements judiciously inserted would make it even better, since for example, a simple 91 PRINT will put a line space between DEPOSIT and 18 MONTHLY PAYMENTS, making the result easier to read. We want this program to provide clear answers for the novice, so what else should we do? For a start, it would help them to know that they had loaded the correct program into PET. 4 PRINT "LOAN SCHEME" will reassure them. Then we could clear the VDU screen when we have input the data so that the answers alone are shown. PRINT CHR$(147) will clear the screen and as we have now lost the input data perhaps we should also display the cost of the goods in the output.

```
81 PRINT CHR$(147)
82 PRINT "LOAN SCHEME"
83 PRINT
84 Z = FNA(S)
85 GOSUB 10000
86 PRINT "COST OF GOODS";
   TAB(30 − LEN (Z$)); Z$
87 PRINT
```

Just for one moment, let us suppose that we are now satisfied with our efforts and that we think the program to be complete. We "RUN" it with the sample data mentioned before and PET immediately displays:

```
LOAN SCHEME
COST OF GOODS                   399.95
DEPOSIT                          40.00
18 MONTHLY PAYMENTS OF           23.75
```

We now write down the figures and return to the customer and proudly announce the results. Our efficiency must be obvious and surely we will make the sale? Alas, real life is not like that and we are soon deflated for the response is: "Oh! I can pay £100.00 down, so what would that make the monthly payment?" The program that we have written does not allow for this situation, so we are back to calculations — or are we? No, because in the light of experience, we could modify the program. Instead of using line 40 to calculate the deposit, we could make an input of the deposit offered:

```
40 INPUT "DEPOSIT OFFERED";D
```

However, think for a minute; sometimes the response to the question: "What deposit do you want to pay?" will not be a definite figure but "What is the least that you require?" We can cater for both responses simply by adding:

```
31 INPUT"DEPOSIT OFFERED ?
   IF LOWEST TYPE MIN";D$
32 IF D$ = "MIN" THEN 40
```

We have made the variable D$ rather than D to cater for the input of MIN. If it is, then line 32 continues the program as before. But if D$ represents an amount e.g. 100.00, then we must convert this from a string variable D$ to a numeric variable D. D = VAL(D$) will do this and we can then go straight to line 50.

It could happen that the deposit offered was less than the minimum required and this may not be noticed; we can add a line to take care of this as well.

```
33 D = VAL(D$)
34 IF D(S/10 THEN PRINT "MINIMUM
   DEPOSIT IS";FNA(S/10):GOTO 31
35 GOTO 50
```

If you try running the program now, you will find that whilst it produces the required result, it also ends by printing RETURN WITHOUT GOSUB ERROR. This is because after line 100, which is the end of the program so far, PET "falls through" to the subroutine in 10000 on. A simple line 9999 END will prevent this. We could usefully clear the screen before any input is requested, so line 3 PRINT CHR$(147) can be added.

The listed program does now begin to look rather more complicated, but by taking it a step at a time, it's been written quite painlessly. And what's more, we have a program which has been capable of being used at any stage in its development — which is by no means completed yet. How about adding the facility of being able to output the payments required for all of the periods we offer, which could typically be 12, 18, 24, 30 and 36 months? We will tackle this and other developments in the next section. In the meantime, we have a quite useful program already. In a business situation it is often import-

First listing of program 'LOAN SCHEME'

```
3 PRINTCHR$(147)
4 PRINT"LOAN SCHEME"
5 DEFFNA(X)=INT(X*100+.5)/100
10 INPUT"COST OF GOODS";S
20 INPUT"INTEREST RATE";I
30 INPUT"PERIOD";P
31 INPUT"DEPOSIT OFFERED ? IF LOWEST TYPE MIN";D$
32 IFD$="MIN"THEN40
33 D=VAL(D$)
34 IFD<S/10THENPRINT"MINIMUM DEPOSIT IS";FNA(S/10):GOTO31
35 GOTO50
40 D=S/10
50 B=S-D
60 C=B*(I/100*(P/12))
70 A=B+C
80 R=A/P
81 PRINTCHR$(147)
82 PRINT" LOAN SCHEME"
83 PRINT
84 Z=FNA(S)
85 GOSUB10000
86 PRINT" COST OF GOODS";TAB(30-LEN(Z$));Z$
87 PRINT
88 Z=FNA(D)
89 GOSUB10000
90 PRINT" DEPOSIT";TAB(30-LEN(Z$));Z$
91 PRINT
98 Z=FNA(R)
99 GOSUB10000
100 PRINTP ;"MONTHLY PAYMENTS OF";TAB(30-LEN(Z$));Z$
9999 END
10000 Z$=STR$(Z)
10010 L=LEN(Z$)-2
10020 IFL=0THEN10060
10030 IFMID$(Z$,L,1)="."THEN10090
10040 L=L+1
10050 IFMID$(Z$,L,1)="."THEN10080
10060 Z$=Z$+".00"
10070 GOTO10090
10080 Z$=Z$+"0"
10090 RETURN
```

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ant to get some useful programs running as quickly as possible, so as to convince the sceptics of the value of the system in which they've invested.

The next stage in developing our loan scheme program is to add the option of calculating the payments required for all the periods we offer, which we will take to be 12, 18, 24, 30 and 36 months. This will enable us to answer the general query: "What are your terms for --------?" quickly and comprehensively. This development does need a bit of thinking about. The input is easy, being very similar to that used for the deposit option. We shall have to alter some line numbers for reasons that will appear later, so delete line 30 and write:

```
25 INPUT "PERIOD ?
   IF ALL TYPE ALL"; P$
26 IF P$◊ "ALL" THEN P = VAL(P$)
```

Now we either have a single value for the period in P or we have "ALL" in P$. If the former, then the program as it stands will work; but what changes are needed to cope with the latter? What we have to do is to run through lines 60, 70 and 80 for each value of the period. This obviously calls for a "FOR ------ NEXT" loop. BASIC does allow us to specify the step between values, as well as the start and finish, so FOR P = 12 to 36, STEP 6 will successively give the correct values to P. But what happens in line 80? Each time we run through the loop a new value will be calculated for R which will replace the previous one, so when we exit from the loop the only value of R available is the last one i.e. R for 36 months. Obviously, we must arrange to save the value of R each time it is calculated. Fortunately, BASIC provides an easy way to do this, although you may not think so from the jargon, for we construct an array using a single subscripted variable (or something like that)! All this actually means is that we save the first result as variable R(1), the second as R(2) and so on. The program changes the number in brackets, the subscript, each time we go round the loop, the result being that our five values for R are all saved as R(1) to R(5).

How do we write the program to perform these operations? We will use J to keep track of the subscript and first we give it the value of 1, 55 J = 1, then we set up the loop, 57 FOR P = 12 TO 36 STEP 6. Lines 60 and 70 remain the same, but we alter 80 to R(J) = A/P and give it the new line number of 77. R(1) now has the value of R when P = 12. J now has to equal 2 so 79 J = J+1. We now have to go back to the beginning of the loop, line 57, to do the calculation for P = 18. 80 NEXT will accomplish this, and since J now equals 2, the result will be saved as R(2). This will be repeated until all five results have been saved and we exit from the loop to line 81.

We have now dealt with the case when P$ = "ALL", but what when P has a single value? This would work previously, but now we have altered the program by putting in a loop — which in this instance we don't need! We must miss out the loop instructions and a couple of IF . . . . . THEN statements in lines 56 and 78 will be sufficient. The complete section of the program now reads:

```
55 J = 1
56 IF P$◊ "ALL" THEN 60
57 FOR P = 12 to 36 STEP 6
60 C = B * (I/100(P/12))
70 A = B + C
77 R(J) = A/P
78 IF P$◊ "ALL" THEN 81
79 J = J + 1
80 NEXT
```

This may seem a little complicated at first, but once you get the idea it is really quite simple. It's well worth making the effort to fully understand it, since it is a technique that is very valuable in many business programs, where the ability to perform repeated calculations and later recall the results is a necessity.

We have just mentioned recalling the results, so how do we do that to produce our output. Very simply, just by using the same technique.

```
95 J = 1
96 IF P$◊ "ALL" THEN 98
97 FOR P = 12 TO 36 STEP 6
98 Z = FNA(R(J))
99 GOSUB 10000
100 PRINT P; "MONTHLY PAYMENTS
    OF"; TAB(30 − LEN(Z$));Z$
101 PRINT
102 IF P$◊ "ALL" THEN 9999
103 J = J + 1
104 NEXT
```

You may remember that we left a few spare lines after inputting the period. This is to allow us to check that the data input is valid. As the program stands, it will perform the calculations for any period of months typed in, even 1 or 1000. Admittedly, these are unlikely errors, but 21 instead of 12 or 42 instead of 24 are very possible. There are many ways in which we carry out this check, but a simple one can be based on the fact that all the valid periods can be divided by 6, resulting in whole numbers (integers) ranging from 2 to 6. We can code this in BASIC in two lines. IF P/6 ◊ INT(P/6) THEN "ERROR" checks for whole numbers e.g. 21/6 = 3.5 an error. 42/6 = 7 will pass this test but will fail IF P/6 〈 2 OR P/6 〉 6. Actually, as often happens, the program becomes a little simpler if we reverse the last test to IF P/6 = 〈6AND P/6〉 = 2 THEN "PROCEED AS NORMAL". An error e.g. 42/6 = 7 will then carry on to the next statement which is the error message, so saving another jump statement.

```
Sample runs of program "LOAN SCHEME"

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 36 MONTHLY PAYMENTS OF                 19.10        INCLUDING CHARGES OF 187.50
```

Loan scheme — final version

```
3 PRINTCHR$(147)
4 PRINT"LOAN SCHEME"
5 DEFFNA(X)=INT(X*100+.5)/100
10 INPUT"COST OF GOODS";S
20 INPUT"INTEREST RATE";I
25 INPUT"PERIOD ? IF ALL TYPE ALL";P$
26 IFP$<>"ALL"THENP=VAL(P$):GOTO 28
27 GOTO31
28 IFP/6<>INT(P/6)THEN30
29 IFP/6=<6ANDP/6>=2THEN31
30 PRINT"INVALID PERIOD":GOTO25
31 INPUT"DEPOSIT OFFERED ? IF LOWEST TYPE MIN";D$
32 IFD$="MIN"THEN40
33 D=VAL(D$)
34 IFD<S/10THENPRINT"MINIMUM DEPOSIT IS";FNA(S/10):GOTO31
35 GOTO50
40 D=S/10
50 B=S-D
55 J=1
56 IFP$<>"ALL"THEN60
57 FORP=12TO36STEP6
60 C(J)=B*(I/100*(P/12))
```

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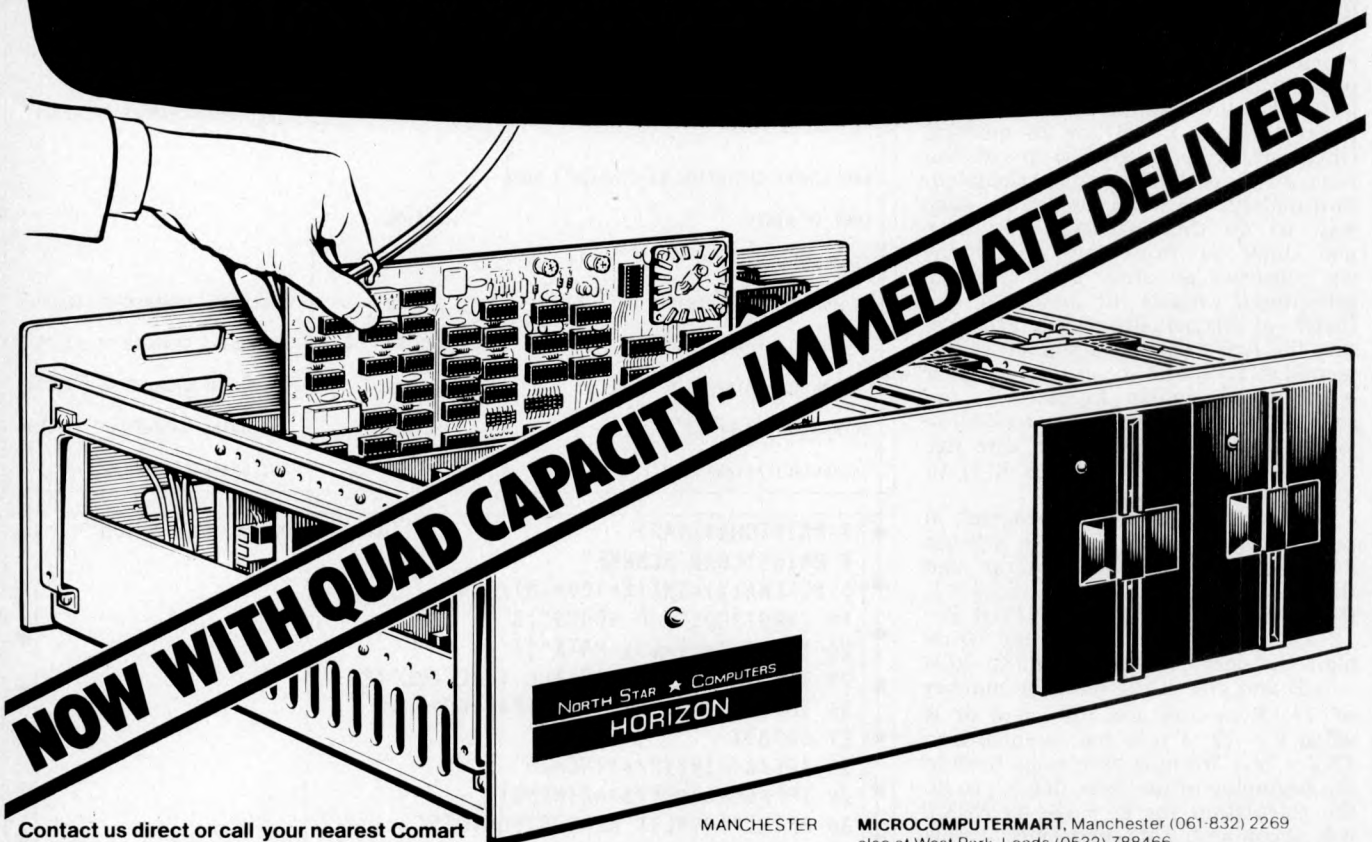

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The coding now is:

```
28 IF P/6 ◊ INT(P/6) THEN 30
29 IF P/6 = ⟨6 AND P/6⟩=2 THEN 31
30 PRINT "INVALID PERIOD" : GOTO 25
```

There is one further valuable addition we could make to the program, and that is to give the option of having the output printed out. Devices external to PET are given numbers and that for a printer is usually 4. To output to the external device, a file is opened — OPEN 1,4 is the code. Now any statement starting PRINT #1, will cause the output to be sent to that device. So after enquiring whether the option is wanted and receiving the answer "yes" we run through a series of statements identical to lines 82 to 104 but with PRINT #1, instead of PRINT. Actually, they are not quite identical for you will notice that the TAB instructions are slightly different. This is caused by the way the printer used, a Teletype 43, responds to the TAB instruction. On PET, TAB(30) causes printing to start in the 30th print position from the beginning of the line, but on the Teletype TAB(30) causes printing to start in the 30th print position from where the print head is situated. This means that if we have already printed DEPOSIT, printing will start in print position 37 and not 30 as required. We therefore have to deduct the length of any items already printed, including spaces between words, from the required position number e.g. TAB(23) after DEPOSIT.

Another addition has been made to the printed output. If the quotation is given to the customer, we should show the credit charges which would be made in each case for the differing periods. This information is present in variable C and we can use the same technique to preserve the values as we did for R, i.e. C(J) is substituted for C in lines 60 and 70. For clarity we want to print the credit charges on the same line as the repayments, but we cannot give the instructions in the same statement line since we have to GOSUB to format C(J). By ending the payment print instruction with a ";" we suppress the carriage return and line feed, so achieving our object. The only other alteration to the program occurs in line 102 where we alter THEN 9999 to THEN 110 to give the printed output option.

We now have a fairly comprehensive answer to our problem, which even the most inexperienced junior can use to give quick and accurate answers to queries. The full listing does show quite a complicated piece of programming, and I certainly would not like to have to sit down write it all at one go. However, I hope you have seen that it really is not all that complicated if broken down into steps, as I have done. The experts may scorn my methods, but they meet the criteria I have laid down. The program works and it does just what I want. It operates quickly enough for the output to be shown both on the VDU and the printer at the fastest they will operate. No doubt it could be made more elegant, but time is short and there are, no doubt, many other tasks to perform.

```
70 A=B+C(J)
77 R(J)=A/P
78 IFP$<>"ALL"THEN81
79 J=J+1
80 NEXT
81 PRINTCHR$(147)
82 PRINT" LOAN SCHEME"
83 PRINT
84 Z=FNA(S)
85 GOSUB10000
86 PRINT" COST OF GOODS";TAB(30-LEN(Z$));Z$
87 PRINT
88 Z=FNA(D)
89 GOSUB10000
90 PRINT" DEPOSIT";TAB(30-LEN(Z$));Z$
91 PRINT
95 J=1
96 IFP$<>"ALL"THEN98
97 FORP=12TO36STEP6
98 Z=FNA(R(J))
99 GOSUB10000
100 PRINTP ;"MONTHLY PAYMENTS OF";TAB(30-LEN(Z$));Z$
101 PRINT
102 IFP$<>"ALL"THEN110
103 J=J+1
104 NEXT
110 PRINT"DO YOU REQUIRE PRINTED RESULT ?"
120 PRINT"IF YOUR ANSWER IS YES, THEN SWITCH"
130 PRINT"THE TELETYPE ON AND LOAD PAPER"
140 PRINT"PRESS DATA BUTTON ON TELETYPE AND"
150 PRINT"TYPE 1 ON PET KEYBOARD"
160 PRINT"OTHERWISE TYPE 2"
170 INPUTH
180 IFH<>1THEN9999
190 OPEN1,4
200 PRINT#1,"LOAN SCHEME QUOTATION BY C.AXSON & SONS"
210 PRINT#1
220 Z=FNA(S)
230 GOSUB10000
240 PRINT#1," COST OF GOODS";TAB(37-LEN(Z$));Z$
250 PRINT#1
260 Z=FNA(D)
270 GOSUB10000
280 PRINT#1," DEPOSIT";TAB(43-LEN(Z$));Z$
290 PRINT#1
300 J=1
310 IFP$<>"ALL"THEN 330
320 FORP=12TO36STEP6
330 Z=FNA(R(J))
340 GOSUB10000
350 PRINT#1,P ;"MONTHLY PAYMENTS OF";TAB(28-LEN(Z$));Z$;
360 Z=FNA(C(J))
370 GOSUB10000
380 PRINT#1,TAB(10);"INCLUDING CHARGES OF";Z$
390 PRINT#1
400 IFP$<>"ALL"THEN9999
410 J=J+1
420 NEXT
9999 END
10000 Z$=STR$(Z)
10010 L=LEN(Z$)-2
10020 IFL=0THEN10060
10030 IFMID$(Z$,L,1)="."THEN10090
10040 L=L+1
10050 IFMID$(Z$,L,1)="."THEN10080
10060 Z$=Z$+".00"
10070 GOTO10090
10080 Z$=Z$+"0"
10090 RETURN
```

ON THE LINE

David Hebditch draws the series to a close with an update of the new Personal Computer Network.

"End of transmission"

Since this column started some fifteen months ago, we have provided a fairly complete teach-in on the hardware and software technology of data communications on micro systems. We've also explored the increasing importance of telecommunications in an era of energy crisis; move the information to people rather than people to the information.

In that context, it's not "niggling" to keep pressure on the Post Office to improve their quality of service; it's almost a public duty. Every time I get twinges of guilt something happens to banish them (and if anyone from the PO is reading this, perhaps they could explain why there is still no telephone in my new house on the first anniversary of the order being placed).

The stand at the PCW show last year attracted a lot of interest. A pair of PETS were used by many visitors to swap messages with the PETALECT stand. The link from my Apple to Rair Timesharing's PDP-11 worked well . . . we also linked successfully to a DEC System 10, an IBM 370/168 VM System, a CDC something-or-other and (wait for it) an Atlas! I hasten to add that these calls were established by authorized users.

The Personal Computer Network was launched at the show and we have since signed up over sixty participants. This list will, I believe, rise to well over a hundred before the end of the year. Even if you have no communications hardware yet, you can still participate in the technical discussions by completing the form in the November PCW, or by writing to me care of the Editor.

Even when we have published the directory of members, there would still seem to be a practical problem in the administration of the network. It's occurred to me that a lot of the time, money and patience can be wasted by working through the list to find someone ready to go "on line". What we need is some kind of computer "clearing house" which you can connect to and enter your times of availability and to find out who else is looking for a contact.

Accordingly, I have started discussions with a couple of commercial time-sharing companies to see if they would be prepared to provide such a facility. In addition to providing a central directory source, we could also implement an extensive range of other goodies. Here are some of them . . .

An online, frequently updated *bulletin* could be used instead of the traditional newsletter, to keep members in touch with development. A mailbox or *message-switching* program would enable electronic mail experiments to be carried out. *Tele-conferencing* techniques could be employed as a means of developing new concepts and practices in such areas as high-level protocols. A series of *communications test programs* can aid the development of special hardware and software at the user site.

The availability of high capacity disc units with the time-sharing service could provide a low-cost means of storing bulk data. Some of the prices I have seen quoted suggest that this arrangement may work out to be cheaper than diskettes for many micro users.

Obviously the existing software library could be made available (for running on the mainframe) but we could also usefully experiment with the *distribution of programs* written in basic BASIC.

And last, but certainly not least, it should be possible to use the big com-

continued on Page 101

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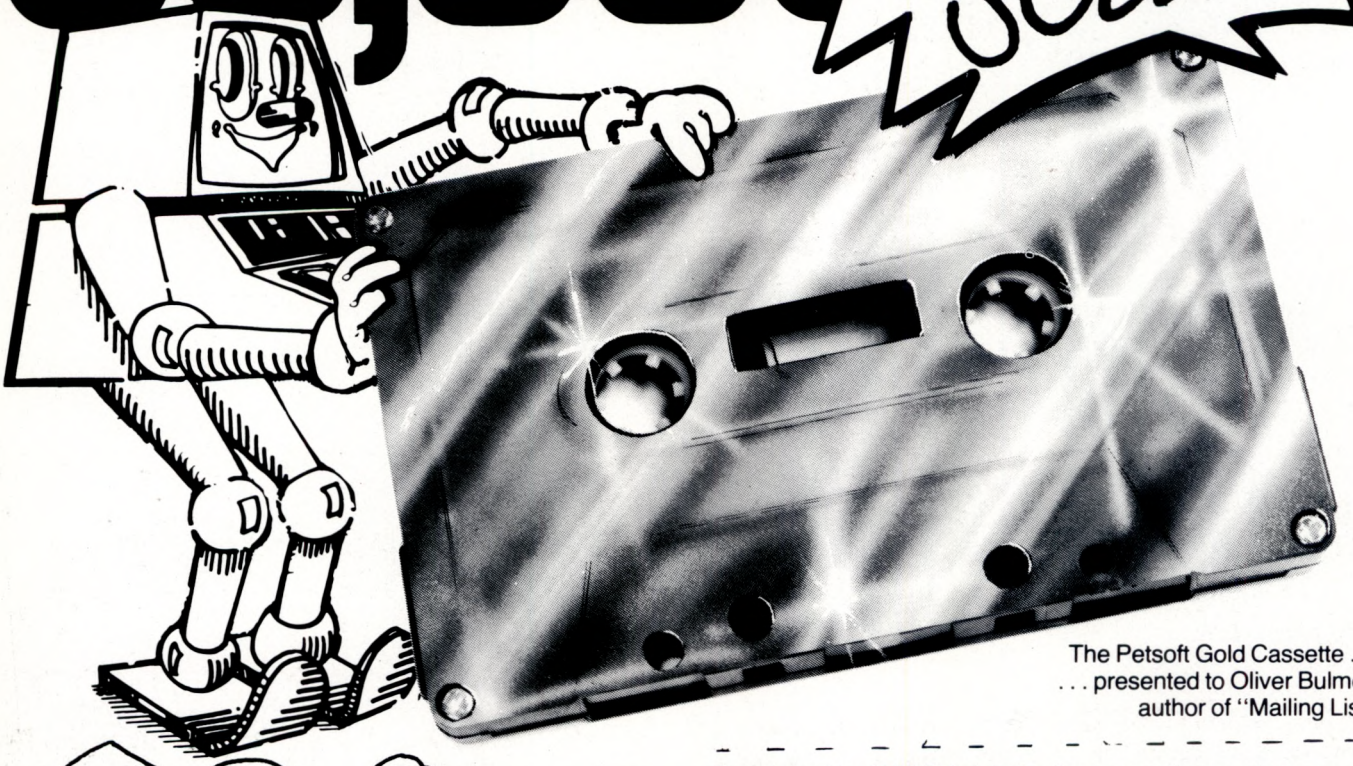

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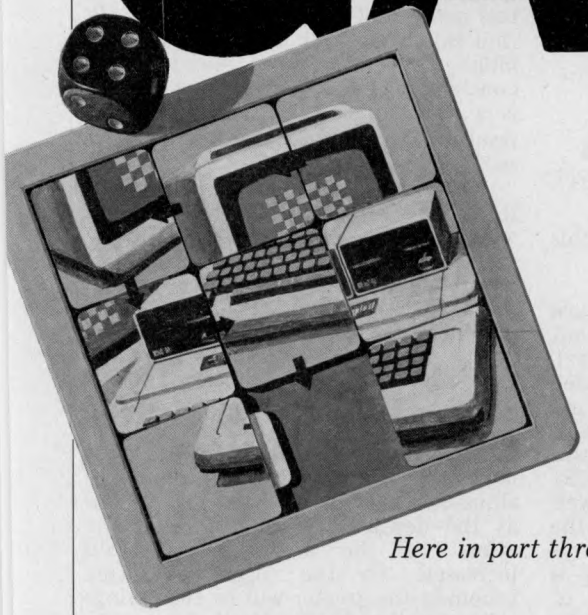


PRUNING BIG TREES

Here in part three of the series, David Levy introduces a minimax refinement known as the alpha-beta algorithm.

Games with big trees

Last month we discussed the use of the minimax method to search game trees, using noughts and crosses as our example. This is a game with sufficient symmetry to reduce the number of essentially different moves at the start to three: the centre, a corner and the middle of an edge. At the second ply there are a total of 12 essentially different positions, so with only seven spaces then remaining there will be an upper bound of 12 x 7! on the total number of terminal positions in the whole of the game tree. In practice the total will be somewhat less than this figure, since a number of paths will lead to a win for one side or the other, or a draw (i.e. a position in which every row, column and diagonal has at least one "0" and one "X" in it), before all nine elements of the 3 x 3 array have been filled. In order to play a perfect game of noughts and crosses with the crudest of evaluation functions, we could search the game tree exhaustively, using a score of +1 for a variation won by the program, −1 for a variation won by the opponent, and 0 for a draw.

Most interesting two-person games have much larger trees than this: in chess there are roughly one million terminal positions in an average 4-ply search, in Go the figure would be ten thousand million for a 4-ply search at the start of the game. How can we cope with such gigantic combinatorial growth in our game trees? The answer lies in a refinement of the minimax method known as the alpha-beta algorithm.

The alpha-beta algorithm

The alpha-beta algorithm owes its power to the argument that if a player can choose from a number of moves, once he finds one move which serves his purpose he need not examine the remainder of the moves in that group. Let us look at a simple two-person game tree to illustrate this point (Fig. 1).

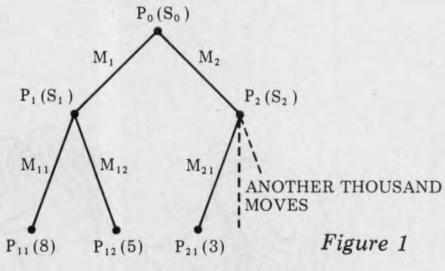


Figure 1

We shall assume that a program searches the tree from left to right, and that the evaluation function assigns scores of 8, 5 and 3 respectively to the terminal nodes P_{11}, P_{12} and P_{21}. If the program is to move from position P_0, it first considers move m_1 and then tries to decide what its opponent will do from position P_1. The opponent may choose between scores of 8 and 5, and since we have adopted the convention that the opponent's target is a low score, the opponent will choose position P_{12} with a score of 5.

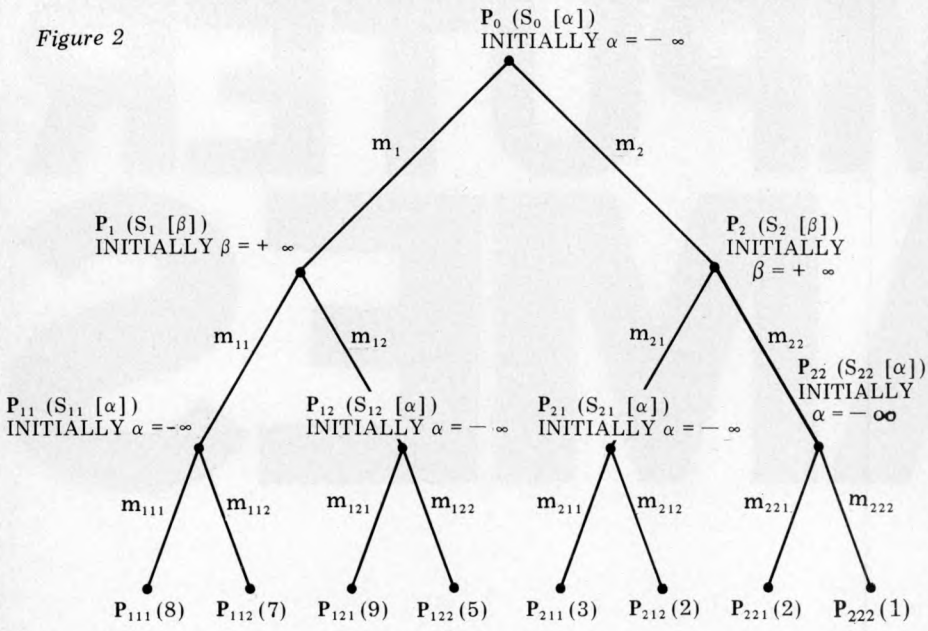
The program now knows that if it chooses m_1, its opponent can prevent it from achieving a score of more than 5. This value of 5 is therefore the value of position P_1, assuming correct play by the opponent, and so the value 5 is assigned to S_1. We call this process of assigning values as the program backtracks up the tree "backing-up".

The score at S_1 is now backed up to S_0 and the program then considers position P_2, to determine whether it will prefer to play move m_1 or m_2. It sees that from position P_2 its opponent can, if he wishes, move to P_{21} for a score of 3, and since 3 is better than 5 from the opponent's point of view, the program will wish to deny its opponent this option and it will not, therefore, choose move m_2. It is completely irrelevant what the scores are for the thousand of unexamined brother nodes, P_{22}, P_{23}, . . . P_{21001}, because the move m_{21} is already know to refute m_2. Thus the program has determined that m_1 is better than m_2, even though it has examined only 3 of the 1,002 terminal nodes of the tree!

Of course this particular example has been specifically designed to sell you the alpha-beta algorithm, and most game trees do not allow us to get away so lightly, but the savings achieved with this algorithm are certainly substantial enough to make alpha-beta an almost essential segment in any program that searches two person-game trees. The algorithm always chooses the same move that would be selected by the minimax algorithm, but usually in a fraction of the time.

Since alpha-beta is so very important in game playing, I make no apologies

Figure 2



for including another, more complex example (Fig. 2). This will show how the method words for a 3-ply tree and will illustrate why it has been given its strange name.

Initially, all non-terminal nodes at even ply are assigned the value $-\infty$ (α). All non-terminal nodes at odd ply are assigned the value $+\infty$ (β). As usual it is the program's turn to move from the root position P_0, and the program is trying to maximize the value of α. The opponent moves from positions P_1 and P_2, trying to minimize the value of β. The program moves from the positions at ply—2 (P_{11}, P_{12}, P_{21} and P_{22}), trying to maximize α.
The tree search now proceeds as follows:

1 Examine P_{111}. The score of 8 is greater than $-\infty$ so α at S_{11} is set to 8. This score is then compared with β at S_1 and found to be less than $+\infty$, so this value of β is also set to 8. In order to decide whether the program might be willing to play m_1, this score of 8 at S_1 is compared with $-\infty$ at S_0 and found to be greater, so α at S_0 is set to 8.

2 Examine P_{112}. The score of 7 is less than α at S_{11}, which is now 8, and since it is intended to maximize α, the value of α at S_{11} is not adjusted, and therefore the value of β at S_1 and that of α at S_0 also remain unchanged.

3 Examine P_{121}. The score of 9 is greater than $-\infty$, so α at S_{12} is set to 9. This score is then compared with β at S_1 and found to be greater, and since it is intended to minimize β the program can reject move m_{12}, knowing that its opponent can do better with move m_{11}.

4 The left hand side of the tree has now been examined and the search proceeds to the comparison of the best score achieved so far (8) with whatever can be reached, assuming best play by both sides, if the program should choose m_2. This part of the search commences with an examination of P_{211}, which is found to have a score of 3. This is compared with α at S_{21} and found to be greater, and since it is intended to maximize α the program will set this value of α to 3.

5 Examine P_{212}. The score of 2 is less than 3, so α at S_{21} (currently 3) is left unchanged, since it is intended to maximize α. This score of 3 is then compared with β at S_2, found to be lower, and since it is intended to minimize β this value of β at S_2 is set to 3. Finally this value of 3 is compared with α at S_0 (currently 8) and found to be lower. Since it is intended to maximize α, the program already knows that m_2 is inferior to m_1, because playing m_2 is not consistent with maximizing α.

The search is now over and it can be seen that only five of the eight terminal nodes needed to be examined. If you wish to verify the validity of this process by practical means, try assigning different sets of values to positions P_{122}, P_{221} and P_{222}, and you will always find that the program prefers move m_1 to move m_2.

How powerful is the alpha-beta algorithm?

During the past few years there has been considerable research into the question of just how big are the savings achieved using this algorithm rather than simple minimax. A full discussion of the theoretical and practical results of this research is well beyond the scope of this series, but the studious reader will find this work well documented in the bibliographic references found at the conclusion of this article. What follows is a summary of the most important results, and a brief discussion of their significance.

Monroe Newborn has investigated the power of the alpha-beta algorithm when searching game trees in which the moves within any group are examined in a random order. Table 1 shows, for various branching factors (b), the number of terminal nodes which we would expect a program to examine, using alpha-beta, in searches of 2 and 3-ply.

It will be seen that as the branching factor increases, so the proportion of nodes that can be ignored thanks to the alpha-beta algorithm also increases. And as the depth of search increases the effect of the algorithm is again increased. So the bigger the tree becomes, the greater will be the savings using the alpha-beta method.

The savings become even more dramatic when the branches of the

Table 1

	2-ply search		3-ply search	
b	total terminal nodes	expectation	total terminal nodes	expectation
2	4	3.67	8	6.84
4	16	12.14	64	40.11
8	64	38.65	512	220.37
16	256	122.11	4096	1214.45

"Are you the computer gentleman who asked for two parallel ports?"

tree are examined in an intelligent order. In general it is true to say that within any group of moves the best one should be examined first, so that if the best one is not good enough we need not waste time in examining the second best, third best and inferior moves. If the tree is searched in such a way that the moves are examined in their optimal order, then the number of terminal nodes examined will be approximately $2 \times \sqrt{N}$, where N is the total number of terminal nodes on the tree. Thus, for a game of chess in which the branching factor is typically 36, the number of terminal nodes on the tree is 36^4 for a 4-ply tree. Yet by using the alpha-beta algorithm, if the tree is optimally ordered we need examine only 2×36^2 terminal nodes before we find the best move from the root of the tree, a saving of well over 99% when compared with the simple minimax method.

Taking the figures from Newborn's results quoted above, we can compare the expected number of nodes examined with random ordering and the number of nodes examined with optimal ordering (Table 2).

Table 2	2-ply search		3-ply search	
b	random	optimal*	random	optimal*
2	3.67	3	6.84	5.66
4	12.14	7	40.11	15
8	38.65	15	220.37	44.248
16	122.11	31	1214.45	127

*The approximation $2 \times \sqrt{N}$ referred to above is made slightly more accurate by subtracting 1. This is not important for very large trees but it has been done here for the sake of accuracy.

I hope that the reader is now convinced that for all two-person game trees, except the smallest of the small, alpha-beta is a must. The most important implication of these results is that if it is at all possible, you should generate and/or examine the moves within any group or family in such a way as to take maximum advantage of the savings that can be achieved, and this means ordering the search in some way. We shall discuss various techniques for speeding up the alpha-beta search in our next month's article, but one obvious method can be mentioned here. First, generate all the moves at the root of the tree, m_1 m_2 . . . etc., and evaluate the resulting positions with the evaluation function. Sort the moves so that the move with the highest score will be examined first, then the move with the next highest, and so on.

Next look at the first position on the list and generate its successor positions. These are assigned scores using the evaluation function and they are then sorted, this time with the lowest scored position coming at the top of the list and the highest scored position at the bottom. (This is because the program's opponent is trying to minimize the score.)

This process is repeated all the way down the tree, except for the terminal nodes, which are not sorted. Now, when searching the tree with the alpha-beta algorithm, the tree will be found to be much nearer an optimally sorted tree than if this process had not been applied. One disadvantage of this method, however, is that it requires us to keep in memory all the successor nodes to each node on the principal variation, apart from the terminal nodes. So in a search of a chess tree, with 36 moves at each node, this method would require us to keep in memory:

a the root node
b 36 nodes at each level of look-ahead apart from the terminal node.

In order to combat this problem we might try to find an extremely compact method of representing a position, but if this compactness results in a slowing down of the search process while each position is unravelled or created, much of the effect of the fast alpha-beta algorithm will be lost. Such problems require careful thought and it is often necessary to experiment before the best balance is achieved between representation and optimality of search.

Other useful techniques for examining the moves in a sensible order can often be found by thinking a little about the nature of the game. Let us consider once again the game of noughts and crosses. The elements of the 3 x 3 array might be numbered as in the following diagram:

1 2 3
4 5 6
7 8 9

A simple way to generate all the legal moves from any position is to look at the elements, starting with 1 and working up to 9, and putting any empty space on the move list. But with a basic knowledge of the strategy of the game we can speed up the search process by looking first at element 5, then 1, 3, 7 and 9, and finally at 2, 4, 6 and 8. This method of move generation takes no longer than 1, 2, 3, 4, . . . 9, yet it enables the alpha-beta algorithm to examine the moves in a more sensible order, thereby taking us closer to an optimal search process.

Next month we shall examine a flow-chart for the alpha-beta algorithm and look at further ideas for speeding up the search process.

Task for the month

Write a program to play noughts and crosses, taking advantage of symmetry and employing the alpha-beta algorithm. Search the whole game tree using the primitive evaluation function described above (+1 is a win for the program, −1 a win for the opponent and 0 a draw).

Test the program (a) when the moves are generated in a random order; and (b) when the moves are generated in the order: centre, corners, middle of edges. The results should indicate a useful improvement with ordered search over random search.

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Interrupt — cont from P66

promising of the new technologies — viewdata — cannot be seen in its true development without recognition of the social fact that it's closely linked not only to television ownership, but also to the telephone. Ask yourself . . . how could viewdata and all that it promises for computer terminals in the home have entered a society which had not already placed a premium on establishing comprehensive telecommunications links.

Further, it's not enough to just recognise that these products — and technologies — are developing in the social context outlined above; in turn we should also ponder the way in which the particular form of television we all know so well has developed in the western world. A moment's thought enables us to see that the TV as we know it was not a technology, simply invented in isolation for later massive effect.

In important ways, television responded to and was shaped by social trends in society, the most significant of which was the twin growth in industrial society of high geographical mobility alongside the break-up of the extended family and resultant shift to the present nuclear form (mum, dad and the kids living away from relatives and moving house a number of times during their lives).

Television — that small box in the living room — neatly adapted to fit this growing trend of an isolated, yet self-sufficient family type. It was no accident . . . the idea of putting it in a corner of the private home was developed at the cost of quality and versatility of image (compare, for instance, TV to the cinema). This is just one of many examples of recent home technologies that consolidate and encourage our latter day family structure.

I would be the first to concede that space available restricts me to only a simple sketch. I hope, however, I have been able to show that the way to look at microelectronics is not in the manner adopted by most of the mass media, or even the NCC project.

The spectre of technological determinism must be removed . . . the idea that technology is in some way aloof from society. Only by doing this will people recognise that reality is much more complex than the starry-eyed futurologists would have us believe. And equally we must see that, just as the silicon chip is a product of a particular social milieu, so too will be any similar developments in the future. They will not carry the inevitable consequences of an alien technological invasion, rather they will influence the decisions people will make about how our society is, and will in the future, be organised.

Frank Webster, High Wycombe, Bucks.

BOOKFARE

A cold blast of realism . . . Malcolm Peltu takes as his main theme this month, Joseph Weizenbaum's critique of The Computer Age: A Twenty Year View.

The program kills!

"The computer in its modern form was born from the womb of the military. . . It is probably a fair guess, although no one could possibly know, that a very considerable fraction of computers devoted to a single purpose today are still those dedicated to cheaper, more nearly certain ways to kill ever larger numbers of human beings."

This sour (and somewhat ungrammatical) note characterises the tone of one of the most important critiques of the current wave of euphoria about the potential of micro-inspired information technology, a chapter by *Joseph Weizenbaum* in what is probably the best book to-date on the approaching "information revolution".

The book is called *The Computer Age: A Twenty Year View* and includes essays from a broad spectrum of American specialists such as microelectronics pioneer and chairman of Intel, Robert Noyce; leading pundit on the emerging "information society", Professor Daniel Bell of Harvard University; and luminaries of what Weizenbaum calls the "artificial intelligentsia", — Seymour Papert, Marvin Minsky and Terry Winograd. But it is on Weizenbaum's critque of the book, included as the last chapter, that I wish to concentrate because it poses questions that are seldom even hinted at in the general technological drive.

Weizenbaum is a professor of computer science at the Massachusetts Institute of Technology (MIT), but that does not stop him from questioning the ethical foundations of that subject and even the sometimes false worship paid to MIT (which he calls "the very temple of high science and technolgy").

In *Computer Power and Human Reason,* which was mentioned in a previous review, Weizenbaum presented a detailed argument about why he fears that computers are unlikely to be employed for the benefit of humanity. He has sharpened these arguments in his critique of *The Computer Age.*

One by one he knocks down the bullish dreams of the technological enthusiasts. On computers in education: "No fix, technological or otherwise, of the American education system that does not recognise that American schools are rapidly becoming America's principal juvenile minimum security prisons can be expected to have socially therapeutic effects. Giving children computers to play with, while not necessarily bad in itself, cannot touch this or any other real problem".

Will the home computer become as pervasive as today's television sets, he asks? The answer is a firm NO. He says that the picture painted of the home of the future with robots cleaning wall-to-wall carpets is one of a "middle class, even an upper-middle-class home" and that typical personal computer applications have little relevance to solving the real problems found in the majority of homes.

He likens the "euphoric dream" of home computer enthusiasts to the belief that radio, TV and satellite technology would expose the mass of children to the beneficial influence of being offered at home the correctly spoken word, great drama, great literature and the most excellent teachers. But in the end, these technologies have merely delivered, according to Weizenbaum, "an occasional gem buried in immense avalaches of the ordure of everything that is most banal and insipid or pathological in our civilisation".

The obsession with computer games, particularly war games, indicates that home computers are about to follow the "same calamitous scripts," says Weizenbaum. He quotes an MIT student who commented while playing computer spacewar that, "We ought to get more points for killing than merely surviving" and says that this could prove to be prophetic in a rather deeper sense.

Weizenbaum's over-riding fear is that people place too high reliance on the accuracy of computer-produced results, although the computer system may be contaminated by a "broad spectrum of inadequate and inaccurate" facts, say in economic models. During the Vietnam war, for example, an Air Force computer was programmed to alter all the coordinates for bombing missions in Cambodia to make it appear that the bombs were dropped on "legitimate" targets in Vietnam. These false figures were then transmitted to a Pentagon computer and were accepted as truthful because they were provided by computer.

Weizenbaum uses this incident to pose serious questions about the responsibility of computer scientists for the application of their technology and goes as far as to suggest that the programmer who wrote the systems to

Illustration by Mike Litherand

falsify bombing reports in Vietnam falls into the same *moral* category as an Adolf Eichman, who was "just obeying orders".

He says that the frequently used arguments about the neutrality of computers and the inability of programs to exploit or correct social deficiencies are an attempt to absolve programs from responsibility for the harm they cause, just as bullets are not responsible for the people they kill. But, he suggests, that does not absolve the technologist "who puts such tools at the disposal of a morally 'deficient' society."

He ends with a number of unanswered questions; questions that are rarely asked but which raise vital issues about the limitations of computing power. For instance: What limits ought people in general and technologists in particular *impose* on the application of computers? What irresistible forces are our "worship of high technology" bringing into play? And what is the impact of the computer, not only on the economies of the world or on the war potential of nations, but on the self-image of human beings and on human dignity?

Weizenbaum's chapter is only 20 pages long but its partisan plea on behalf of humans against machines is worth more than the reams of outpourings that ushered in the new decade on a wave of technological claptrap. It also provides a magnificent coda to the generally thoughtful, thought-provoking and knowledgeable book.

Although it costs about three times the price, *The Computer Age* is better value than the *Impact of Microprocessors on British Business* (which is the result of a survey funded by the Department of Industry to find out the consensus view of 35 British businessmen, trade unionists and assorted pundits on the effect of micros).

The consensus opinion given most publicity was that "Britain has no choice but to go forward with microelectronics — or go out of business". That emphasis is not surprising, given that the aim of the study was to help the government's public relations exercise on behalf of the micro. Amongst its more than 200 agreed conclusions the book provides a bland summary of the main issues but it lacks the technical depth and social scope of *The Computer Age*. Surely it's time to go beyond thinking of the micro in terms of profits and to relate the technology to criteria of human and social objectives, as so trenchantly stated by Weizenbaum.

Business bits

Following in the jetstream of the microcomputer's surge into the small business market is a shoal of plain-English intros to computers, aimed at the much-sought-after business user.

Those books always claim to be jargon-free and to give a practical insight into the realities of business computing. Often, however, they are infested with jargon, Boolean algebra and outdated technology. And the picture painted of the real world rarely exists beyond the dreams of the systems analysts as immortalised in systems specs that work on paper but nowhere else.

Three recent books avoid these pitfalls while a fourth, *Purchasing Computers* by *Edward Sambridge*, should be compulsory reading for anyone involved in obtaining a computer.

Two of the new business guides are produced by the same publisher, Input Two-Nine. Although they are both aimed at what appears to be the same type of reader and much of the same ground is covered, they differ in style and scope. The second edition of *Computerisation for the Small Business* is by *Ted Cluff*, Secretary-General of the Institute of Data Processing Management and provides a brisk and bracing march through the basic landscape of business computing, pointing out all the necessary landmarks but without lingering to savour the details. Each chapter ends with a practical checklist, which is alright as a quick refresher course on the landmarks but is full of too many general often unanswerable questions like "Is there a will in the company to succeed in the operation of installing a computer?"

Journalist *Nicholas Enticknap's The Philips Guide to Business Computers and the Electronic Office* is more of an A to Z guide of the detailed terrain. Despite its commercial sponsorship by Philips, the text avoids any bias, although Philips gets the lion's share of the photographs, including a spread on their equipment for the electronic office.

Enticknap places current computing in its historical context and takes great pains to describe in informal language the nitty gritty of DP life, from operating systems and programming languages to collators, data range checks and acoustic couplers. It's a tougher read than Cluff's crisp words but in the end more rewarding for someone wanting an understanding of the way computers work, as well as how to manage them.

Although not solely for the business reader, *Personal Computing* by *Daniel R. McGlynn* provides a good introduction to the potential of these smaller, cheaper systems in professional and small business applications. It covers all the expected ground in terms of scope of personal computer market, technology and applications. What separates it from the over-enthusiasm which mars some books on personal computers is a clear and frequently restated perspective of some of the limitations of personal computers — particularly in software. Unfortunately, as is typical of too many Stateside books, it's totally oriented to the US market and the publishers haven't even attempted to angle it for the UK. This means you are told of computer stores in Birmingham Alabama but not Birmingham England; it has a skimpy list of stores in the rest of England. And its list of "foreign" magazines includes only one UK monthly — Systems International — but none of the personal computing press.

The Sambridge book may not be exactly bedside reading but it is an invaluable desk-side reference, containing a detailed analysis of "model" terms of contracts for computers, with the discussion aimed particularly at the first-time user. It's based on work by the Nationalised Industries Computer Committee and the Institute of Purchasing Supply. By raising questions like agreed standards of performance, the supplier going bankrupt and attachment of equipment, Sambridge gives a good whiff of the realities of computing life, although nobody should think that, merely by following the guidelines, all problems will be sorted out in the hairy customer-supplier ongoing trauma situation. (Note: A bottle of good wine to the first PCW reader to get the above last paragraph published in Private Eye's Ongoing Situations column).

Fables and chips

What is there in common between Franz Kafka, Doris Lessing, Al Einstein, Beatrix Potter, the Book of Creation, E.M. Foster and H.C. Andersen. Answer: very little, except that *Leslie George Katz* has put together bytes from their works and produced a quirky and enjoyable little book, *Fairy Tales for Computers.*

The aim of the selection is to offer pre-electronic age fairy tales for computers in tomorrow's computer age to try to show them some of the quaintness of early human antipathy to the precision processing of intelligent computers. The selection is all very tongue-in-cheeky and, in some cases, very obscure. For example, *Beatrix Potter's Tailor of Gloucester* is all about the lack of a sufficient quantity of plum-coloured silk twist to finish a jacket. It's included because it pays such high compliment to a quantifiable measure! *(If you can understand that, dear reader, you're a better man that I - Ed).*

The most trenchant piece, in fact a gem, is *The Machine Stops* by *E. M. Foster.* This is a short story set in an age where a machine (it was written as early as 1928, long before he could name the beast Computer) runs a subterranean world of cocooned, pasty-bodied people — until something goes wrong . . . *The Nature Theatre of Oklahoma* by *Franz Kafka* is a typically surrealist piece about the day the Theatre advertised a paradise of employment and leisure which could be (and is by the editor) taken as a comment on ideas of the future "Leisure Society".

But *The Nightingale* by *Hans Christian Andersen* is a clear parable of our times, with a live nightingale at first rejected in favour of a more consistently reliable robot nightingale, but with nature triumphing in the end. All together, an invigorating little book. (Note: another bottle of vino to the first letter opened pointing out the deliberate mistake in this month's Bookfare; the winner must also give the corrected text).

Discussed in this month's Bookfare have been:
The Computer Age: A Twenty-Year View edited by Michael L Dertouzos and Joel Moses (Massachusetts Institute of Technolgy Press, London £15.00)
The Impact of Microprocessors on British Business (National Computing Centre, £5.50);
Purchasing Computers by Edward Sambridge (Gower Press, £12.50)
Computerisation for the Small Business by Edward G. Cluff (Input Two-Nine, £4.50)
The Philips Guide to Business Computers and the Electronic Office by Nicholas Enticknap (Input Two-Nine £3.95 or £4.95 hard-cover)
Personal Computers by Daniel R McGlynn (John Wiley & Sons, £6.00)
Fairy Tales for Computers edited by Leslie George Katz (Nonpareil Books, Boston, £3.00 available from Colletts Books, London).

SIMPLE TV/MONITOR CONVERSION

Largely for reasons of cost, many a micro user will make do with an ordinary domestic TV, rather than bear the expense of a purpose built VDU. That means one has to suffer all the usual problems of degradation of image — caused to some considerable extent by a need to use the set's unnecessary demodulation circuitry and the consequent inclusion of an (often cheap and nasty) modulator. Peter Dunkley outlines one way around the problem.

Having chosen to attach a conventional television to the output of your micro, you face some problems. Generally the video is fed, via the r.f. modulator, to the TV's aerial socket. You have the cost and complexity of the modulator and connecting leads, together with the need for some form of power supply.

The degradation in quality (compared to a VDU) can be attributed to one major source. . . the filters in the i.f. and detector systems. Although these filters are essential for the normal functioning of the set in that they avoid sound, colour subcarrier and adjacent channel interference, for VDU purposes, they do limit the resolution of the display. Also the modulator and the tuning of the set can drift; results can degrade still further and continual fine tuning may become necessary.

A solution

Mains television sets nearly always have a live chassis and therefore are difficult to modify for an external video input; at the very least, they will require a bulky isolation transformer.

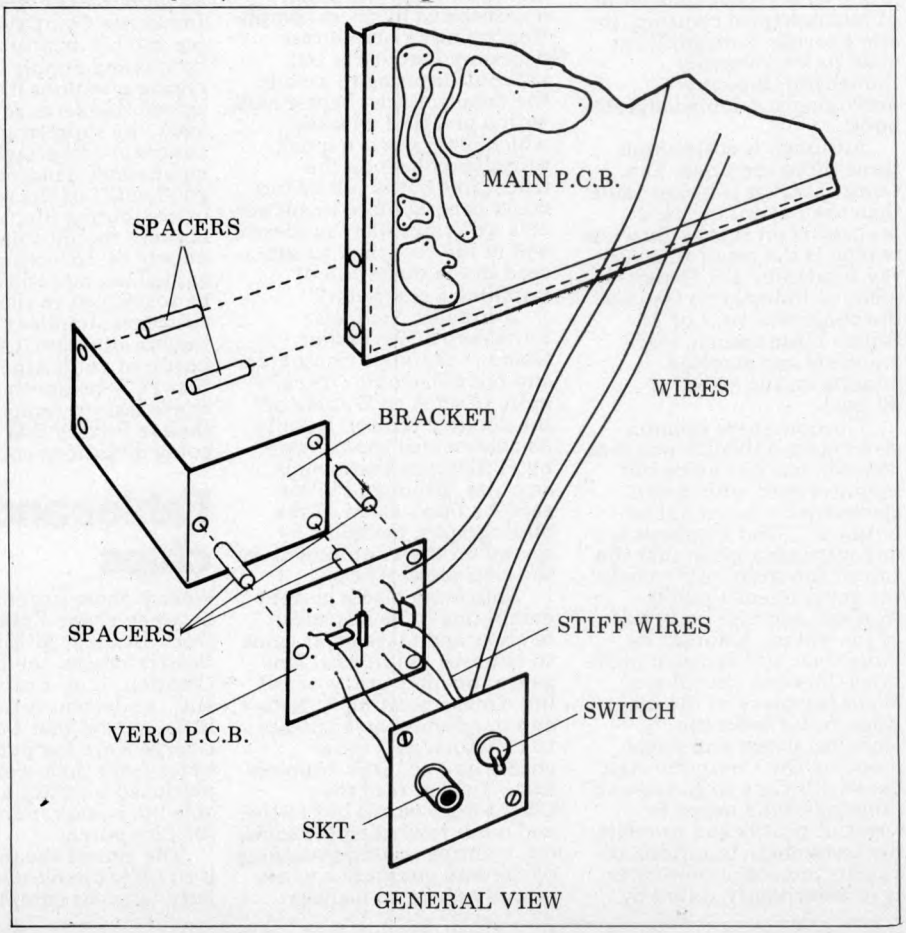
I decided the answer was to slightly modify a portable 12" mains/battery operated set, but in such a way that it could still function correctly as a television — at the flick of a switch. Therefore, although this exercise involves buying a low price, portable TV, its dual function gives an added bonus. The cost of modification is comparable with that of a modulator and accomplishment of the work should be within the capabilities of anyone who can solder, carry out limited mechanical work and who understands a little about television sets.

The model I used was a Rank Bush Ranger 2 (No. BM 6514 B). It's a 12" and I chose it because a) it's British, b) it's the cheapest I could find (£65-70 inc VAT from Comet) and c) perhaps most importantly, the set already contains an isolation transformer in its power supply.

Although the instructions I give here will relate specifically to this set, my guess is that most mains/battery portables will prove equally suitable — provided you're able to work out how to apply the same kind of modifications.

A glance at the service sheet and a quick prod with a scope probe showed that simple modification was not possible as virtually any additional wiring around the video detector resulted in degradation of the TV sound. Also, severe "damage" would have to be done to the printed circuit board and at that stage I didn't know whether the mod was practicable. I therefore designed the additional detector output stage as given in the diagrams (below and right).

The main pcb in the set is well legended on both sides so there should be no problem in following the instructions.



GENERAL VIEW

Removing the back of the television

(These instructions come from the relevant Rank service data sheet. . . it's worth having if you can get it).

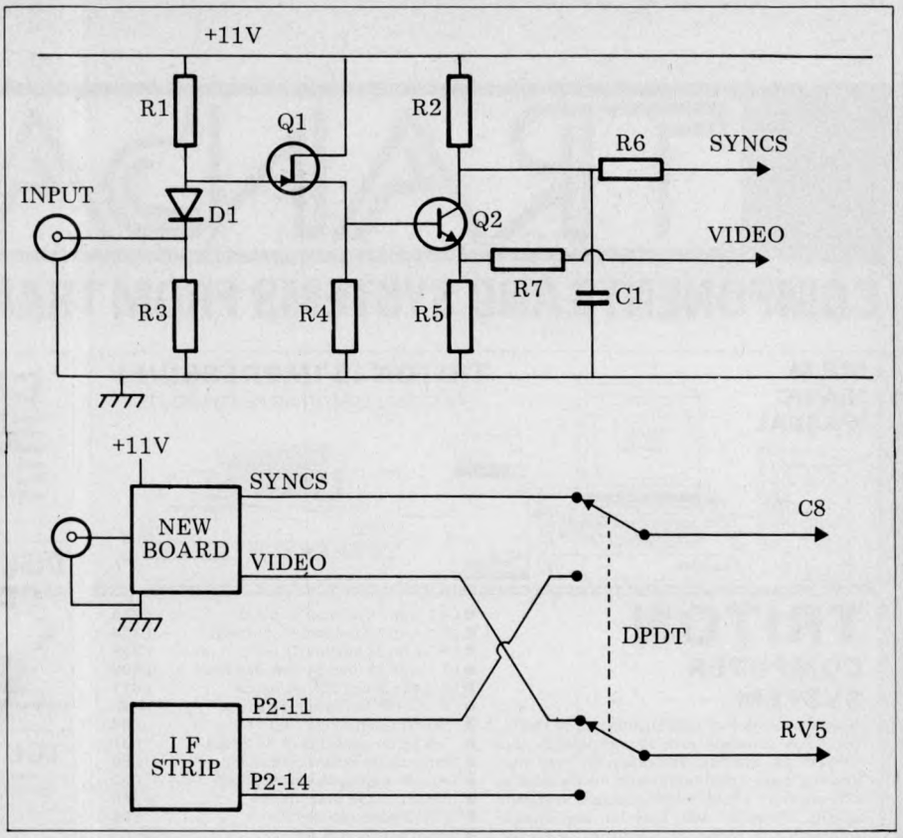
1 Remove the back of the receiver (several screws).
2 Slacken the keyhole slot screw at the top left hand side of the cabinet.
3 Slacken the pivot screw on the right hand side of the chassis, located by R23.
4 Remove the crt base.
5 Unclip the battery lead from the retaining clip on the top of the chassis.
6 Lift up the left hand side of the chassis until the keyhole slot screw is clear of its slot and the base of the chassis is clear of the retaining lug on the cabinet.
7 The chassis may now be swung away from the cabinet.
8 To re-assemble, reverse this procedure, ensuring that all the screws are retightened and that the crt base is refitted with its leads over the top of the main chassis.

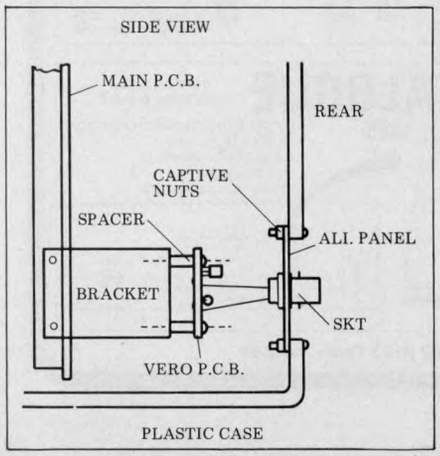
Making the mods

On the main pcb locate contrast pot RV5 and plug 2 pin 14 (bottom edge of pcb). These are joined by a wire (green?) and there's also a grey wire between plug 2 pin 11 and C8; remove both wires neatly.

Locate also the following points; earth, which is the lowest edge of the main pcb, and 11v HT, the pcb track that runs part way round the tube neck hole in the middle of the board. When connecting the 11v HT use the end of R17 furthest from R47. Check these with a test meter before use.

Build the new board as detailed in the diagram. Make up a metal panel and metal bracket as shown and mount bracket, board and panel as shown in the diagrams. Cut a hole in the rear of the cabinet. As there are stiffening ribs inside the cabinet it's easiest to position the hole with reference to the inside and not just blindly mark out on the outside and hack away. Connect up the new panel to the switch and the old pcb. Wires are taken to the rear of the main pcb (the "wrong" side). . . allow a little slack to go round parts of the cabinet back when fitted. Stiff wires are best used for the switch and socket panel so that it supports itself in approximately the right position. After the cabinet back has been refitted, two screws then attach this panel to the rear of the cabinet (the diagrams should make this reasonably clear). Note that an additional step will now become necessary in the cabinet back removal instructions, i.e. remove screws holding modification panel in place.





Conclusion

Let me make it quite clear that I have only modified this particular set, and no other. As I pointed out earlier, although there is no reason why similar modification should not be done to other portables, each case would have to be considered individually. Also I made no attempt to build a high quality VDU with a bandwidth of 15-20 MHz; this was not my intention. However, a distinct improvement in display quality results on a 24 line by 40 character display when compared to a modulator fed system.

I don't claim too much originality for the actual design. There are great similarities between "my" circuit and the Rank original. On a video fed test card all the resolution gratings are comfortably visible whereas the same test card "off air" stops well short of this level of acceptability. I would estimate the resolution of the VDU to be in excess of 6MHz.

I demonstrated my set on a Nascom 1 and found that I could just about read a full line; ideally the line length needed reducing. Tweaking the HT voltage would probably help, but could introduce other problems. A better solution would be a software fix.

A note of warning. . . television sets do contain high voltages and are designed to be totally isolated from outside interference. As this modification violates this principle and the set is not "busy little finger" proof, the new panel should be connected to earth and an earthed mains lead fitted.

With your modified Bush, as a bonus you can still listen to your chosen programme while in VDU mode then at the flick of a switch you can flip over to watch the interesting bits. In addition, for those interested in portability and versatility, the VDU will function happily on 12 volts (drawing 1½ amps) — an ideal solution, perhaps, for the campsite micro enthusiast!

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R2 270R
R3 75R (82R if 75R not available).
R4 3K3
R5 270R
R6 470R
R7 100R

Capacitor
C1 1nF

SEMICONDUCTORS
D1 1N916 or similar
Q1 2N3819
Q2 BC172B (BC109C would do)

MISC
BNC socket 75ohm. (e.g. Radiospares 455-680)
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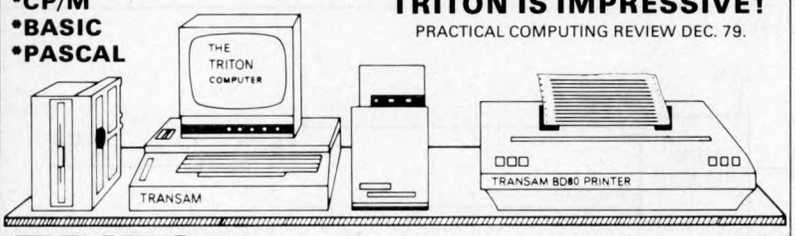

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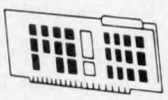

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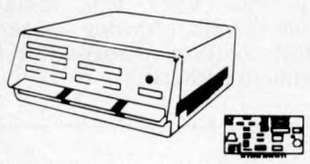

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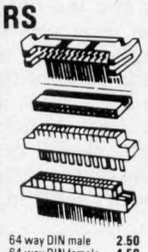

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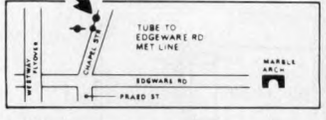

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Dick Pountain ruminates on the pruning of calculator programs, and the randomizing of a certain random number generator.

SAVING STEPS
MORE OR LESS RANDOM

Looking back to my promise of a couple of months ago to provide you with more advanced programming information, a problem occurs to me. Namely, what *is* advanced? Since I flatter myself that perhaps ten or more people read this column, what some readers find advanced may be insultingly obvious to others. (I have evidence from correspondence that there are people out there with more programming experience than myself!) Since this problem is essentially insoluble, all I can do is apologise now to any readers to whom the following is old hat.

What I want to do for a change is to follow through the evolution of a part of a program which I recently wrote and which nicely illustrates the logic of program development. (The notation used is for my Casio FX502P, but it can be followed on any calculator with indirect addressing. For the benefit of TI and Hewlett Packard owners: Min means STO, MR means RCL. M+ means SUM and M− means INVSUM, X ↔ M means EXC, and FRAC means INVINT.)

The program is for costing the printing of magazines, and one subroutine is designed to compute what combination of 32, 16 and 24-page sections are required to make up a given size of magazine. This is achieved by dividing the page total by 32 and then performing tests on the fractional remainder to see how many 24s and/or 16s are required. Stated in this way the program structure which immediately suggests itself is:

```
÷ 32 = Min 1 FRAC
− .75 = x≥0 GOTO 1
+ .25 = x≥0 GOTO 2
+ .25 = x≥0 GOTO 3
MRI INT Min1 0Min2 Min 3
GOTO 4
 LBL1 MR1 INT Min1 1Min2 0Min3
GOTO 4
 LBL2 MR1 INT Min1 0 Min2 1Min3
GOTO 4
LBL3 MR1 INT−1=Min1 1Min2 Min3
LBL4
```

The numbers of 32s, 24s and 16s required are now in memories 1, 2 and 3. Like most of my first attempts, this is a naive and horribly wasteful approach, but it works, which is better than having something elegant which doesn't!

What measures suggest themselves to refine it? The three conditional branches are clumsy; perhaps indirect addressing could eliminate them. The idea of "testing" expressed in my first formulation of the problem has proved misleading since the remainder from the division can generate its own branching address as follows:

```
÷ 32 = Min1 FRAC
x 4 = INT Min4 IND GOTO 4
```

The indirect GOTO will cause branching to labels 0,1,2 or 3 in half the number of steps required by the three x≥0 tests.

The second half of the program is a horrible mess with a rat's nest of GOTOs which would give a structured programmer palpitations, and much duplication of memory instructions. By suitably altering the order of the labels, it should be possible to allow the program to "fall through" these sections rather than jumping in and out, so that few memory instructions need to be duplicated:

```
MR1 INT Min1 0Min2 Min3. . . . . .
LBL 1 1M−1Min3
LBL 3 1Min2 GOTO 0
LBL 2 1Min3
LBL 0
```

This has halved the number of memory operations and exterminated a couple of GOTOs and the result is beginning to look almost civilised.

The last steps of pruning and tidying involve making maximum use of the contents of the X-register (display register) at each step. For instance, the MR1 INT Min 1 is unnecessary as M−1 placed after FRAC achieves this effect in one step. Also, the indirect address could be stored in one of the working memories and its value used when appropriate — which also frees a memory register.

The end result is:

```
÷ 32 = Min1 FRAC M−1
x4 = INT Min2 0Min3
1 IND GOTO 2
LBL1 M−1 Min3
LBL2 X↔M3
LBL3 X↔M2
LBL0
```

What has been achieved here is a reduction from 62 to 26 program steps, but more important to me is the sense of pleasure in making every step earn its keep and in utilising more powerful instructions to do it. The more advanced programmers among you may be able to write economically from the first attempt, but I find for myself that there is virtue in following this evolutionary path from a naive but quick-to-write and logically obvious prototype. The refinement process then becomes more than a mere tidying up of loose ends; rather it is an attack on the structure of the algorithm itself, with the object of making it fit the calculator's way of working rather than one's own.

Calculator corner 2

Finally, as promised, a brief word on the Casio's Random Number Generator. Most owners of this machine will have discovered by now that the distribution of numbers given by using RAN# (or even RAN# RAN# as suggested in the manual) in a program is very poor indeed.

Those who have not verified this may like to run this program:

```
LBL1 AC RAN# x 10 + 1 = INT Min0
IND ISZ GOTO1.
```

This stores the frequency with which the digits 1-10 are generated in their respective memories 1-10, and over 100 or so trial you may well find *none* of certain digits generated! Typical standard deviations for 1000 trials (mean frequency 100) are between 40 and 80!

Using double RAN# doesn't improve things and often it gets caught in loops of varying size generating the same sequence cyclically.

The answer, provided by Mr. Caulfield of Casio, is as follows:

The random number generator, like others of its kind, requires a "seed", and on the 501/502 the contents of the X-register are taken for this seed. The sequence 1 M+n, MRn RAN# will, by providing a constantly increasing seed, give a good distribution (σ 5.4 on 1000 trials in my case). n represents any memory register, and of course you may be able to find a suitable seed already in your program without dedicating an extra register.

While on the subject, owners of other calculators without random number generators who don't know a good routine will find this sequence gives an excellent distribution:

```
RCLn + π = x^y 5 = FRAC STOn
```

A seed between 0 and 1 should be stored in memory n before use. The power 5 may be replaced by other numbers; I haven't investigated the effect on distribution except that x^2 which executes rather faster gives a marginally inferior one.

THE MEMORY LINGERS ON ~PART 2

Last September PCW published a design by John Stephenson for a simple SC/MP based PROM programmer. He has now developed an enhancement which enables the copying of selected sections of existing PROMs, thus, for example, allowing you to bypass burnt-in bugs while keying in the correct code.

A SELECTIVE PROM COPIER

Copier hardware

Two additional sockets are required, connected pin-for-pin to their opposite numbers SK1 and SK2 on the Programmer, with the exception of Pins 18 and 20 (PGM and $\overline{CS}$). Since these two sockets are only used as ROM, Pin 18 of each is grounded. Both Pin 20s are taken to one side of S3, and the other side of this is connected to Pin 20 on SK2. The lead which ran from SK2 Pin 20 to IC1 Pin 3 is disconnected from SK2 and is run to the wiper of S3.

S3 now forms a Read Master/Read Copy switch, necessary since both Master and Copy occupy the same memory position, 0400 — 07FF.

Programmer

To provide faster copying for 2708s the Monostable period may be reduced to 10ms (nominal) by means of S4, selecting a 2MFD capacitor. This must not be used when programming 2716s, and, with 2708s, preferably not for blocks of data less than 16 bytes long, as data corruption may then occur.

Software

This program can be used for both programming and copying. When loaded with the start and end addresses of the data to be copied from the Master EPROM, (at 0F20, 21, 22, 23) and the start address to which the data is to begin in the copy EPROM, the program sequences through the addresses, reading data from the Master and programming it into the copy. Auto-indexed-addressing is used to allow easy sequencing, and P1 is used to point to the Master source address, with P2 as the copy destination address. The program can be used to insert blocks of data into a copy, corrections for example, by copying up to the bug, programming the fresh data, which has been loaded into RAM, from 0F70 to 0FEF, and then continuing with the copying from the end of the bug.

Operation

Load up with Master and Copy, and apply power (don't be tempted to insert chips with power on!).

Load start address of Master block to 0F20, 21
Load end address of Master block to 0F22, 23
Load start address of copy to 0F24, 25
(Blocks may be any size up to 1K)
Load 0F37 with the number of cycle repeats required, 80H for a 2708 (128 repeats) and 01H for a 2716.
Remember that S2 must be set to select the upper or lower 1K of a 2716 to be programmed.

Set S1 to "Program", S3 to "Read Master", and S4 as appropriate to the block length or EPROM type, and run the program from "START", 0F29.

Notes and comments

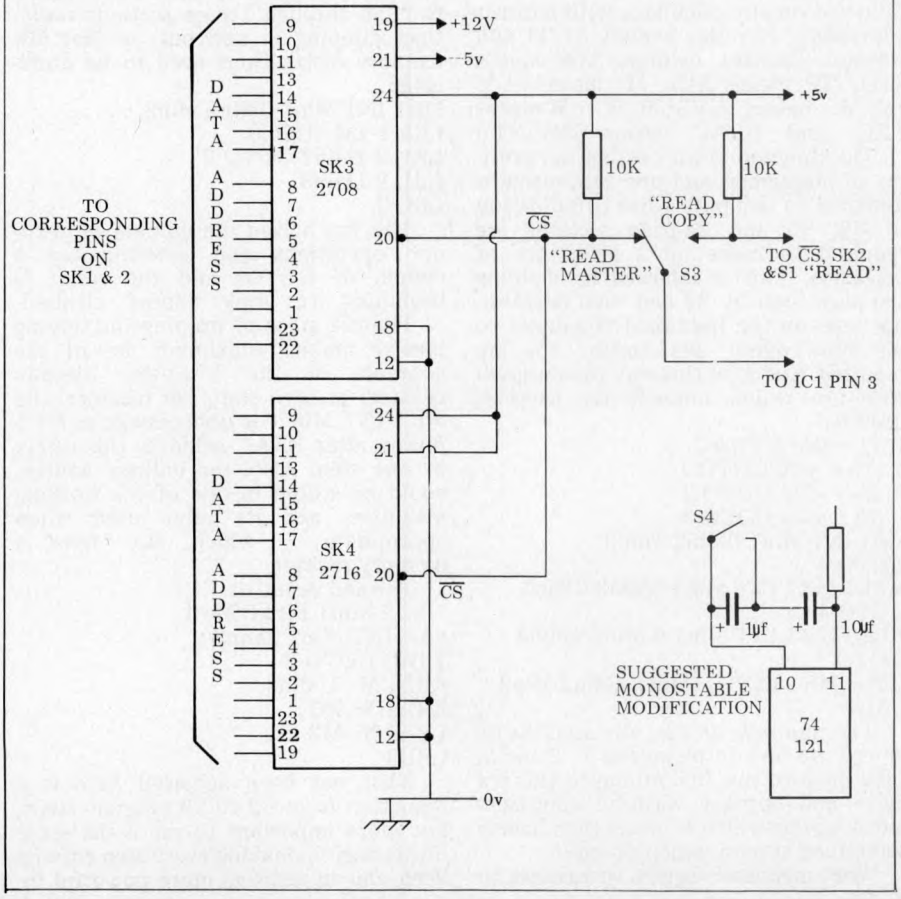
The prototype copies ¼K in approximately 7½ minutes. This is not up to the theoretical limit of 30 seconds, but who cares? People who *do* care can reduce the monostable time still further but only by adding complication and at the risk of destroying the PROM!

The multiple switches could be replaced by a multi-pole switch if required, as S1 and S3 can be ganged.

Further, S3 could be implemented with a handful of gates operated by "flag 0" on the SC/MP. It would then be very simple to write a verification program to compare copy and master for errors caused by duff PROMs, etc.

If you can't afford Zero-insertion-force sockets (like me!) shop around for 24 pin gold-plated ones and ease out the contacts with a dressmaking pin. This avoids lots of bent I.C. legs!

Program listing, p102



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ACT 800 (£3,450)	Computhink: 021 455 8585: (50)	48K RAM: 6502: dual 5¼" F/D (800K): 12", 30x64 VDU: RS232 port: 1 P/P	DOS: ExBASIC: A: Dis A: U	High res graphics: also model with dual 8" F/D (2.4MB), £4,450: option — extra dual 5¼" F/D (800K): (B)
Alpha Micro (£8,200)	Alpha Micro (UK) Ltd 01-250 1616 (TBA)	64K-16M RAM: 16 bit: dual 8" F/D (2.4MB): 6 S/P: modular	multi-user O/S: BASIC: M/A: Pascal: U	Expands to 1200 MB, 32 terminal system: (E)
Altos ACS 8000 (£3,398)	Logitek: 02572 66803 (TBA)	64K RAM: Z80: 1K ROM: dual 8" F/D (1MB): 2 RS232: 1 P/P	CP/M: *BASIC: Fortran: Cobol: Pascal: M/A*	(S&H)
Apple II (£810)	Microsense: 0442 63561 (80+)	16-48K RAM: 6502: 8 I/O slots: option — single 5¼" F/D (116K), £425	O/S: BASIC: *Pascal:* games:	280x192 high res graphics: integer BASIC in 6K ROM (S)
Attache (£7,000)	R.H.Thorpe Ltd: 0276 29492. R.J.Spiers Ltd: 0603 416573 (TBA)	48K RAM: 8080: dual 8" F/D (616K): 9", 16x64 b&w VDU: 180 cps printer	ExBASIC: *Fortran*	(S)
Billings BC-12FD (£4,295)	Mitech: 04862 23131 (TBA)	64K RAM: Z80A: dual 5" F/D (640K): 12", 24x80 b&w VDU	DOS: BASIC: *Fortran: Cobol: A*	8" F/D (2MB) to replace 5", £6,000: additional dual 8" F/D, £2,750 (S)
CBS Mk 1, 2&3 (Mk1, £4,900; Mk2, £5,900; Mk3,£8,150)	Compelec: 01-636 1392 (N/A)	64K RAM: Z80: dual 8" F/D (1MB): 12", 24x80 VDU: 132 col, 30 cps printer: 2 S/P: 1 P/P	CP/M: BASIC	Mk. 2 with 2MB F/D, £5,900. Can upgrade to Mk.3 — £8,150 (11MB H/D and 4 more S/Ps): Desk mounted: (S&H)
Challenger 1P & C2 (1P, £238; C2, £404)	CTS: 0706 79332: MBM: 01-980 3993. Mutek: 0225 743289. Millbank Computing: 01-549 7262. U-Microcomputers: 0606 853390. Byte Shop: 01-518 1414	4-32K RAM: 6502: C int: RS232 port:	O/S: BASIC: A: *ExBASIC*	D/A conv: col capability: 8K microsoft BASIC in ROM: option — dual 5¼" F/D (160K), £550: for C2, dual 8" F/D (1.15MB) and 20MB H/D: runs OSI business software on 8" F/D. (S)
Challenger C3 (£2,334)	As above	32-56K RAM: 6502, 6800, Z80: dual 8" F/D (1.15MB): 2-16 S/P	OS65U: BASIC: *CP/M: Fortran: Cobol*	Also C3B & C3P H/D modules: 74MB for about £10,000: (S&H)
Comma VO3 (£4,200)	Comma: 0277 811131: (N/A)	32K RAM: LSI 11: dual 8" F/D (512K): 4 serial DLU11S ports: modular	*RT11 O/S (£750): BASIC: Cobol: Fortran*	Many configurations possible: (H)
Compelec Series (£2,400)	Compelec: 01-636 1392: (N/A)	64K RAM: Z80: dual 8" F/D (512K): 2 RS232 ports: 1 P/P	CP/M: A: CBASIC: cobol: Fortran: Pascal	Also with double density F/D (1MB), £2,900: 1K EPROM: (S)
Compucolor II (£998)	Abacus: 01-580 8841: (6)	8-32K RAM: 8086: 13", 32x64 8-colour VDU: single 5¼" F/D (51K): RS232 port	ExBASIC (ROM): A	16K module, £1,078: 34K, £1,209: maintenance and programming manual available: (I)
Compucorp 625 (£6,000)	Compucorp: 01-952 7860: (17)	60K RAM: Z80: dual 5¼" F/D (700K): 9", 16x80 b&w VDU: 40 cps printer: 1 RS232 port	A: BASIC: U	Also 655 model with 320K F/D capability and 12", 20x80 VDU — £4,345 (B)
Comp Workshop System 1 (£1,600)	Comp Workshop: 01-491 7507 (N/A)	32K RAM: dual 5¼" F/D (170K): 9", 16x64 b&W VDU: modular	A: BASIC: Fortran: Flex: Pascal: Pilot	This is an example configuration from a fully compatible modular range: (E)
Cromemco System 2, System Z2H, System 3 (£1,995/£4,998/ £3,293)	Comart: 0480 215005; Datron: 0742 585490; Microcentre: 031 225 2022 (20)	64K RAM: Z80: dual 5¼" F/D (346K) Sys 2 and Z2H... dual 8" F/D (1.24MB) Sys. 3: S/P: P/P	CDOS: *BASIC: Cobol: Fortran; Multi-user BASIC: A:*	All systems expandable to multi-user (2—7 users), £3,455 £6,400: 11 and 22MB options: also dual 8" F/D (996K) on Sys. 2 and 3: (E)
DAI (£998 48K version)	Data Applications (UK): 0285 2588 (TBA)	12-48K RAM: 8080: C int: 24x60 VDU int: RS232 port: Over 20 industrial ints: 2 C ints	BASIC (ROM): U (ROM)	Up to 255x335 resolution graphics: 3 notes and noise generator: PAL output to TV: games paddle
Digital Microsystem DSC-2 (£5,395)	Modata: 0892 39591 (TBA)	64K RAM: Z80: dual 8" F/D (2.28MB): 4 RS232 ports: EIA port	CP/M: BASIC-E: *CBASIC: Cobol Fortran: Pascal*	Up to 6 additional F/D units possible: (H)
Durango F-85 (£8,250)	Comp Ancillaries: 07843 6455 (12)	64K RAM: 8085: dual 5¼ F/D (1MB): 9", 16x64 green VDU: 132 col 165 cps printer: N/P	*O/S: DBASIC*	Takes up to 5 work stations: fully integrated system: options — additional dual 5¼" F/D (1MB) and 12 MB H/D: (S)
Dynabyte DB8/1 (£1,500)	Dynabyte UK/Europe Ltd: 0723 65559 (6)	32-64K RAM: Z80: S100 bus: 2 RS232 ports: 1 P/P	CP/M: BASIC: Cobol: *Pascal*	Expands to multi-user system: option — dual 8" F/D (1MB), £2,000: also DB8/2 with dual 5¼" F/D (400K), £3,000 (E)
Equinox 200 (£9,995)	Equinox: 01-739 2387 (N/A)	64-256K RAM: Z80: 10MB H/D: 15", 24x80 b&w VDU: 150 cps printer: 6 S/P	CP/M: BASIC: Cobol Fortran: MVT/FAMOS	(S&H)
Euroc (£7,995)	Eurocalc Ltd: 01-405 3113 (TBA)	64K RAM: 8080A: dual 8" F/D (1MB): 15", 25x80 b&w VDU: 132 col 140cps printer	CP/M: CBASIC: A: U:	A year's maintenance and stationery supply inc: (S)
Executive Minicomputer	Binatone 01-903 5211	See Video Genie		
Exidy Sorcerer (£650)	Liveport Data Products 0736 798157 (27)	8-32K RAM: Z80: RS232: 1 P/P: S100 connector: 30 x 64 VDU I/O	O/S: ExBASIC (ROM): *Editor: A: CP/M: Algol: Fortran*	High res graphics capability: 16K version, £760: 32K £859: 48K, £960: option — dual 5¼" F/D (630K), £1,200: User programmable character set: (I)

List of Abbreviations

A Assembler
B BASIC
C Cassette
E Extensive
F/D Floppy disc
G/C Graphics card
H Hardware
H/D Hard disc
I Introductory
Int Interface
M/A Macro assembler
N/A Not available
N/P Numeric pad
O/S Operating system
P/P Parallel port
S Software
S/P Serial port
T/E Text editor
TBA To be announced
U Utility

Please note: Software items listed in *italic* are not included in the basic price of the equipment. All prices are *exclusive* of VAT.

IN STORE

DIRECT ACCESS

Machine (Price from)	Main Distributor/s (No. of Dealers)	Hardware	Software	Miscellaneous (Documentation)
HP 85 (£2,240)	Hewlett Packard Ltd: 0734 784774 (16)	16-32K RAM: C.P.U.: 5" 16x32 b&w VDU: C (200K): 64 cps printer: RS232 port: 4 P/P	BASIC:	Full dot matrix graphics: N/P: compact portable unit: (S)
IMS 5000 (£1,935)	Equinox: 01-739 2387 (20)	32-64K RAM: Z80: dual 5¼" F/D (320K)	CP/M *BASIC: Cobol: Fortran: Pascal*	3 drives option: (S&H)
IMS 8000 (£3,515)	As above	64-256K RAM: Z80: dual 8" F/D (1MB)	CP/M: BASIC: cobol: Fortran: *Pascal: Micro Cobol: MVT/ FAMOS: Multi-user*	4 drives option: (S&H)
IMSAI VDP 42 (£3,900)	Computermarket: 0603 615089 (TBA)	32-64K RAM: 8085: dual 5¼" F/D (400K): 9", 24x80 b&w VDU: 1 S/P: 1 P/P	IMDOS (CP/M comp): A: ExBASIC: U: *CBASIC: Cobol: Fortran*	Supports 8 additional F/D drives: also available, VDP 44 with F/D (780K), £4,400: (H)
IMSAI VDP 80 (£6,200)	As above	32-64K RAM: 8085: dual 8" F/D (1.2MB): 12", 24x80 b&w VDU: 1 S/P: 1 P/P	IMDOS: A: ExBASIC: U: *CBASIC: Cobol: Fortran*	(H)
ITT 2020 (£867)	ITT: 0268 3040 (15)	16-48K RAM: 6502	Monitor: A: ExBASIC: Dis A:	360x192 high res graphics: Ex-BASIC in 6K ROM: options — single 5¼" F/D (116K), £425; 16K RAM, £110; RS232 port, £96: 32K system, £931: 48K system, £995: (B)
LX-500 (£3,500)	Logabax Ltd: 01 965 0061 (13)	32K RAM: Z80: dual 5¼" F/D (180K): 12" 25x80 b&w VDU: 100cps printer	DOS: BASIC: A	Other printers available: (S)
Megamicro (£6,080)	Bytronics: 0252 726814 (5)	256K: 8080A: dual 8" F/D (1MB): 12", 20x80 b&w VDU: 120cps printer: 2 S/P: 2 P/P	CP/M: U	(H&B)
Micro-Engine (£2,080)	Pronto: 01-599 3041 (TBA)	64K RAM: MCP 1600: 2 RS232 ports: 2 P/P	BASIC: Pascal	CPU has user written word set: options — dual 5¼" F/D (1MB) and dual 8" (2MB): (S&H)
Microstar 45 Plus (£4,950)	Data Efficiency: 0442 57137 (TBA)	64K RAM: 8085: dual 8" F/D (1.2MB): 3 S/P: RS232 port	STARDOS: CP/M: BASIC: Cobol: Fortran	(E)
MSI 6800 (£1,203)	Strumech: 05433 4321 (5)	16K RAM: 6800: C: 9", 16x64 b&w VDU: 1 S/P	BASIC: Mini A: U	Up to 8 serial or parallel ints possible: (S&H)
MSI 6800 System 1 (£2,175)	As above	32K RAM: 6800: dual 5¼" F/D (160K): 9" 16x24 b&w VDU: 1 RS232 port	DOS: BASIC: U: *A: Fortran*	As above: option — dual 8" F/D (624K), £1,640: (S&H)
MSI 6800 System 2 (£7,500)	As above	56K RAM: 6800: single 8" F/D (312K): 10MB H/D: RS232 port: 9", 16x64 b&w VDU	DOS: BASIC: Multi-user BASIC: A	Rack mounted: options — dual 8" F/D (624K), £1,640; 10MB H/D, £4,250: (S&H)
MSI System 7 (£5,200)	As above	56K RAM: 6800: dual 5¼" F/D (640K): 9", 16x24 VDU: 1 P/P	DOS: BASIC: A	Choice of FDOS, SDOS or Flex: also option — 10MB H/D: (H&S)
North Star Horizon (48K, £4,650)	Comart: 0480 215005; Comma: 0277 811131; Equinox: 01-739 2387 (20)	24-56K RAM: Z80A: dual 5¼" F/D (360K): 15", 24x80 b&w VDU: 150 cps printer: 2 S/P: 1 P/P	DOS: BASIC: *CP/M Cobol: Fortran: Pascal*	(E)
Oxford Mini-computer	Binatone 01-903 5211	See Video Genie		
PET 8K,16K & 32K (£550, £675 & £795)	Commodore: 01-388 5702 (150)	8-32K RAM: 6502: C: 9" 25x40 VDU: IEEE488 port	O/S: BASIC: A: *Forth Pilot:*	BASIC in 8K ROM: options — dual 5¼" F/D (353K), £795; same, but (800K), £995, plus, with the 2001-8, £30 for the disc operating ROM: (I)
Powerhouse 2 (£1,175)	Powerhouse Micros: 0422 48422 (TBA)	32-64K RAM: Z80A: 5", 27x96 b&w VDU: 1 P/P: RS232 port	FDOS: BOS: BASIC: *ExBASIC: (14K EPROM), £260*	Graphics card available, £190: option — dual 5¼" F/D (700K): (I)
Rair Black Box (£2,300)	Rair: 01-836 4663 (N/A)	32-64K RAM: 8085: dual 5¼" F/D (160K): 2 RS232 ports	CP/M: BASIC: Cobol: Fortran: M/A	16K RAM expansion, £250; dual 5¼" F/D (520K)' £1,000: (H)
Research Machines 380-Z (£1,048)	Research Machines: 0865 49791 (N/A)	16-56K RAM: Z80A: C: RS232 port:	Tiny BASIC: graphics: *A: ExBASIC: CBASIC: Cobol: Fortran: Algol: CP/M: U:*	Designed for education: high res graphics being developed: options — dual 5¼" F/D (168K), £895 and dual 8" F/D (1MB), £1,695: 56K version, £1,654: (S)
SDS 100 (£4,290)	Airamco: 0294 57755 (11)	64K RAM: Z80: dual 8" F/D (1MB): 12", 24x80 VDU: S100 bus: RS232 port: N/P: 1 P/P	CP/M: A: ExBASIC: *Cobol: Fortran*	Facility for 8K PROM: (E)
S.E.E.D. System One (£2,175)	Strumech: 05433 4321 (4)	32-56K RAM: 6800: dual 5¼" F/D (160K): 9", 16x24 b&w VDU: RS232 port	DOS: BASIC: U: *Fortran: Cobol: M/A*	Up to 8 I/O ports: max of 4 F/D drives: option — dual 8" F/D (624K): (E)
Semel 1 (£2,900)	Strutt Electrical: 0822 5439 (N/A)	16-64K RAM: Z80: single 8" F/D (250K): 12", 24x80 b&w VDU: RS232 port	BASIC: *Cobol: Fortran*	Supports up to 8 drives option — single 8" F/D (250K), £500: (I)
Sharp MZ-80K (£520)	Sharp Electronics (UK) Ltd: 061 205 7321 (22)	6-34K RAM: Z80: C: 10", 24x40 b&w VDU	BASIC: A:	Graphics: loudspeaker: BASIC in 14K RAM: 34K machine, £740: (B)
Simpelec Mk 1 (£6,900)	Compelec: 01-636 1392 (N/A)	64K RAM: Z80: dual 8" F/D (1MB): 12", 24x80 VDU: 2 S/P: 1 P/P	CP/M: BASIC	Also Mark II with 2MB F/D, £7,900; will upgrade further: (S&H)
Sirocco (£3,900)	Elvingate Computers: 069 245189 (TBA)	64K RAM: Z80: dual 5¼" F/D (940K): 12", 24x80 VDU: RS232 port	CP/M: CBASIC: *Cobol: MBASIC: Fortran*	Direct memory addressing: memory mapped VDU: free standing keyboard: option — 10MB H/D
Smoke Signal Chieftain 1 (£3,050)	Windrush Micro Designs 069 245189 (TBA)	32-64K RAM: 6800: dual 5¼" F/D (160K): 12", 24x80 VDU: 112 cps printer: RS232C port	DOS: BASIC: *DBASIC: RBASIC: A: Fortran: U*	Also Chieftain 3 with dual 8" F/D (1MB), £3,950 (E)
Solitaire WP & BS200 (£6,750&£7,950)	Solitaire KPG: 04252 71448 (TBA)	64K RAM: 8085: 14" VDU (with own CPU): 45 cps printer: CPU port: dual 5¼" F/D (700K) with "WP", and dual 8" F/D (960K) with "BS200"	DOS: BASIC (optional on the "WP")	All Solitaire systems are compatible: graphics on 11x13 dot matrix: (S)
Solitaire/HBS100 (£9,500)	As above	64K RAM: 8085: 10MB H/D: 14" VDU (with own CPU): 200 cps printer: CPU port	DOS: BASIC	Up to 8 interface terminals can be used: also HBS200 with 20-80 MB of H/D: HBS100 limit is 40MB: (S)

DIRECT ACCESS

IN STORE

Machine (Price from)	Main Distributor/s (No. of Dealers)	Hardware	Software	Miscellaneous (Documentation)
Sord M100 ACE (£2,650)	Midas Computer Services Ltd: 0903 814523	48K RAM: Z80: single 5¼" F/D (143K): 12" 24x64 col VDU RS232 port	O/S: BASIC	With colour graphics: 8K ROM: option — single 5¼" F/D, £300: (I)
Sord M223 (£3,500)	As above	64K RAM: Z80: single 5¼" F/D (350K): 12", 24x80 b&w VDU: S100 bus: RS232 port	O/S: BASIC	Other configs possible: extra F/D, £450: (I)
Superbrain (£1,995)	Icarus: 0632 29593 (TBA)	64K RAM: 2xZ80: dual 5¼" F/D (320K): 12", 25x80 b&w VDU: S100 bus: RS232: TRS80 port	CP/M: A: *BASIC: Cobol: Fortran: APL Pascal*	Limited graphics: mainframe int available: options — dual 5¼" F/D (320K): dual 8" F/D (2.4MB): 8-120 MB H/D: (S&H)
Tandberg EC10 (£5,000)	Tandberg: 0532 35111: (N/A)	50K RAM: 8080A; single 8" F/D (250K): 12", 25x80 b&w VDU: RS232 port	ExBASIC (24K): Multi-user BASIC: A: U: *Cobol*	(S&H)
Tandy TRS 80 Level 1 (£380)	Tandy: 021 556 6101 (200)	4-16K RAM: Z80: C: 12", 16x64 b&w VDU	BASIC: A:	BASIC in 4K ROM: upgradable to level 2: (I)
Tandy TRS 80 Level II (£515)	As above	4-48K RAM: Z80: C: 12", 16x64 b&w VDU: RS232 int: 1 P/P	BASIC: *M/A: Fortran*	16K machine includes N/P: 4-16K upgrade, £120 (£85 without pad): max config, £1,005: option — single 5¼" F/D (78K), £478 (max of 4): (I)
TECS (£1,600)	Technalogics: 051 724 2695 (TBA)	16-56K RAM: 6800: 8K PROM: RS232 port: C int	BASIC: *T.DOS: Prestel: Monitor:*	256 ch graphics: Prestel compatible: plugs into standard TV: option — dual 5¼" F/D (320K), £800: (S&H)
TEI 208 (£3,841)	Abacus: 01-580 8811 (5)	32-60K RAM: 8080/8085: dual 5¼" F/D (320K): 9", 24x80 green VDU: 3 S/P: 3 P/P	CP/M: *BASIC: Cobol: Fortran: Pascal: Algol*	(S&H)
TEI 212 (£4,886)	As above	32-60K RAM: 8080/8085: dual 8" F/D (1MB): 15", 24x80 green VDU: 3 S/P: 3 P/P	CP/M: *BASIC: Cobol: Fortran: Pascal: Algol*	(S&H)
Terodec DPS 64/1-4 (£3,014)	Terodec (Micro-systems) Ltd: 0344 51160: (TBA)	64K RAM: Z80: dual 8" F/D (1MB): 12", 24x80 b&w VDU: 2 S/P: 3 P/P	CP/M: *BASIC: Cobol: CBASIC: Fortran: Algol: Pascal*	TMZ 80, enhanced model in integral work station, £5,495 (with 4MB F/D): DPS 64 with 2MB F/D is £3,319: options — dual 8" F/D (1MB), £1,150: dual 8" F/D (2MB), £1,455: (S&H)
Vector Graphics MZ (£2,595)	Almarc: 0602 625035: Sintrom Microshop: 0734 85464: Metrotech 0895 57780: (5)	56K RAM: Z80: dual 5¼" F/D (630K): 3 S/P: 2 P/P	DOS: BASIC: A: *CP/M2: Algol: CBASIC: Cobol: Fortran: Pascal*	Includes PROM burner: also System B with graphics and N/P, £3,195: (E)
Video Genie EG 3003 (£378)	Lowe Electronics: 0629 2817: Binatone: 01-903 5211 (N/A)	16K RAM: Z80: 500 bps C: 32x64 TV int: extra C int: 1 P/P	BASIC: *M/A: Fortran*	BASIC in 12K ROM: graphics available: F/D under development: Binatone call *their* 16K model "Executive Minicomputer" and a 4K version, "Oxford Minicomputer" — prices TBA: (I)
Zenith WH-11A (£4,359)	Heath Ltd 0452 29451 and 01-636 7349 (N/A)	LSI 11: 16-32K RAM: 25x80 VDU: S/P: P/P	*O/S: BASIC: Fortran:* A: U:	PDP 11 compatible: option — dual 8" F/D (512K): (S&H)
Zenith Z89 (£1,490)	As above	16-48K RAM: Z80: single 5¼" F/D (102K): 12", 25x80 b&g VDU: RS232	*BASIC: A: H.DOS: CP/M: MBASIC: CBASIC: Fortran*	3 drives option: (I)
Zentec (£5,700)	Zigal Dynamics Ltd: 02405 75681 (1)	32-64K RAM: 2x8080: dual 5¼" F/D (512K): 15", 25x80 b&w VDU: RS232 port	O/S: A: U: *BASIC: Micro Cobol*	User programmable character set: option — dual 8" F/D (1MB): (S)
Zilog MCZ 1/05 (£4,200 — portable)	Micropower: 0256 54121: Memec: 084421 5471 (N/A)	64K RAM: Z80: dual 8" F/D (600K): RS232 port	RIO O/S: M/A: U: *BASIC: Cobol: Fortran: Pascal*	Debug in 3K PROM: also available as desk top unit or R/M model, both £4,800: (S&H)
Z Plus (£4,000)	Rostronics: 01-874 3665 (TBA)	32-64K RAM: Z80: dual 8" F/D (1MB): 2 S/P: 2 P/P	CP/M: A: U: *BASIC: Cobol: Fortran: Pascal*	(S&H)

SINGLE BOARDS

Machine (Price from)	Main Distributor/s (No. of dealers)	Hardware	Software/ Firmware	Documentation	Miscellaneous
Acorn (£65)	Acorn: 0223 312772 (N/A)	1.1/8K RAM: 6502: EPROM socket: Hex K/B: C int: 8 digit LED display: up to 16 ports: options — Eurocard 64 way connector: VDU card: Full K/B card	½K monitor: *BASIC*		Kit: programmable address linking; on board 5V regulator: available assembled, £79 (S&H)
Aim 65C (£265)	Pelco: 0273 722155 (4)	1-4K RAM: 6502: 12K ROM: full K/B: 20 char LED display: 20 char thermal printer: Cx2: RS232 port.	A: Dis A: T/E: 8K monitor in ROM		Available as S100 system with A or BASIC in ROM (£480) from Portable Micros (0280 702017): they also have briefcase version (£750) (E)
Cromemco SC (£260)	Comart: 0480 215005 (17)	1K RAM: Z80A: 8K EPROM sockets: RS232 port: 3 P/P: option — S100 bus.	*Monitor and control BASIC in EPROM*		5 program interval timers: can put own BASIC programs in EPROM (E)
ELF II (£114)	Newtronics: 01-348 3325	1/4K RAM: RCA 1802: Hex K/B: 2 digit LED: TV int: C int: RS232 port: options — 4K RAM, £69; full K/B; VDU card	1K monitor: A: Dis A: T/E: *BASIC:*		TTY, n-line decoders: low resolution graphics (high resolution available) kit (H)
Explorer (£295)	Newtronics: 01-739 1582 (15)	4K RAM: 8085: Hex K/B: RS232 port: S100 bus: C int: options — 6 slot S100 £32; 8K EPROM sockets £50.	2K monitor: *CP/M: BASIC*		Programmable 14 bit counter: kit (S&H)
H8 (£262)	Heath: 0452 29451 (TBA)	4K RAM: 8080A: Octal K/B: 6 digit LED: speaker: options — single 5¼" F/D (102K), £399; 16K RAM, £314; C int, £72	1K monitor: *BASIC in RAM: FORTRAN: T/E: A: U:*		Kit (S&H)
Hewart 6800S (£299)	Hewart: 0625 22030 (N/A)	16K RAM: 6800: full K/B: VDU int: 2xC int; 1 S/P: 2 P/P: option — 16K RAM, £90	1K monitor: A: T/E		Can be upgraded with 6809 (H)
Hewart 6800 MkIII (£152)	As above	1K RAM: 6800: VDU board: options — single 5¼" F/D (75K), £350; PROM programmer, £32: calculator board, £32	1K monitor		(H)

interface components

NASCOM IMP AVAILABLE EX-STOCK

The incredibly low-price Nascom IMP is now available off the shelf at Interface Components. It plugs into any microcomputer system with a serial RS 232 interface, including the popular Nascom 1 & 2.

Although an impact matrix printer, its versatile feed mechanism allows it to accept A4, foolscap and quarto letterheads making it suitable for word processing applications. And it's quiet too. Line printers and many typewriters are deafening by comparison.

Finished in a smart blue plastic enclosure, the IMP is only £325 plus VAT (post and packing extra) completely assembled.

FEATURES

- 80 characters wide
- 60 lines per minute
- Bi-directional printing
- 10-line print buffer
- 96 character ASCII set (includes $,#,£)
- Automatic CR/LF
- $8\frac{1}{2}$" paper (pressure feed)
- $9\frac{1}{2}$" paper (tractor feed)
- Baud rate 110 to 9600
- External signal for optional synchronisation of baud rate

ORDER FORM

Send your orders to:
Interface Components Ltd, Oakfield Corner,
Sycamore Road, Amersham, Bucks HP6 6SU.
Telephone: 02403 22307 Telex: 837788.

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PCW/3/80

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Machine (Price from)	Main Distributor/s (No. of dealers)	Hardware	Software/ Firmware	Documen- tation	Miscellaneous
Mk 14 (£39.95)	Science of Cambridge: 0223 311488 (N/A)	8060: 1/4-2K RAM: Hex K/B: 7 char LED: options — VDU int (32x16 with graphics), £29; C int, £6; PROM prog, £10, 2K memory expansion, £15	Machine code		Designed for control applications rather than high level computing expansion (H)
Nascom 1 (£165)	Nascom: 02405 75155 (20)	4K RAM: Z80: full K/B: TV int: 2 P/P: 1 S/P	2K monitor: *BBASIC: tiny BASIC: A: T/E: U*		Now available as Nascom 2 with 8K RAM and 8K microsoft BASIC in ROM, £295
SBC 100 (£135)	Airamco: 0294 57755 (11)	1K RAM: Z80: 8K ROM: S100 1 S/P: 1 P/P: option — voltage regulator	*1K monitor: DOS in ROM*		Kit: available assembled, £196 (E)
Superboard (£188)	MBM: 01-981 3993 (N/A)	4-8K RAM: 6502: 10K ROM: full K/B: VDU int: C int: options — RS232; single 5¼" F/D (100K), £316; 8K RAM, £188	BASIC in 8K ROM:		Available with 32K RAM and single 5¼" F/D, £867 (S&H)
SYM-1 (£160)	Newbear: 0635 30505 (N/A)	1-4K RAM: 6502: 244 bps C int: VDU int: 2x6522 ports: option — TV int.	4K monitor: *BASIC: A*		Can be expanded to 64K RAM (S&H)
Triton 4.1 (£286)	Transam: 01-402 8137 (N/A)	2K RAM: 8080: 3K ROM: full K/B: 16x64 VDU or TV int: C 1 S/P: option — 2K RAM, £30	1K monitor: 2K BASIC: U		64 character graphics: 8 levels interrupt: kit (S&H)
Triton 5.1 (£294)	As above	2K RAM: 8080: 4K ROM: full K/B: 16x64 VDU or TV int: C int: 1 S/P: C: options — 8K RAM, £97; 8K EPROM, £97	1½K monitor: 2½K Ex-BASIC: U		Kit: assembled version, £393 (S&H)
UK 101 (£219)	Computer Shop: 01-440 7033	4K RAM: 6502: full K/B: 16x48 VDU or TV int: C int: RS232 port: option — 4K RAM, £49	1K monitor: 8K BASIC: *Dis A: U*		Graphics: will run Superboard software (S&H)

List of Abbreviations

A Assembler
B BASIC
C Cassette
E Extensive
F/D Floppy disc
G/C Graphics card
H Hardware
H/D Hard disc
I Introductory
Int Interface
M/A Macro assembler
N/A Not available
N/P Numeric pad
O/S Operating system
P/P Parallel port
S Software
S/P Serial port
T/E Text editor
TBA To be announced
U Utility

Please note: Software items listed in *italic* are not included in the basic price of the equipment. All prices are *exclusive* of VAT.

USER GROUPS INDEX

DIRECT ACCESS

Here are the details of additions and changes recently notified. A full index will be published next month.

EAST ANGLIA
Anglia Computer User Group. Contact Jan Rejzl, 128 Templemere, Sprowston Road, Norwich NR3 4EQ

NORTH LANCASHIRE
North Lancs User Group. Contact John Robinson, 12 Harold Ave., Blackpool, Lancashire.

LONDON
SELMIC (South East London Microcomputer Club). £5 subscription. Meetings at Woolwich Polytechnic. Contact John Williamson, 129 Greenvale Rd., Eltham Park, London SE9 1 PG. Tel: 01-850 4195

Thames Valley Amateur Computer Club now meets first Tuesday monthly (was Thursdays)

East London Computer Club chairman is now Dr. Graham Crisp, 45 Leadale Ave., Chingford, London E4 8AX. Tel: 01-529 6010

MIDDLESEX
Sunbury Amateur Computer Club. Membership free. Contact Mr S N Taylor, 8 Priory Close, Sunbury on Thames, Middlesex, TW16 5AB. Tel Sunbury 86649.

DIARY DATA

DIRECT ACCESS

Wembley, England	IMEC — European Information Management Exhibition & Conference. Clapp & Poliak Europe Ltd., 232 Acton Lane, London W4 5DL. Tel: 01-995 4806	Feb 18 - Feb 21
Bournemouth, England	BEX — Business Equipment Exhibition. Douglas Temple Studios Ltd., 104b Old Christchurch Rd., Bournemouth, Dorset, Tel: 0202 20533	Feb 20 - Feb 21
Swansea, Wales	OFFEX — Office Equipment Exhibition. Phoenix Exhibitions Ltd., 1st Floor, Burrows Chambers, East Burrows Rd., Swansea. Tel: 0792 460364	Feb 20 - Feb 22
Birmingham, England	IEA — International Instruments, Electronics & Automation Exhibition. Industrial & Trade Fairs Ltd., Radcliffe House, Blenheim Court, Solihull, West Midlands, B91 2BD. Tel: 021 705 6707	Feb 25 - Feb 29
Milan, Italy	International Exhibition of Numerical Control, Automation & Industrial Robots. CEU S.p.A., Via Monte Rose 21, 21049 Milan	Mar 3 - Mar 7
Birmingham, England	Computermarket '80, Couchmead Ltd, 42 Great Windmill Street, London W1V 7PA. Tel: 01-437 4187	Mar 4 - Mar 6
London, England	Microforum Europe. Business Equipment Trade Association, 109 Kingsway, London WC2B 6PU. Tel: 01-405 6233	Mar 11 - Mar 13
Manchester, England	Computermarket. Couchmead Ltd., 42 Great Windmill Street, London W1V 7PA. Tel: 01-437 4187	Mar 11 - Mar 13
Sheffield, England	Business Efficiency & Office Equipment Exhibition. Gwen Shillaber Design, 81 Whiteladies Road, Clifton, Bristol, BS8 2NT. Tel: 0272 312850	Mar 11 - Mar 13
Glasgow, Scotland	Computermarket '80. Couchmead Ltd., 42 Great Windmill Street, London W1V 7PA. Telephone: 01-437 4187	Mar 18 - Mar 20
London, England	Computermarket '80. Couchmead Ltd., 42 Great Windmill Street, London W1V 7PA. Telephone: 01-437 4187	Mar 25 - Mar 27

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DIARY DATA

London, England	Viewdata '80 Exhibition. Online Conferences Ltd., Cleveland Road, Uxbridge, UB8 2DD. Tel: 0895 39262	Mar 26 - Mar 28
Brighton, England	Computer Aided Design Conference & Exhibition. Iliffe Promotions Ltd., Dorset House, Stamford Street, London SE1 9LU. Tel: 01-261 8000	Mar 31 - Apr 2
London, England	Peripherals '80 Exhibition. Iliffe Promotions Ltd., Dorset House, Stamford Street, London SE1 9LU. Tel: 01-261 8000.	Apr 16 - Apr 17
London, England	All Electronic Show. All Electronic Show, 34-36 High Street, Saffron Walden, Essex. Tel: 0799 22612	Apr 29 - May 1
Liverpool, England	Mersey Micro Show. Online Conferences Ltd., Cleveland Road, Uxbridge UB8 2DD. Tel: 0895 39262	April 30 - May 2
Brussels, Belgium	Compec Europe Exhibition. Iliffe Promotions Ltd., Dorset House, Stamford Street, London SE1 9LU. Tel: 01-261 8000.	May 6 - May 8
Manchester,England	Business Efficiency & Office Equipment Exhibition, Gwen Shillaber Design, 81 Whiteladies Rd., Clifton, Bristol BS8 2NT. Tel: 0272 312850	May 13 - May 15
Anaheim, USA	National Computer Conference and Exhibition (NCC). 210 Summit Ave., Montvale, NJ 07645	May 19 - May 22
Dallas, USA	Int. Telecommunications Exbn — INTELCOM. Horizon House — Microsol Inc., 25 Victoria Street, London SW1H OEX. Tel: 01-222 0466	May 19 - May 23
London, England	International Word Processing Exhibition and Conference. Business Equipment Trade Association, 109 Kingsway, London WC2B 6PU. Tel: 01-405 6233	May 20 - May 23

DIRECT ACCESS

TRANSACTION FILE

For sale

Tandy TRS-80. . . level II, 16K, complete with video, tape recorder light pen, RS232 printer interface, manuals etc. Over £1,000 new (at current prices) — accept £600 cash. Prefer buyer collects, so can demonstrate. Fitted wall cabinet also available. Phone Dave Holloway on Asthall Leigh (099 387) 241, evenings/weekends.

PET 2001-8. . . 9 months old, used only in home — £475. Phone Chris McDermott on Stewarton (05603) 4182.

Teletype ASR33. . . good working order, complete with plinth and paper support — £400 ono. Phone High Wycombe 35975 or 20707 (office hours).

PDP8 minicomputer. . . (early transistor version). 4K core, teletype interface, 4 discs, manuals and some software. Bulky system, must be collected. Phone Connell on High Wycombe (0494) 31314 — negotiate around £295.

Technico TMS 9900 Development Board. . . has monitor PROM, 32 bits I/O, RS232 interface, 2708 EPROM programmer. Cost new over £300 — will sell for £150. Phone 02602 78293.

PET 2001-8K. . . new March 1979. Includes green screen, 60 games and PET routines, cover, manual. Perfect condition — £450. Also Teletype ASR33 terminal/printer. Perfect working order, includes PET interface and software/RS232 interface; spare parts (including motor). Most mechanics/stand/20ma interface/manuals — £350. Phone R. Wilmot on Horsham (0403) 69835.

Elector BASIC card. . . 4K BASIC in ROM, V-24 I/F, bus board + 77-68 RAM card — 2K RAM. Sockets throughout, £100 the lot or may split. Phone 021 784 6364 (Pete).

4K Floating Point BASIC (CCSOFT). . . for Nascom-1. In 4x2708 EPROMS, with documentation — £35. Phone 0702 218662.

Motorola 6800 D2. . . microprocessor kit, built and tested, with documentation and programs; plus extra RAM, £115. Phone Cambridge (0223) 314934.

PET 2001-8K. . . as new, only used at home, plus manuals — £480 ono. Phone 095 276 320, evenings or weekends (near Workington).

Mk.14. . . revised monitor, I/O, tape interface, improved keyboard, extra RAM, single step, PSU, instructions — all for £50 or will split. Phone 021-357 3488.

Smart 1. . . Nascom memory expansion, 16K RAM. Fully built, with connectors and spares — £100. P. Watson, 101 Village Road, Bromham, Bedford MK43 8HU. Phone Oakley 2867. Also MEK D2 for sale.

Triton computer. . . 7K memory on board, 1K monitor and 2K Tiny BASIC — 10 cassettes containing games plus leads and case. Securicor delivery — £300. Contact Mr Brian Ewan, 16 Fairacres, Harwood, Bolton BL2 3NT. Phone 0204 389498.

TI-57. . . 50 merged step programmable calculator, 8 memories, £25 ono. Includes mains recharger, full instructions and some programs — 6 months old. Contact Andrew Watson on Bisley (045 277) 233, evenings or weekends.

Casio FX-201P. . . programmable calculator, 127 steps with instruction manual — as new, £32. Contact Tim Cook, House six, Room eight, Edward Square, Middlesbrough, Cleveland TS1 30H

Nascom 1. . . tested by Nascom Microcomputers and fitted with latest NASYS 1 2K monitor. Full documentation and 3 amp PSU. No case — £150 ono. Phone Colchester 74791, evenings.

TI-59. . . programmable calculator, 9 months old, with maths/utilities library, programming aids and astrology speciality pakettes, mains adaptor and supporting documentation. Contact Mr K. Barnes, 6 Blaven Walk, Fareham, Hants or phone Fareham 280642 after 6pm any evening.

Teletype ASR33. . . TTY terminal/printer with stand; as new — £425. Phone Bradford 683608

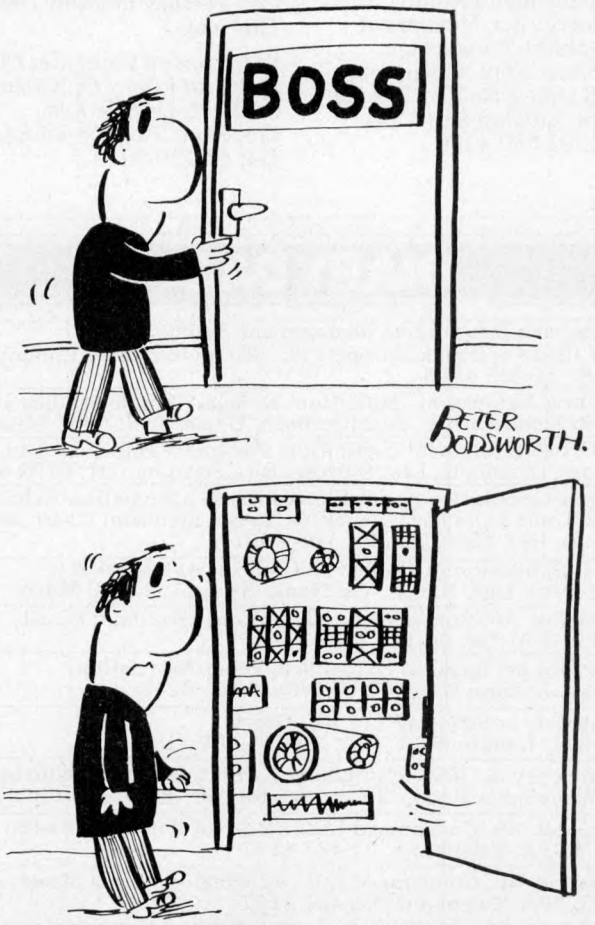
VDU. . . for sale or swap for microcomputer board. RS232 or 20ma loop ASCII i/f, 24x80; full or half duplex; 50-9,600 baud. Upper case keyboard. Excellent order, complete with full manufacturer's circuits and manual. Also two oscilloscopes (one portable) for sale or barter as above. Phone 0342 22105 anytime.

Mini computer. . . suitable for RTTY use but capable of expansion in other modes if desired. To be used in conjunction with ST5 Terminal Unit and domestic TV set. Contact L. Roffey, 15 The Furrows, Harefield, Middlesex UB9 6AT.

Teletype ASR33. . . punch, reader, stand, ASCII code, very clean, overhauled last year — £150 ono. Logabax, printer, LX180, 180 cps, synchronous, 7x7 matrix, continuous form, fan folded, tractor feed, paper width 4" to 15", little used — £400 ono. Both the above working with all manuals and diagrams. Phone 021-358 3841 anytime.

Ciphers Cub VDU. . . 16 lines by 64 ch, separate full keyboard, automatic scrolling, upper and lower case, clear 7x9 dot matrix characters, CCITT V24 or current loop interface, switchable baud rates etc. Nearly new, cost £437, accept £250. Phone Leatherhead 74674, evenings.

Challenger 2P. . . advanced micro, 64x32 video with modulator for UK TV. 8K BASIC, 4K RAM, cassette interface, sound O/P, D/A converter (for advanced sound O/P), remote AC control facility. Fully expandable via mother board. As new, with manuals — only £350. Phone Leo on Harrogate 888912, evenings.



Wanted

I am the proud owner of a PET (32K) and would like to find other PET owners in my area with whom I might exchange views and knowledge. Anyone interested, please contact Mr Allan Clarke, 35 Campbell Street, Gainsborough, Lincs DN21 2PJ.

Wanted for nostalgic reasons. . . information leading to the acquisition of an instruction display panel from an NCR 500. Phone 01-866 1179 and ask for David.

On The Line Cont. from Page 82

puter for those "number crunching" jobs which just take too long (or do not fit into 64K) on the home micro. All in all, the concept certainly seems sound, but obviously the price needs to be right.

I'll be writing in PCW on other related developments in micro communications in a new column called "Network Notes" which will appear every few months—according to needs. In the meantime, keep writing in with those ideas.

Finally, in next month's PCW I shall be reviewing the communications capability of all the major micro systems, as well as assessing the products of modem suppliers.

Starting in our May edition, David Hebditch will be presenting a new monthly series on Man/Machine Interaction.

PASCAL Cont. from Page 73

tions and our string handling functions and procedures cannot cope with literal strings (e.g. LENGTH ('HI THERE') will cause a compiling error.

The UCSD string functions and procedures are as follows:

1 FUNCTION LENGTH (STRING): INTEGER returns the number of characters in the string STRING.

2 FUNCTIONS POS(STRING, SOURCE): INTEGER
returns the position of substring in string SOURCE.

If more than one occurrence exists, POS will return the first. If no occurrence exists, POS will return 0.

3 FUNCTION CONCAT (SOURCE1, SOURCE2, . .): STRING
returns a string which is the concatenation of the set of strings passed in the parameter list taken in order. Note the replacement version in Box 8 is a procedure rather than a function and only concatenates a pair of strings.

4 FUNCTION COPY (SOURCE, INDEX,SIZE) : STRING
returns a string containing the substring of length size starting at position INDEX in STRING.

5 PROCEDURE DELETE (DESTINATION,INDEX,SIZE)
deletes SIZE characters from the string DESTINATION starting at position INDEX.

6 PROCEDURE INSERT(SOURCE, DESTINATION,INDEX)
inserts substring SOURCE into string DESTINATION starting at position INDEX.

In addition, Box 8 contains two procedures to read and write strings (STREAD and STWRITE). This is managed at system level in UCSD PASCAL so READ and WRITE will accept strings as parameters.

Exercise: Write a program to read in a positive integer less than 10,000 and print out the value in words, e.g.:

input 1705
output ONE THOUSAND SEVEN HUNDRED AND FIVE

Use a function to extract the digits from the number, one at a time starting with the thousands, and a variable parameter to convert the digit into a word. Anything from 10 to 99 will need special treatment, especially up to 19. Use CONCAT to put the output string together.

Conclusion

This chapter has expanded the concepts of the procedure beyond that of a means of modularising programs. Value parameters are passed when there is no requirement to return their values at the end of the called procedure. Functions are used when a single result of a simple data type is required and variable parameters are used for more complicated returns. We concluded with a collection of string handling functions and procedures designed to emulate UCSD's string handling facilities.

We should like to express our thanks to Equinox Computer Systems Ltd., for their continued loan of a 56K Horizon on which the string handling procedures were developed.

Look up table

PASCAL Reserved Words
FUNCTION

Computer Jargon	
Stack	
Push	
Pop	
Actual Parameter	
Formal Parameter	
Value Parameter	Call-by-value
Variable Parameter	Call-by-Name
Side-Effect	

UCSD Exceptions
STRING = Standard type

Section 4 details implications and standard functions available

8

```
1  PROGRAM STRINGS ;
2  CONST MAXLINE = 80 ;
3  TYPE STRING = ARRAY[1..MAXLINE] OF CHAR ;
4  (*VARIABLES AS NEEDED
5  IN THE MAIN PROGRAM*)
6
7  FUNCTION LENGTH (S:STRING) : INTEGER ;
8  VAR TEMP : 1..MAXLINE ;
9  BEGIN
10     TEMP := MAXLINE ;
11     WHILE S[TEMP] = ' ' DO
12         TEMP := TEMP - 1 ;
13     LENGTH := TEMP
14 END ; (*LENGTH*)
15
16 FUNCTION POSITION(PATTERN, SOURCE:STRING):INTEGER ;
17 VAR I, J : INTEGER ;
18     FOUND : BOOLEAN ;
19 BEGIN
20     J := 0 ;
21     REPEAT
22         FOUND := TRUE ;
23         FOR I := 1 TO LENGTH (PATTERN) DO
24             IF PATTERN[I] <> SOURCE[J+I] THEN FOUND := FALSE ;
25         J := J + 1
```

Box No. 8 (Cont'd)

```
26      UNTIL FOUND OR (J>LENGTH(SOURCE)) ;
27      IF FOUND THEN POSITION := J ELSE POSITION := 0
28  END ; (*POSITION*)
29
30  PROCEDURE STREAD (VAR S:STRING) ;
31  VAR I,J: 1..MAXLINE ;
32  BEGIN
33      I := 1 ;
34      REPEAT
35          READ(S[I]) ;
36          I := I + 1
37      UNTIL EOLN ;
38      FOR J := I TO MAXLINE DO
39         S[J] := ' '
40  END ; (*STREAD*)
41
42  PROCEDURE STWRITE (S:STRING) ;
43  VAR I, J : 1..MAXLINE ;
44  BEGIN
45      FOR I := 1 TO LENGTH(S) DO
46         WRITE(S[I])
47  END ; (*STWRITE*)
48
49  PROCEDURE CONCAT(S1,S2 : STRING ; VAR DESTINATION : STRING) ;
50  VAR I, L1,L2:1..MAXLINE ;
51  BEGIN
52      L1 := LENGTH (S1) ; L2 := LENGTH (S2) ;
53      IF (L1 + L2) >MAXLINE
54      THEN WRITELN('STRINGS TOO LONG')
55      ELSE
56      BEGIN
57          FOR I := 1 TO L1 DO
58              DESTINATION[I] := S1[I] ;
59          FOR I := 1 TO L2 DO
60              DESTINATION[L1 + I] := S2[I]
61      END
62  END ;(*CONCAT*)
63
64  PROCEDURE COPY(SOURCE:STRING;VAR DESTINATION:STRING; INDEX,SIZE:INTEGER);
65  VAR I, J: 1..MAXLINE ;
66  BEGIN
67      FOR I := 1 TO SIZE DO
68      BEGIN
69          J := INDEX + I - 1 ;
70          DESTINATION[I] := SOURCE[J]
71      END ;
72      FOR I := SIZE + 1 TO MAXLINE DO
73          DESTINATION[I] := ' '
74  END ; (*COPY*)
75
76  PROCEDURE DELETE (VAR DESTINATION:STRING  ; INDEX,SIZE:INTEGER) ;
77  VAR I : 1..MAXLINE ;
78  BEGIN
79      FOR I := INDEX + SIZE TO LENGTH(DESTINATION) DO
80      BEGIN
81         DESTINATION[I-SIZE] := DESTINATION[I] ;
82         DESTINATION[I] := ' '
83      END
84  END ; (*DELETE*)
85
86  PROCEDURE INSERT(SOURCE:STRING ; VAR DESTINATION:STRING ; INDEX:INTEGER);
87  VAR I, SIZE : 1..MAXLINE ;
88  BEGIN
89      SIZE :=LENGTH(SOURCE) ;
90      IF SIZE + LENGTH(DESTINATION) > MAXLINE
91      THEN WRITELN('STRING OVERFLOW --INSERTION NOT MADE')
92      ELSE
93      BEGIN
94         FOR I := LENGTH(DESTINATION) DOWNTO INDEX DO
95            DESTINATION[I+SIZE] := DESTINATION[I] ;
96         FOR I := 1 TO SIZE DO
97            DESTINATION[INDEX + (I-1)] := SOURCE[I]
98       END
99  END ; (*INSERT*)
100
101 BEGIN (*MAIN PROGRAM*)

XXX END .
```

The Selective Prom Copier relocatable program Cont. from Page 64

```
        P1 Points to Master : P2 Points to Copy
        0F20, 21  MASTER START ADDRESS (MS)
        0F22, 23  MASTER END ADDRESS (ME)
        0F24, 25  COPY START ADDRESS (CS)
        0F26,     LOOPCOUNT
        0F27, 28  END+
START   0F29      02      CCL             Clear link and
        0F2A      C0 F8   LD(MELo)        increment
        0F2C      F4 01   ADI 1           Master end address
        0F2E      C8 F9   ST(END + Lo)
        0F30      C0 F1   LD(MEHi)        Store result at
        0F32      F4 00   ADI 0           "END +"
        0F34      C8 F2   ST(END + Hi)
REP     0F36      C4 80*  LDI 80*         Load loop total to counter
        0F38      C8 ED   ST(LOOPCOUNT)*(80 or 01)
        0F3A      C0 E5   LD(MSHi)        LOAD LOW AND HIGH —
        0F3C      35      XPAH1
        0F3D      C0 E3   LD(MSLo)        BYTES OF M.S. to P1
        0F3F      31      XPAL1
        0F40      C0 E3   LD(CSHi)        LOAD LOW AND HIGH —
        0F42      36      XPAH2
        0F43      C0 E1   LD(CSLo)        BYTES OF CS TO PZ
        0F45      32      XPAL.2
        0F46      C4, 02, 07  LDI 2, CAS  SET FLAG 1
LOOP    0F49      C5 01   LD @ (P1+1)     Master Read and Increment
        0F4B      CE 01   ST @ (P2+1)     Copy Write and Increment
        0F4D      8F 08   DLY 08          DELAY
        0F4F      31 01   XPAL1, XAE      COPY P1
        0F51      40 31   LDE, XPAL1      into E REG.
```

```
0F53   C0  D4      LD (END+Lo)          Load "END+" Then,
0F55   60          XRE                  using "EXOR" test
0F56   9C  F1      JNZ(LOOP)            for equality with
0F58   35  01      XPAH1, XAE           P1 register
0F5A   40  35      LDE, XPAH1
0F5C   C0  CA      LD(END+Hi)           If equal jump to loop.
0F5E   60          XRE
0F5F   9C  E8      JNZ(LOOP)
0F61   B8  C4      DLD(LOOPCOUNT)       Decrement counter and
0F63   9C  D5      JNZ(REP)             escape on Zero Count.
0F65   C4, 00, 07  LDI, 0, CAS          RESET FLAG 1
0F68   3F          XPPC3                RETURN TO MONITOR
```

PROGRAMS

Keyword retrieval system

by Derrick Daines

How often do you spend hours searching for a magazine article, recipe or whatever? You just *know* it's around somewhere, but can't quite lay your hands on it. Well, if you're like me, it happens often. So often that I felt that a computerised magazine filing system was called for. The program that follows is exactly that — it enables you to store details of the articles or whatever and recover the salient facts by keying in important words. Provided that you have organised your literature (on the bookshelves, I mean) in some sensible order — by author, by volume or by subject perhaps — then hours of frustration will be avoided.

The program is, of course, written in BASIC, with the disc-operating system of my machine in mind — the SWTP 6800. I first made a short list of those computing files that I might need — articles on programming, hardware and new products — then realised that programming articles ought to be subdivided into Assembler language, BASIC and Pilot. The hardware file I also subdivided into general and those especially applicable to my own machine, the 6800. Each reader will have his own preferences and will be able to change the menu of lines 50—100 to suit. Similarly, the sub-menu headings of lines 1010 — 7000 will be altered. Notice that these are only the headings; the real sub-menu is at lines 250-280 and is the same for each.

On running the program therefore, one is presented with the main file menu of lines 10-120 and the appropriate file is opened on selection. The sub-menu is then presented, giving the choice of search, input or return to menu. Let's take the input first, since this is where we will all start. A dummy file is needed to kick off and without it you'll get an error message. I created the dummy files using the DOS BUILD command, naming each file but entering nothing more than a carriage return in each.

When we indicate that we want to enter new data, the appropriate file is opened for WRITE. The input data has three fields — (a) title, (b) index and (c) comment. The title field is not, perhaps, so obvious as it might seem. Many magazine articles have titles that convey little or nothing about the contents — and PCW has published its fair share of these. It is therefore necessary to enter an extended title devised by the user, designed to give this information. It is separated from the published title by a dash. This is important, since it is a peculiarity of my DOS system (perhaps shared by others) that a comma is taken to be the end of a DATA statement. The result is that ANY use of the comma in ANY data-field string effectively truncates the field at that point. The comma is therefore verboten; hence the use of the dash.

The index field of course contains the information as to where the information is to be found — eg. PCW Jan. 1979 p.25 (Notice — no commas!).

Finally, the comment field is added as a further guide to article selection. As far as possible this should be objective comment, rather than the subjective 'Great program!' variety, since it will be found without any doubt that one's tastes and needs change as knowledge and experience is gained. Besides, the subjective comment rarely conveys information; the objective, "Needs 24K to run" does.

Finally it should be added that as written, any field can be up to 72 characters long, which is more than sufficient for most purposes.

The search loop is elegant and reveals the real power and purpose of the system. Suppose that my wife wants a recipe of say, soup made out of onions and has a vague remembrance that the one she wants included wine and breadcrumbs. She inserts her recipe disc into the machine, calls up the menu, and asks for a search and is told to input keywords (lines 410 — 480). She can tap in up to ten keywords and obviously would choose onion (return), wine (return), and breadcrumbs (return). The disk system swings into action. It searches every file title and prints out those file entries that have ALL the keywords in the title field (published or extended). Obviously, the more keywords typed in the smaller the number of displayed entries and of course if she has not been careful in her choice of keywords — or initially in her choice of extended title — it is possible that no entries are displayed, or unsuitable ones. Conversely, if I tapped in only one keyword — say transistors — it is possible that I might get several hundred displayed entries. It requires care, but is extremely useful. Going back to my wife's problem; if she remembered the onions and breadcrumbs but forgot the wine part, it would make no difference. The recipe that she wanted would be displayed along with all others that included onions and breadcrumbs.

The hardest and most time-consuming task of all is to create the

PROGRAMS

data files. There is no shirking this task; once the program has been created and tested, several evenings must be given over to entering the data — the carriage return finger gets quite numb! To speed things up a bit, I whisk through a dozen or so mags at once, inserting slips of paper in all those places where articles are to go into the same file. It all sounds rather tedious and probably is, but you'd be amazed how many articles I found that I had intended to read but forgot! Maybe that was why this aspect of the job took so long!

So — I now have a system that enables me to find any article within a few minutes and it gets plenty of work to do. Upkeep from now on is minimal. Whenever I get a computer magazine and have finished devouring it, I take it into the den and enter the file details — this takes about five minutes, The mag then takes its place on the shelf with the rest and once a year or so I bind sets together.

Apart from the problem of making sure that each mag or book is in its correct place when I am not using it, there are two other small areas of worry. One is when any file gets too big, the disc is going to take a long time — several minutes — searching it all. The other is, what happens if I wish to delete an entry —perhaps preparatory to throwing a book away? In fact, this is going to require another small program that will solve both problems at once. The system will print out every entry in turn and ask for a decision from the user as to which of the new files the entry is to go to — or whether it is to be deleted. Perhaps if the editor agrees, this program can be published later.

```
0001 FOR X=1 TO 5:PRINT:NEXT X
0006 DIM A$(10)
0010 PRINT TAB(20);"COMPUTING FILE"
0020 PRINT TAB(20);"==============="
0030 PRINT "ON-GOING CATALOGUE OF LITERA
TURE"
0040 PRINT
0050 PRINT "    1 - COMPUTER PROGRAMS (A
SSEMBLER)"
0060 PRINT "    2 - COMPUTER PROGRAMS (B
ASIC)"
0070 PRINT "    3 - COMPUTER PROGRAMS (P
ILOT)"
0080 PRINT "    4 - HARDWARE - 6800 SPEC
IFIC"
0090 PRINT "    5 - HARDWARE GENERAL"
0100 PRINT "    6 - NEW PRODUCTS"
0110 PRINT "    7 - GENERAL INTEREST"
0120 PRINT "    8 - FINISHED WITH PROGRA
M."
0130  X=8:GOSUB 200
0140 PRINT :PRINT:PRINT
0160 ON A GOTO 1000,2000,3000,4000,5000,
6000,7000,8000
0170 OPEN #1,F$
0175 IF A<=2 THEN 180
0177 ON A-2 GOTO 10,8000
0180 ON A GOSUB 400,8010
0190 GOTO 50
0200 PRINT :INPUT"          SELECT",A
0210  A=ABS(INT(A)):IF A=0 THEN200
0220 IF A>X THEN 200
0230 RETURN
0240 PRINT
0250 PRINT "   1 - SEARCH"
0260 PRINT "   2 - INPUT NEW FILE DATA"
0270 PRINT "   3 - RETURN TO MENU"
0280 PRINT "   4 - END"
0290  X=4:GOSUB 200
0300 RETURN
0400 PRINT :PRINT:PRINT
0410 PRINT "GIVE KEYWORDS SEPARATED BY C
/R"
```

PROGRAMS

```
0420 PRINT "TO END INPUT OF KEYWORDS, TA
P C/R"
0460 PRINT :PRINT:FOR X=1 TO 10:INPUT A$
(X)
0470 IF A$(X)="" THEN 490
0480 NEXT X:PRINT "TOO MANY KEYWORDS. RE
-ENTER":GOTO 460
0490 READ #1,B$,C$,D$
0500 IF EOF(1)=1 THEN 600
0505 REM - THE FIRST INPUT WORD THAT DOE
S NOT MATCH, GO TO NEXT READ!
0510  T=LEN(B$):FOR G=1 TO X-1:L=LEN(A$(
G))
0520 IF T<L THEN 490
0530 FOR H=1 TO T-L+1
0540 IF MID$(B$,H,L)<>A$(G) THEN 560
0550 GOTO 570
0560 NEXT H:GOTO 490
0565 REM - WORD MATCHES
0570 NEXT G
0575 REM - ALL INPUTS MATCH
0580 PRINT "TITLE:   ";B$
0582 PRINT "INDEX:   ";C$
0584 PRINT "COMMENT: ";D$
0586 PRINT
0590 GOTO 490
0600 PRINT :PRINT "END OF FILE"
0610 INPUT "   SEARCH THIS FILE AGAIN",A
$
0620 IF LEFT$(A$,1)<>"Y" THEN 640
0625 RESTORE #1
0630 PRINT " INPUT  YOUR KEYWORD(S)":GOT
O 460
0640 CLOSE #1
0650 RETURN
1000 REM
1010 PRINT TAB(8);"COMPUTER PROGRAMS (AS
SEMBLER)"
1020 PRINT TAB(8);"==================
========"
1030 GOSUB 240
1040  F$="1.COMPASS.DAT"
1050 GOTO 170
2000 REM
2010 PRINT TAB(10);"COMPUTER PROGRAMS (B
ASIC)"
2020 PRINT TAB(10);"==================
====="
2030 GOSUB 240
2040  F$="1.COMBAS.DAT"
2050 GOTO 170
3000 REM
3010 PRINT TAB(10);"COMPUTER PROGRAMS (P
ILOT)"
3020 PRINT TAB(10);"==================
====="
3030 GOSUB 240
3040  F$="1.COMPIL.DAT"
3050 GOTO 170
4000 REM
4010 PRINT TAB(10);"HARDWARE - 6800 SPEC
```

PROGRAMS

```
IFIC"
4020 PRINT TAB(10);"====================
====="
4030 GOSUB 240
4040  F$="1.HARD6800.DAT"
4050 GOTO 170
5000 REM
5010 PRINT TAB(10);"HARDWARE GENERAL"
5020 PRINT TAB(10);"================"
5030 GOSUB 240
5040  F$="1.GENHARD.DAT"
5050 GOTO 170
6000 PRINT TAB(10);"NEW PRODUCTS"
6010 PRINT TAB(10);"============"
6020 GOSUB 240
6040  F$="1.NEWPROD.DAT"
6050 GOTO 170
7000 PRINT TAB(10);"GENERAL INTEREST"
7010 PRINT TAB(10);"================"
7020 GOSUB 240
7040  F$="1.GENINT.DAT"
7050 GOTO 170
8000 END
8010 REM - INPUT NEW DATA
8020 PRINT :PRINT:PRINT
8025 OPEN #2,1.TEMP.SCR
8030 SCRATCH #2
8035 READ #1,B$,C$,D$
8040 IF EOF(1)<>0 THEN 8080
8045 WRITE #2,B$,C$,D$
8050 GOTO 8035
8080 PRINT "TITLE - THE FIELD LOOKED AT
DURING A SEARCH."
8090 PRINT "INDEX - WHERE THE ARTICLE MA
Y BE FOUND."
8095 PRINT "COMMENT - ELABORATION OF TIT
LE OR ADDITIONAL INFORMATION."
8100 PRINT :PRINT: PRINT"INPUT YOUR DATA
  -"
8110 INPUT "TITLE",B$
8120 INPUT "INDEX",C$
8130 INPUT "COMMENT",D$
8140 PRINT :PRINT:INPUT "ENTRIES OK",A$
8150 IF LEFT$(A$,1)="N"THEN 8100
8160 WRITE #2,B$,C$,D$
8170 PRINT :INPUT"   FILED.    MORE ENTR
IES",A$
8180 IF LEFT$(A$,1)="Y" THEN 8100
8190 CLOSE #1,#2:KILL F$
8200 RENAME TEMP.SCR.1 F$
8210 RETURN
```

Scrolled message for MK14

by Mark Franklin

The following program will allow the MK14 to display messages, stored backwards in memory, in a scrolled format. The data for the message at 0B00 (extra RAM), is arranged in eight byte blocks. The maximum number of blocks (or lines) is FF_{16} (255_{10}). The byte which determines the time each line is displayed is stored at 0F19. The number of lines is stored at 0F50. Note: The byte at 0F most also be stored at 0F5A, otherwise strange things will occur. The byte at 0F1A determines where the data starts in RAM,
ie. 0B00 (0F1A 00)
0B08 (0F1A 08)

PROGRAMS

```
0F19 XX delay
0F1A XX position
0F1B XX number of lines
0F1C C0FE
0F1E C838
0F20 C40B
0F22 36
0F23 C0F6
0F25 C802
0F27 C400
0F29 32
0F2A C40D
0F2C 35
0F2DC400
0F2F 31
0F30 C408
0F32 C825
0F34 C601
0F36 C201
0F38 B81F
0F3A 9CF8
0F3C B81E
0F3E 9CE7
0F40 B819
0F42 9CE3
0F44 C0D4
0F46 C813
0F48 02
0F49 C0DE
0F4B F408
0F4D C82A
0F4F 8FZZ
0F51 B805
0F53 9CD2
0F55 3F, (90C5 [to loop])
0F57 00 }
0F58 00 } counters
0F59 00 }
0F5A XX      delay
```

FUN & GAMES

Kaleidoscope

BY R G Hall

This program, written in PET BASIC, creates an ever changing pattern on the screen like a kaleidoscope, but in four parts.

The selected character is POKEd on to the screen in sixteen places, but lines 110-140 may choose to do a bit of clearing so as not to fill the screen completely.

Note: Line 50 PRINT "■" may be used to clear the screen RND(TI) makes use of the PET's clock to randomize the pattern. (Try RND(1) etc.).

```
 10 REM   4 SQUARE
 20 REM   BY R G HALL 1979
 50 PRINTCHR$(147):REM  CLEAR SCREEN
 60 REM SELECT POSITIONS
 70 A=INT(RND(TI)*10)
 80 B=INT(RND(TI)* 6)*40
 90 REM SELECT PRINT CHAR.
 100 C=INT(RND(TI)*255)
 110 REM SELECT PRINT OR SPACE
 120 R=INT(RND(TI)*10)
 130 IFR>5THEN 100
 140 C=32
 150 REM POKE TO SCREEN
 160 S=33018:T=33037:U=33458:V=33477
 170 POKES-A-B,C:POKET-A-B,C:POKEU-A-B,C
:POKEV-A-B,C
 180 POKES+A-B,C:POKET+A-B,C:POKEU+A-B,C
:POKEV+A-B,C
 190 POKES-A+B,C:POKET-A+B,C:POKEU-A+B,C
:POKEV-A+B,C
 200 POKES+A+B,C:POKET+A+B,C:POKEU+A+B,C
:POKEV+A+B,C
 210 GOTO 70
READY.
```

BELLS & WHISTLES

Efficient character storage

by David Tucker

In computing it is very often desirable to pack as many characters as possible into a given area of memory.

The usual method of holding text is to encode the text into 8 bit ASCII and store one character per byte. Thus there

BELLS & WHISTLES

are 256 possible different ASCII codes that can be stored in any particular byte.

Very often however the only characters of interest are A to Z, 0 to 9, space and perhaps a couple of punctuation marks.

It so happens that if we take a set of 40 characters we can encode them in such a way that three characters can be stored in 16 bits (2 bytes), thus increasing the storage capacity of a given area of memory by 30%.

We do this by treating the three characters as if they were digits of a number to the base 40.
Suppose a=1, b=2, c=3
Then ABC = 3x40x40+2x40+1 = 4881
The number 4881 could be stored in a 16 bit word.
The maximum value would be 39x40x40+39x40+39 = 63999.
This is less than 65535 (the maximum 16 bit number).

The two subroutines presented here are written in Z80 assembler code although the principles outlined can be applied to any machine.

The ENCODE subroutine takes a three byte ASCII string whose address is in the BC register pair and returns the encoded RADIX-40 characters in the HL register pair.

The DECODE subroutine takes the three RADIX-40 characters in the HL register pair and returns a three byte ASCII string starting at the address contained in BC.

How it works:

The ENCODE subroutine first clears the HL register pair then calls the subroutine FIND which locates the character pointed to by BC and returns its number from the end of the TABLE in register A. BC is then incremented to point to the next character.

DE is loaded with 1600 (40x40) and the subroutine MULT is then called. This subroutine multiplies the contents of register A and adds the result to register pair HL.

The process is repeated for the other two characters with DE set to 40 then 1.

The three characters have now been encoded.

The DECODE subroutine performs the inverse operation to ENCODE.

The register pair DE is first loaded with 1600 then the subroutine TRANS is called. This subroutine performs an integer division of HL by DE leaving the result in register A and the remainder in HL. It then locates the relevant character in the TABLE and transfers it to the location pointed at by BC and finally increments BC. The whole process is repeated with DE set to 40 then 1.

```
0D00                0010         ORG  &0D00
                    0020 ;BC POINTS TO A
                    0030 ; 3 CHARACTER STRING
                    0040 ; ON RETURN
                    0050 ; HL CONTAINS RADIX-40
0D00 210000         0060 ENCODE LD   HL,0 ;CLEAR HL
0D03 CD1F0D         0070        CALL FIND ;1ST CHARACTER
0D06 114006         0080        LD   DE,1600 ;40*40
0D09 CD2F0D         0090        CALL MULT ;DE*A
0D0C CD1F0D         0100        CALL FIND ; 2ND CHARACTER
0D0F 112800         0110        LD   DE,40
0D12 CD2F0D         0120        CALL MULT
0D15 CD1F0D         0130        CALL FIND ; 3RD CHARACTER
0D18 110100         0140        LD   DE,1
0D1B CD2F0D         0150        CALL MULT
0D1E C9             0160        RET  ;FINISH
                    0170 ;
0D1F 0A             0180 FIND   LD   A,(BC) ;GET CHARACTER
0D20 03             0190        INC  BC ;POINT TO NEXT
0D21 C5             0200        PUSH BC ;SAVE
0D22 E5             0210        PUSH HL ; ON STACK
0D23 012800         0220        LD   BC,40 ;TABLE LENGTH
0D26 215F0D         0230        LD   HL,TABLE
0D29 EDB1           0240        CPIR ;FIND CHARACTER
0D2B 79             0250        LD   A,C ;GET NUMBER
0D2C E1             0260        POP  HL
0D2D C1             0270        POP  BC
0D2E C9             0280        RET
                    0290 ;
0D2F A7             0300 MULT   AND  A ;SET CONDITION
                    0310 ;  CODES
0D30 C8             0320        RET  Z ; FINISH IF 0
0D31 19             0330        ADD  HL,DE
0D32 3D             0340        DEC  A ;DEC COUNT
0D33 18FA           0350        JR   MULT ;ROUND WE GO
                    0380 ;HL CONTAINS RADIX-40
                    0390 ; BC POINTS TO RESULT BUFFER
0D35 114006         0400 DECODE LD   DE,1600 ;40*40
0D38 CD480D         0410        CALL TRANS ;1ST CHARACTER
0D3B 112800         0420        LD   DE,40
0D3E CD480D         0430        CALL TRANS ;2ND
0D41 110100         0440        LD   DE,1
0D44 CD480D         0450        CALL TRANS ;3RD
0D47 C9             0460        RET  ;FINISH
                    0470 ;
                    0480 ;
```

BELLS & WHISTLES

```
0D48 AF          0490 TRANS  XOR  A ;CLR A
0D49 ED52        0500 TRANS1 SBC  HL,DE ;SUBTRACT
0D4B 3803        0510        JR   C DONE ;JUMP IF OVERFLOW
0D4D 3C          0520        INC  A ;INC COUNTER
0D4E 18F9        0530        JR   TRANS1 ;ROUND WE GO
0D50 19          0540 DONE   ADD  HL,DE ;RECOVER VALUE
0D51 E5          0550        PUSH HL
0D52 21870D      0560        LD   HL,TABEND ;END OF TABLE
0D55 5F          0570        LD   E,A ;GET A IN DE
0D56 1600        0580        LD   D,0
0D58 ED52        0590        SBC  HL,DE ;GET ADDRESS
0D5A 7E          0600        LD   A,(HL); GET CHARACTER
0D5B 02          0610        LD   (BC),A ;STORE
0D5C 03          0620        INC  BC ;POINT TO NEXT POSITION
0D5D E1          0630        POP  HL
0D5E C9          0640        RET
                 0650 ;
                 0660 ;
0D5F 20414243    0670 TABLE  DEFM / ABC/
0D63 44454647    0680        DEFM /DEFG/
0D67 48494A4B    0690        DEFM /HIJK/
0D6B 4C4D4E4F    0700        DEFM /LMNO/
0D6F 50515253    0710        DEFM /PQRS/
0D73 54555657    0720        DEFM /TUVW/
0D77 58595A31    0730        DEFM /XYZ1/
0D7B 32333435    0740        DEFM /2345/
0D7F 36373839    0750        DEFM /6789/
0D83 302E2C3F    0760        DEFM /0.,?/
0D87 00          0770 TABEND NOP
```

LEISURE LINES

With J. J. Clessa

The Search for the smallest palindrome with an even number of digits attracted over forty replies. As usual the complaint was "Too Easy", although I didn't receive any analytical solutions to support this view. Instead I had the usual collection of program listings for computers, ranging from main frames, through micros down to programmable calculators. I'll not be publishing any of them, but suffice to say the correct answer is 698896 — which is the square of 836.

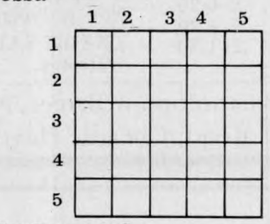
I made a draw for the winning entry using Dave Tebbutt's biased random number generator — which should by rights have awarded the prize to one of his relatives. However, it seems to have hit a bug this time. . . unless Mr P. Albericci of Bristol turns out to be a very distant cousin!

Congratulations Mr Albericci. . . a Paper Mate pen and pencil set will be winging its way to you c/o the PO — let me know if it ever arrives. Meanwhile it's time to think of more diabolical problems — try this one for size:

QUICKIE
Actually, not so much a problem, more an outrage, you have 30 seconds to complete the following "Irish" crossword. Remember not to pull any punches. . .

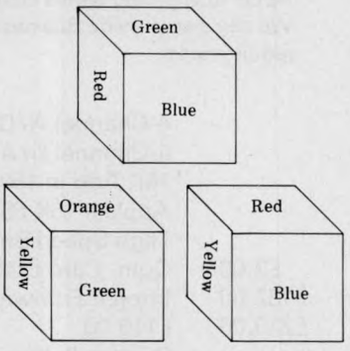
CLUES ACROSS
1. Hit hard
2. A party drink
3. Often in seaside shows
4. Use for making holes
5. What conductors do to tickets

CLUES DOWN
1. Vegetables
2. Female sheep
3. They lay eggs
4. Often sailed on
5. Dropped by Cockneys



PRIZE PUZZLE
This one is quite feasibly done by logical deduction — you could, however, computerise your efforts.

A child's cube has coloured faces. Five colours are possible — red, green, blue, yellow and orange. Three views of the same cube are shown here, and in each of the views the colour on the bottom face of the cube is not repeated on any other face. Which colour occurs twice on the cube?



Answers please on a postcard to Puzzle No. 7, Personal Computer World, 14 Rathbone Place, London W1P 1DE. All solutions must arrive by March 14th latest.

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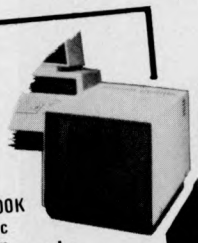

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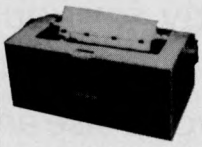

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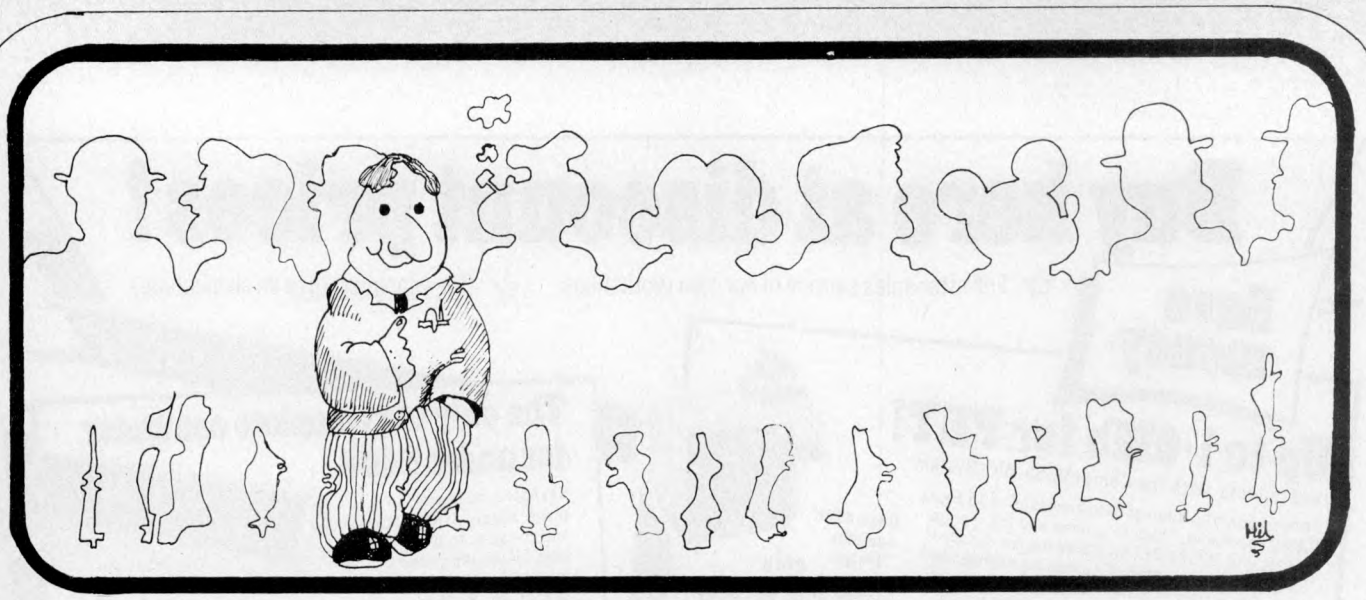

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Printer cable	39.00	45.

CONSULTANCY

Please write or telephone if you require advice on BEGINNING or EXPANDING your computer installation. Software programs customised to your requirements.

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Upgrade Kit :		
Interface :		
Disk Drive :		
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Cluster System :		
Colour TV :		
Media :		
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XITAN SYSTEMS

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£4,054.00 for this system with vdu.

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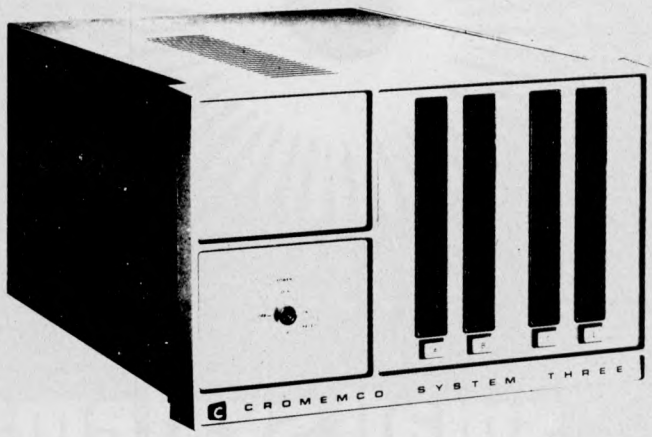

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The **RESEARCH MACHINES 380Z** is an excellent microcomputer for on-line data logging and control. In university departments in general, it is also a very attractive alternative to a central mainframe. Having your own 380Z means an end to fighting the central operating system, immediate feedback of program bugs, no more queuing and a virtually unlimited computing budget. You can program in interactive BASIC or, using our unique Text Editor, run very large programs with a 380Z FORTRAN Compiler. If you already have a mini-computer, 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 a robust, hardwearing piece of equipment that will endure continual handling for years. It has an integral VDU interface – you only have to 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 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 occurence 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 based 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.

**Trademark, Digital Research.*

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.

380Z/56K complete with DUAL FULL FLOPPY DISK SYSTEM FDS-2

£3266.00

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RESEARCH MACHINES Computer Systems are distributed by RESEARCH MACHINES LTD., P.O. Box 75, Chapel Street, Oxford. Telephone: OXFORD (0865) 49792. Please send for the 380Z Information Leaflet. Prices do not include Carriage or VAT @ 15%.

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This superb ex computer video monitor was originally used as an information display on large computer systems. It features all silicon electronics, attractive style, housed in shatterproof two colour A.B.S. case with controls under flap. 240v operation. 625 lines, 75 or 50 ohm composite video input 50 hz – 20 mhz frequency response. Supplied complete in good condition but untested and unguaranteed.

Connect direct to your M.P.U. at only **£47.50** + p&p £6.00
Supplied complete with circuit

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RACAL C10 "Supergrade" cassettes complete with library cases 66p each 10 for **£5.45**

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PHOTO TRANSISTOR Fairchild FPT-100 NPN silicon 30v, 25ma. 4 for £1.00.

4k x 12 RAM static Memory card

Complete 4K x 12 bit memory system on one PCB. This ex computer memory card contains all relevant decoding, read write and control logic for coupling to your M.P.U. or mini computer system. TTL in and out make interfacing a "cinch". We understand that by reading the outputs correctly, the memory can be organised as a 6K x 8! Features include fast 250ns max. access time. Standard +12v, –12v+5v power rails compact construction, non volatile memory, data remains even when power switched off!
Original cost over £800 each, supplied complete with full data and circuit manual, at an unbelievable price of **£39.95** P.P. £1.75
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STOP PRESS LIMITED QUANTITY

Just arrived, details not yet fully known **VENTEK VDU TERMINALS.** 12inch diagonal green screen, RS232 interface, full keyboard including cursor control. Believed 24 lines X 80 characters. Phone for further details. Second-hand price £225 plus carriage & VAT.

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Note, super cased version matches 9" video monitor

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19.20 KHZ	B7G	£2.50
1.00 MHZ	HC6/U	£2.75
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2.50 MHZ	B7G	£2.35
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SAE for latest XTAL stock list

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Latest technology brings you the **SILICONIX VMOS POWER FETS** at a super scoop price. Capable of switching 2 amps D.C. @ 60v. D.C. – 200 MHz. Ideal interface, derived direct from VMOS. £1.50 each, 10 for £12.50; full application data: 20p

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*Ex equipment tested †P.P. 40p

The Perfect Lead...
Acorn Microcomputer System 1

Price £65 plus VAT in kit form

This compact stand-alone microcomputer is based on standard Eurocard modules, and employs the highly popular 6502 MPU (as used in APPLE, PET, KIM, etc). Throughout, the design philosophy has been to provide full expandability, versatility and economy.

Specification

The Acorn consists of two single Eurocards.

1. MPU card

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

2. Keyboard card

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

Keyboard instructions:

Memory Inspect/Change (remembers last address used)
Stepping up through memory
Stepping down through memory
Set or clear break point
Restore from break
Load from tape
Store on tape
Go (recalls last address used)
Reset

Monitor features

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

Applications

As a self teaching tool for beginners to computing.
As a low cost 6502 development system for industry.
As a basis for a powerful microcomputer in its expanded form.
As a control system for electronics engineers.
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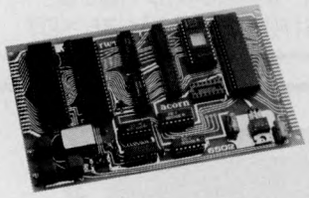
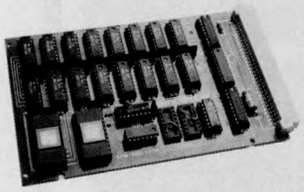
START WITH SYSTEM 1 AND CONTINUE AS AND WHEN YOU LIKE



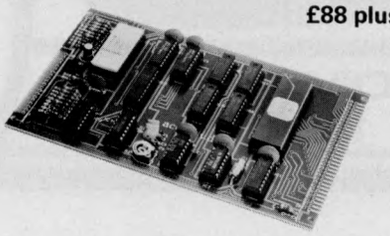
Acorn Controller
£35 plus VAT (min config.)

the CPU card of System 1, it allows for up to 4½ k EPROM, 1¼ k RAM and 32 I/O lines. It has on board 5 V regulator and optional crystal control. Custom programs may be developed on System 1 and the card makes an ideal dedicated hardware module.



Acorn Memory 8 k
£95 plus VAT (kit form)

A fully buffered memory card allowing up to 8 k RAM plus 8 k EPROM on one eurocard, in an Acorn system both BASIC and DOS may be contained in this module. Static RAM (2114) is used and the card may be wired into other systems.



Acorn VDU
£88 plus VAT (kit form)

A memory mapped seven colour VDU interface with adjustable screen format. Full upper and lower ascii and teletext graphics are features of this module which along with programmable cursor, light pen, hardware scroll etc., make this the most advanced interface in its class.

Acorn Software in ROM

Acorn BASIC — a very fast integer BASIC in 4 k
Acorn COS — a sophisticated cassette operating system with load and save and keyboard and VDU routines in 2 k
Acorn DOS — a comprehensive disc operating system in 4 k

Acorn Computers Ltd.
4A Market Hill, Cambridge, Cambs.
Cambridge (0223) 312772.

Order Form

Please send me the following:

- ☐ (qty) Acorn Microcomputer kit @ £65 plus £9.75 VAT.
- ☐ (qty) Acorn Memory kit @ £95 plus £14.25 VAT.
- ☐ (qty) Acorn VDU kit @ £88 plus £13.20 VAT.
- ☐ (qty) Acorn Power Supply (for System 1 only) @ £5.95 plus £0.89 VAT.
- ☐ (qty) Acorn Microcomputer assembled and tested @ £79 plus £11.85 VAT.
- ☐ (qty) Acorn VDU assembled and tested @ £98 plus £14.70 VAT.

Post and packing free on all orders.

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

Please send me further details of this and other Acorn options

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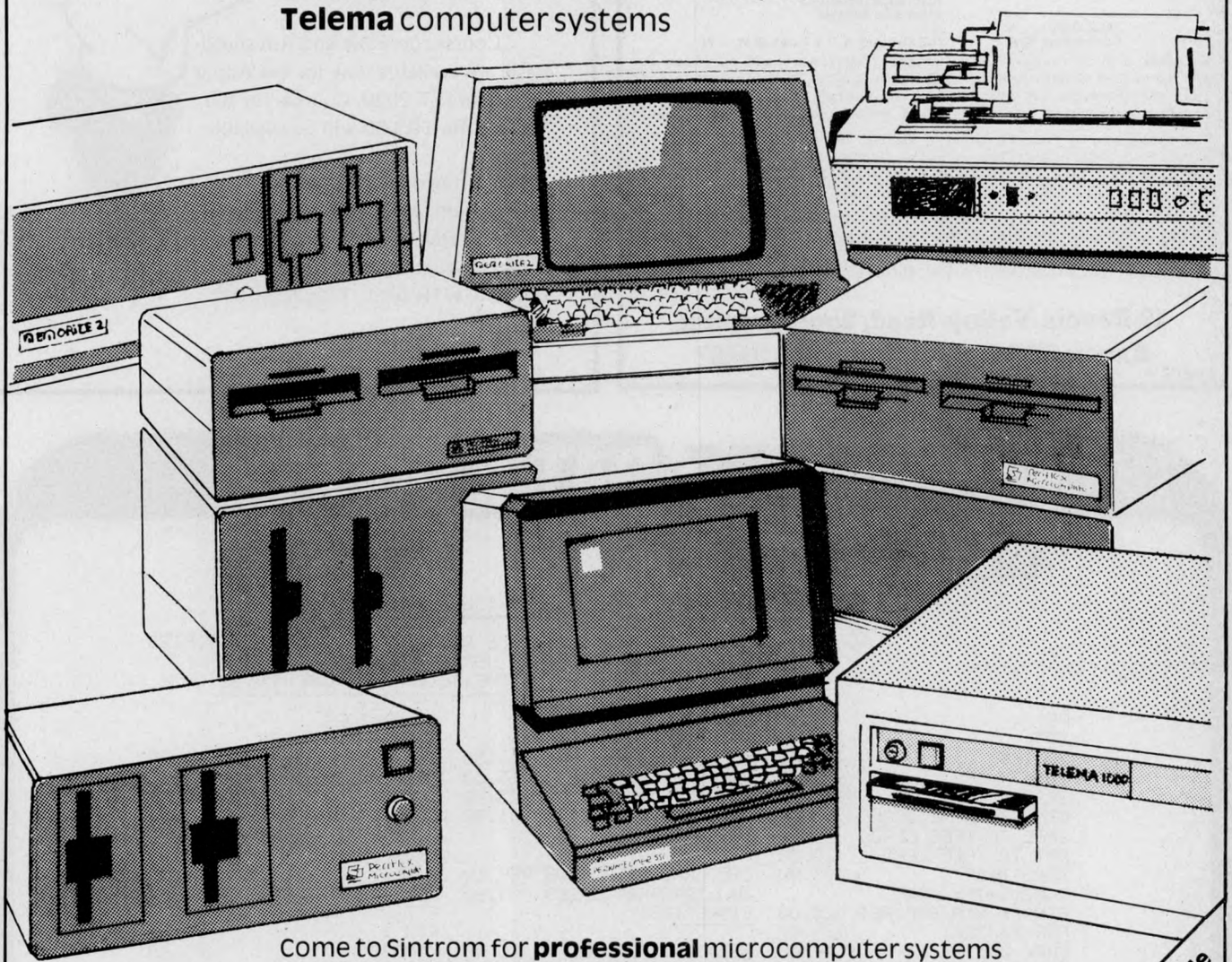

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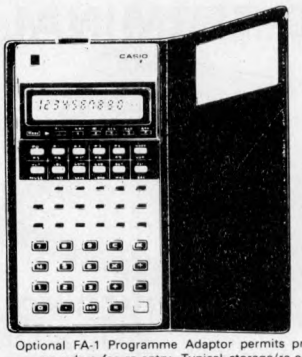

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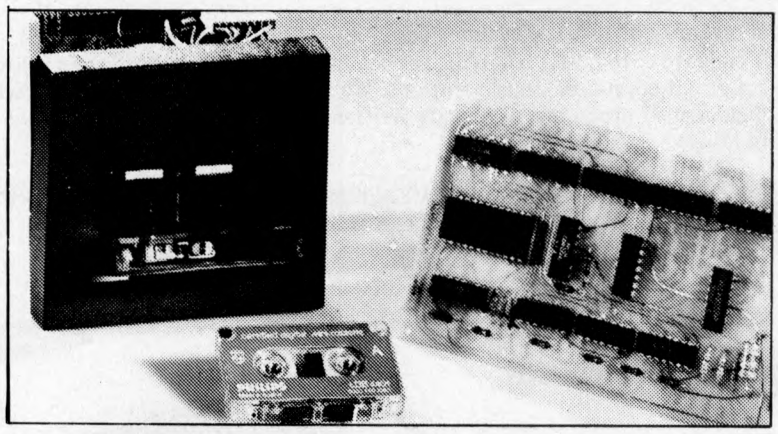

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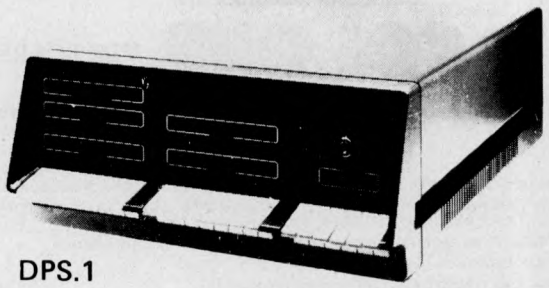

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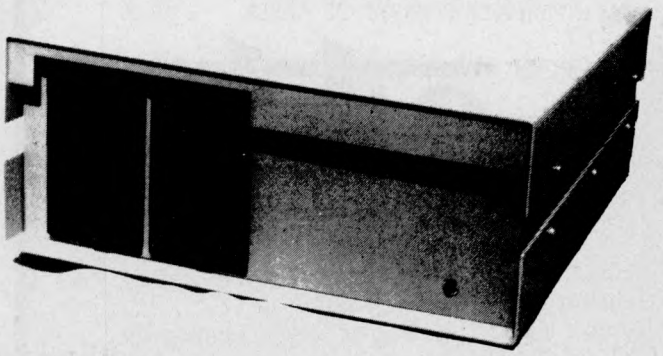

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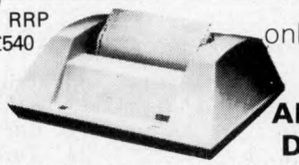

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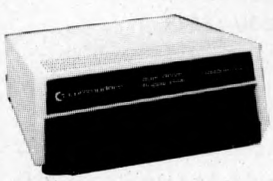

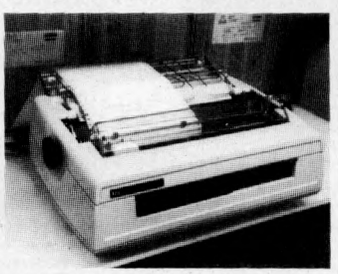

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