Practical Computing

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February 1980

Volume 3 Issue 2

Home computer networks

Reviews: MiniMax Video Genie

Make your PET printer sing and dance

NEW: Professional software guide

Robotics – What's happening

Practical Computing

Editor
Peter Laurie
Technical Editor
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Staff Writer
Duncan Scot
Production
Martin Hayman
Art
Margaret Smith
Editorial Secretary
Susie Manning
Advertisement Department
Tom Moloney
Tina Roberts
David Lake
Publishing Director
Christopher Hipwell
Editorial: 01-261 8752
Advertising: 01-261 8000

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CONTENTS

Our cover by Frank Phipps shows a world of the future, when networked micros make it possible to work at home. The city is wasting away; oil shortage has abolished cars in favour of the horse.

Scotland 18, 19, 20 March – Albany Hotel, Douglas Street, Glasgow
North West 11, 12, 13 March – New Century Hall, Corporation Street, Manchester
Midlands 4, 5, 6 March – Albany Hotel, Smallbrook Queensway, Birmingham
London 25, 26, 27 March – West Centre Hotel, Lillie Road, London SW6

COMPUTERMA

Your first computer?

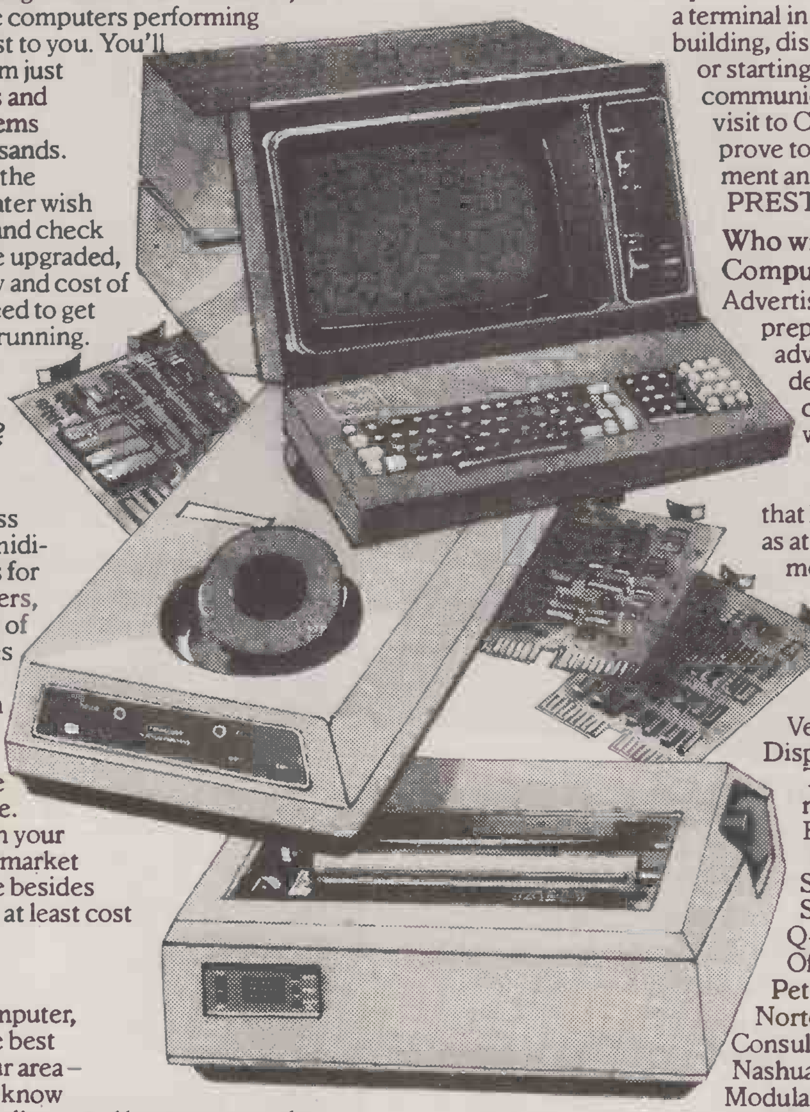
If you're thinking about your first computer for home or office, a visit to Computermarket will save you time and money. You'll be able to compare prices in just one visit, see who is committed to your area, meet people who have installed the sort of equipment you are considering, check out after sales service arrangements with more than just one potential supplier and see computers performing the applications of interest to you. You'll see micro-computers from just a few hundreds of pounds and highly sophisticated systems costing hundreds of thousands. You'll be able to examine the enhancements you may later wish to add to your computer and check out that the system can be upgraded, investigate the availability and cost of the supplies that you'll need to get and keep your computer running. You might even actually see a silicon chip!

OEM/System builder?

Hasn't your marketplace changed since you first thought about the business you're in? 16 bit micros, midi-computers, bread-boards for peanuts, matrix line printers, smart VDUs for the price of dumb ones, famous names that you hadn't heard of only months ago. Custom ized or off-the-shelf, it must sometimes look like the world and his wife is starting a systems house. Who is in your business in your area? A visit to Computermarket will tell you and a lot more besides including who can supply at least cost and fastest delivery.

Computer user?

If you've already got a computer, you'll know who gives the best service on supplies in your area – won't you? You'll already know where you can get short delivery and best terms on the peripheral enhancements you plan – won't you? You'll be aware of the software packages that are available for your existing equipment – won't you? You've probably thought about the additional processor (or its replacement) you will need before too long – haven't you? Why not check and be sure. A visit to Computermarket will confirm that you are right and will continue to get the best deal on peripherals, ancillary equipment, services, software, supplies . . . and it will give you the opportunity to see micro and mini based systems in operation just to keep up-to-date and for interest's sake – won't it?



Communications user?

Are you getting the most from your system? An acoustic coupler can cost very little and yet be the start of a communications network. Modems, multi-plexers . . . the hardware of data communications is developing fast and so is the environment in which the equipment may be employed. Communications experts will be at Computermarket so if it's a terminal in another part of your building, distributing data processing or starting your own satellite communications network (!), a visit to Computermarket should prove to be a worthwhile invest-ment and a chance to study PRESTEL at first hand.

Who will be at Computermarket?

Advertisements such as these are prepared many months in advance of the exhibitions described, but it is already certain that Computermarket will be bigger than ever before – more than twice as big overall. Companies that had already reserved stands as at November (almost four months before the 1980 series of exhibitions) included:- Zygal, Wootton Jeffreys, Willis Computer Supplies, Which Computer?, Wespac, Wang, Versatec, Tullis Neill, Terminal Display Systems, Telema, Tektronix, Tann Synchro-nome, Systime, Sumlock Bondain, Star Computer Centre, Scotia Data Products, SEMS, Selborne Computers, SEL, Rostronics, Robox, Rair, Q-Pac Services, Pragma, Post Office, Plessey Peripherals, Peterborough Data, Richard Norton, Northern Software Consultants, Newbury Laboratories, Nashua, Nascom, NSC Computers, Modular Technology, Modem, Midlectron, Micro Media, Micro Data Products, Micro Centre, Micro Bits, MCS Mini Computer Systems, Lynwood Scientific Developments, Lyme Peripherals, Linn Products, Information Equipment Maintenance, ITT, ICS, Harwoods Business Machines, Hamilton Rentals, John Goldsmith, General Audio & Data Communications, Geest Computers, GEC Computers, Excel, Eurocom, Equinox, Digidata, Digico, Datum, Data Design Techniques, DRG Business Machines, DML, Cytek, Cost Effective Computing, Corner Computer Services, Computing, Computer Workshop, Computer Weekly, Computer Management, Computer Ancillaries, Computastore, Comp

RKET'80

Shop, Commodore Business Systems, Comma Computers, Cole Electronics, Cifer Systems, Camden Electronics, CPS Data Systems, CPN, C.A.R. Business Systems, Byte Shop, Benson Electronics, BL Systems, B & B Computers, Andrews Industrial Equipment, Anadex and A.I.R.

Accountant?
If accounts, payroll, invoicing, credit control, ledger maintenance . . . figure in your life, then an hour or two at Computermarket should be an absolute must. A micro-computer can cost as little as a calculator did just a few short years ago. Trial balance and Profit and Loss statistics can be generated at the touch of a few buttons. Computers can cost hundreds or hundreds of thousands of pounds, save or even sometimes, heaven forbid, squander. You should know what computers are doing today, you might want one or have to use one tomorrow. Your advice may be sought – should be sought – by your own company or that of a client. Admission to Computermarket will cost you nothing, but could very well be worth a great deal in the future.

Data processing manager?
How much would a ten per cent saving on your stationery budget mean to your annual costs? There may be an exhibitor who could achieve that if the two of you met. Is your next peripheral going to be supplied on the most favourable terms? A visit to Computermarket will give you the confidence that you are doing the best for your company. Wouldn't it help if only other Managers in your company could see what it was you were talking about when describing printers/plotters/displays/. . ? Why not bring them along to Computermarket and show them what you've told them about? Does your chief analyst realise how software packages can be run on your hardware? Wouldn't you both benefit from a visit to Computermarket?

Your own business?
Like it or not, computers are affecting your business and that of your clients, suppliers and competitors. A computer can offer the businessperson much more than automated accounting. It can provide accurate, up-to-the-minute details on the performance of the company, flash warning signals over stock levels, credit-worthiness, supplier shortfalls . . . handle payroll, revenue and VAT returns . . . generally give you more time to run the business you know rather than processing paperwork. See the systems at Computermarket.

Computerising correspondence?
Computer control has received a lot of publicity since the advent of the silicon chip, but micro-processors have also made an impact in the office. Word Processors are able to increase the efficiency of typists to varying and often staggering degrees. Where repetition occurs in letters, reports, contracts, etc., a Word Processor can frequently pay for itself in a matter of months. Many of the small business computer systems now available include a word processing facility, thereby offering what is almost a complete 'work processing' system for a cost equivalent to, say, a new company car. Witness work processing at Computermarket.

In the Midlands?
Computermarket'80 opens at the Albany Hotel, Smallbrook Queensway, Birmingham on the 4th, 5th and 6th March between 10 am and 5 pm daily. The Albany Hotel has excellent facilities and is very conveniently located for car parks and New Street Railway and Bus Stations.

In the North West?
The Manchester venue of Computermarket'80 is the New Century Hall (at the foot of the C.I.S. building) in Corporation Street, opposite Victoria Station, close by car parks and connected by bus with the Piccadilly Station. Computermarket – North West is open 11th, 12th and 13th March 10 am to 5 pm.

In Scotland?
Regarded as Glasgow's finest hotel, the Albany in Douglas Street (on the corner of Bothwell Street) houses Computermarket'80 in Scotland. The hotel is within walking distance of the major railway stations and well provided with car parking and motorway access. Computermarket – Scotland is on 18th, 19th and 20th March between 10 am and 5 pm each day.

In London?
Biggest of all the Computermarket'80 venues is at the West Centre Hotel, Lillie Road, London SW6. The West Centre Hotel is a few minutes walk from West Brompton underground station and is also convenient for the Earls Court underground. Limited car parking is available at the hotel itself. For those visiting London Computermarket is open 25th, 26th and 27th March as with all venues, the exhibition is open from 10am to 5pm each day.

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COMPUTERMARKET'80

It is regretted that in order to preserve the businesslike nature of Computermarket, admission is not open to persons under 18 or to student parties.

"The trade are going over the moon about it...

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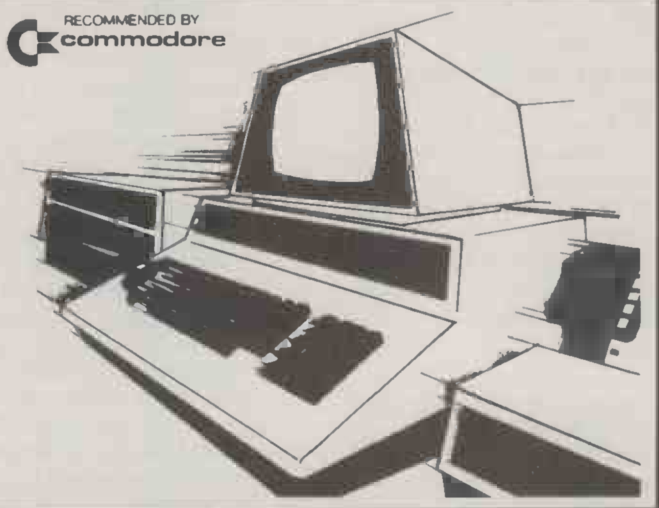

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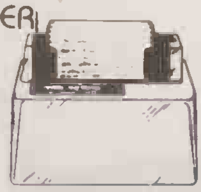

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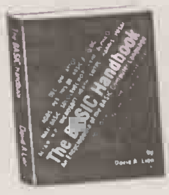

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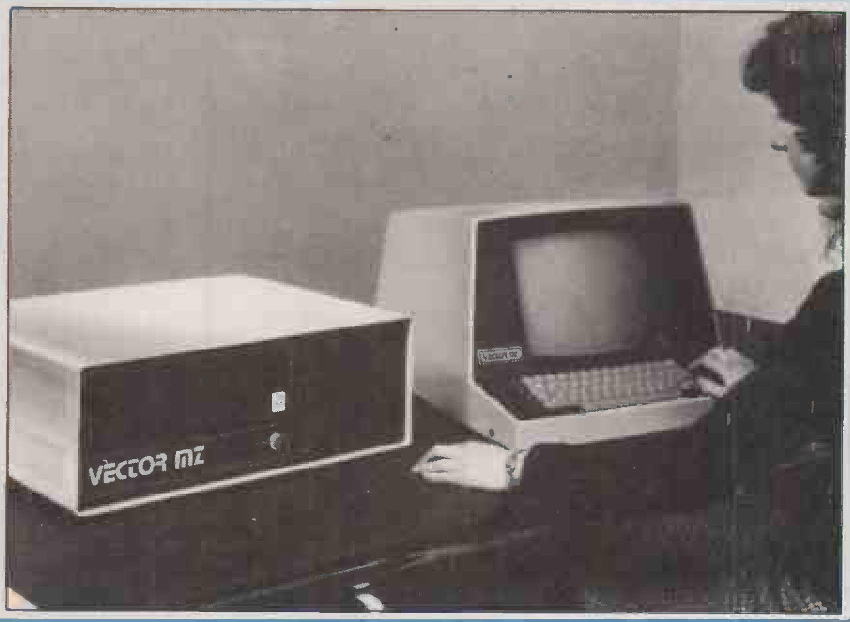

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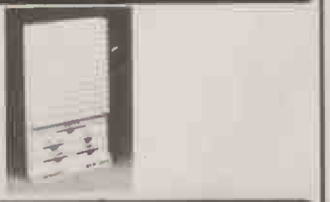

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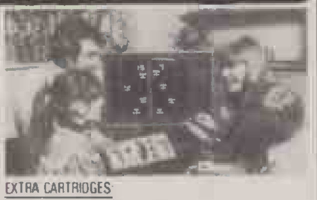

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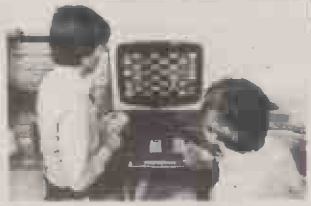

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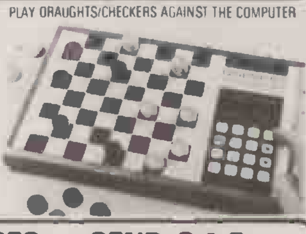

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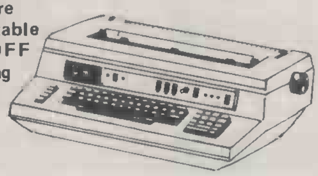

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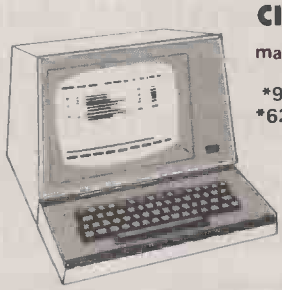

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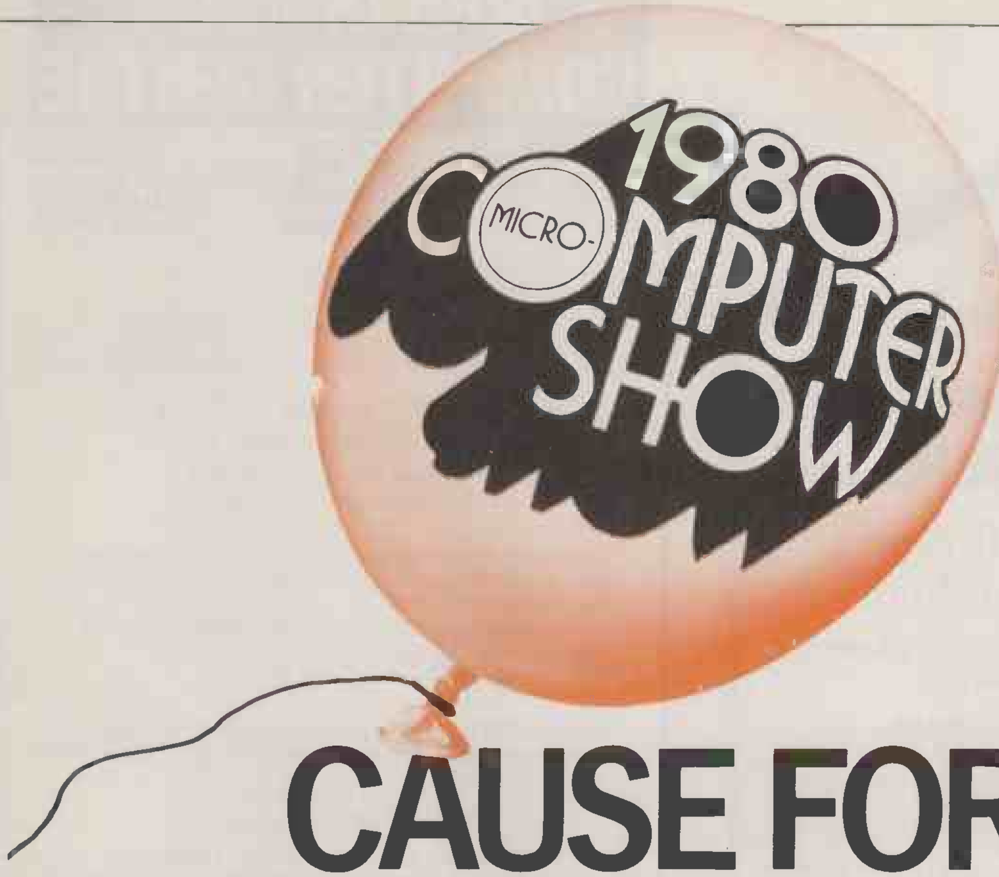

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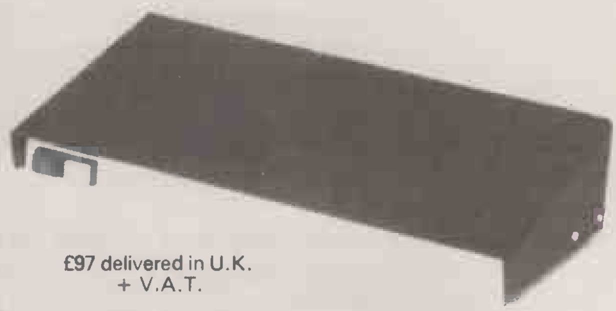

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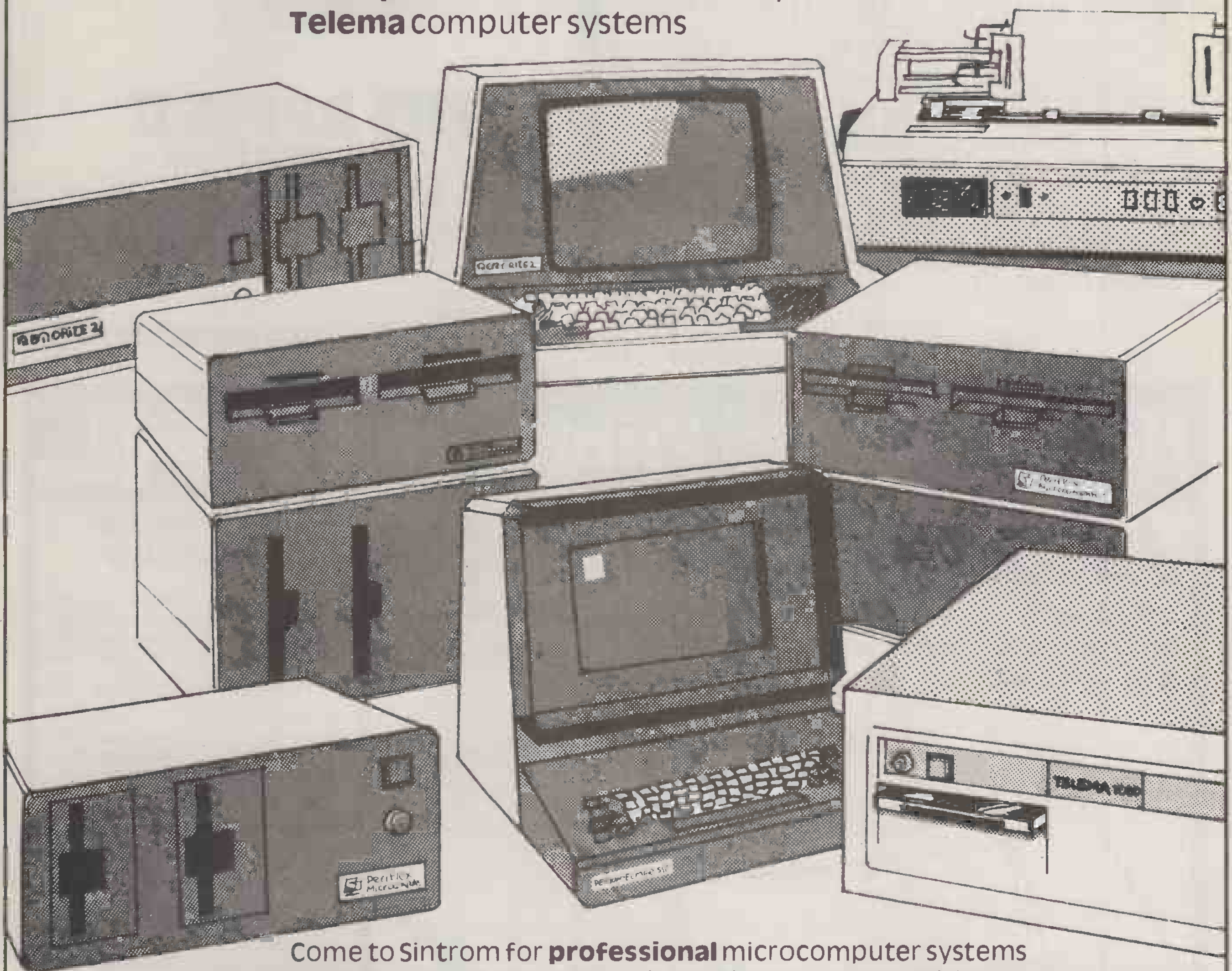

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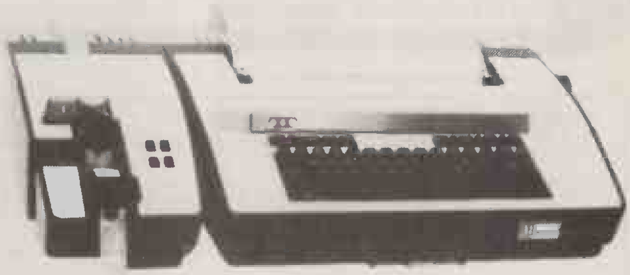

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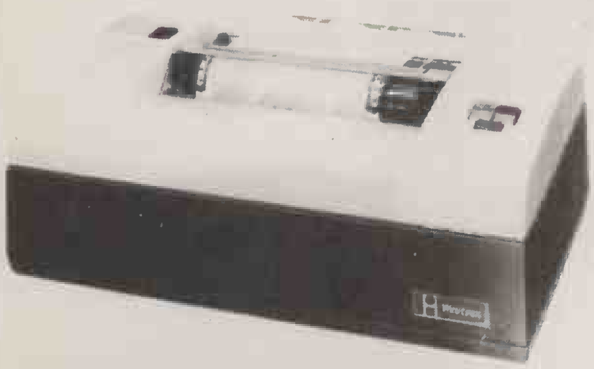

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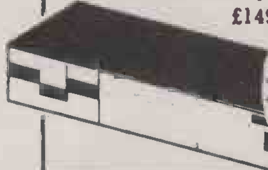

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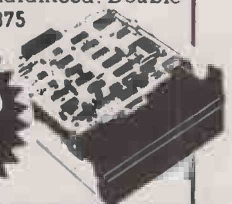

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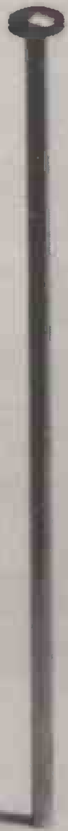

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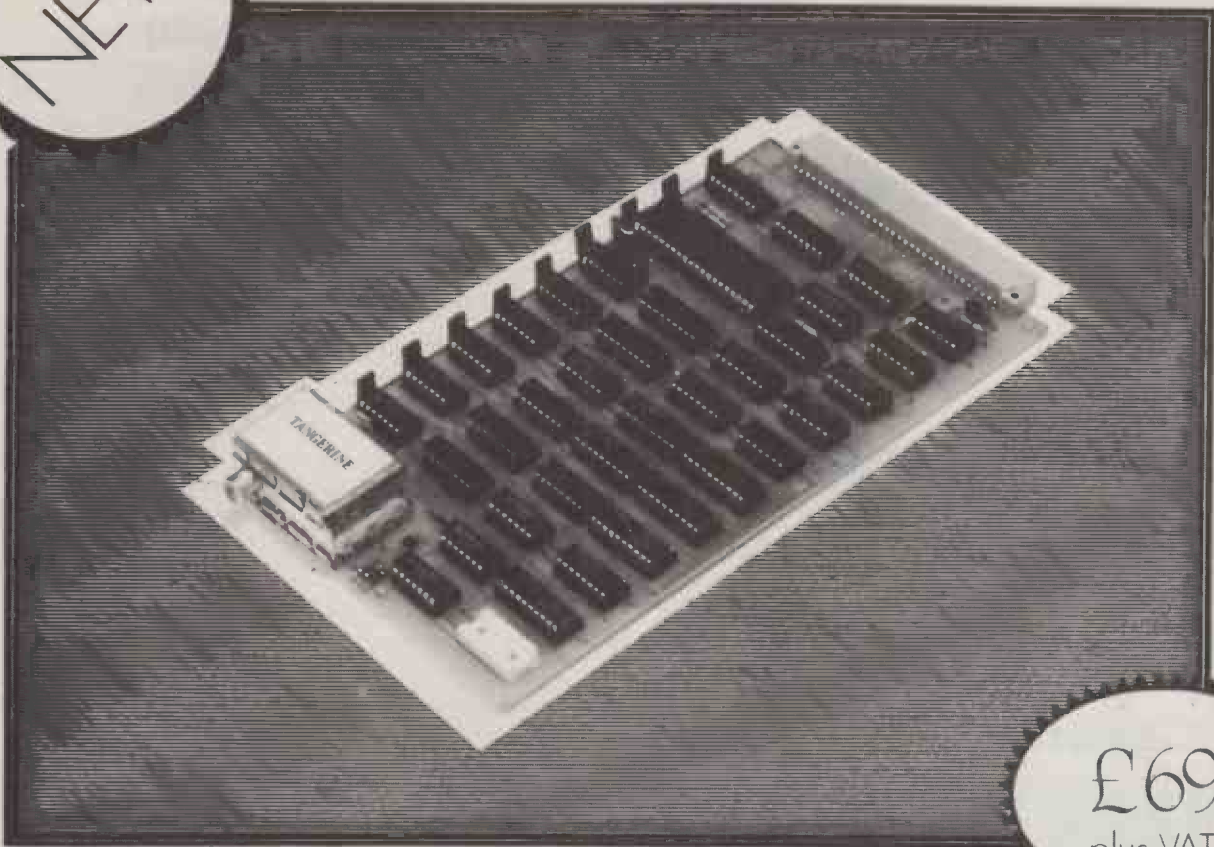

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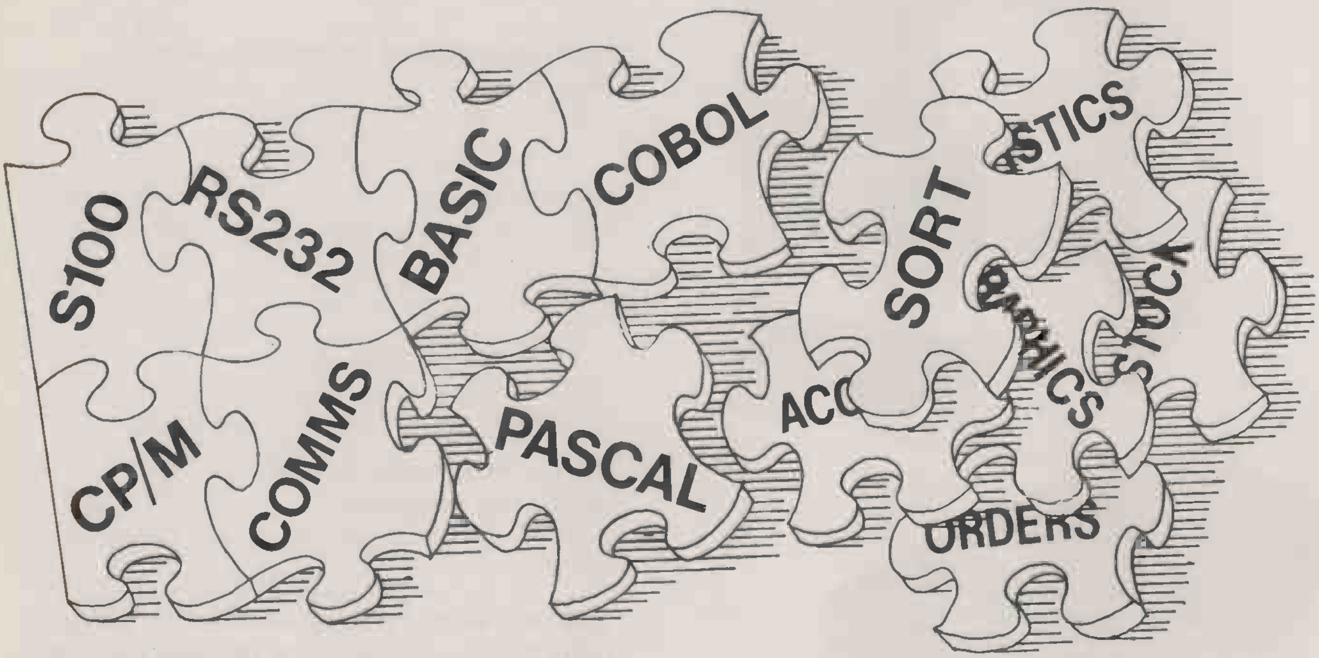

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• Circle No. 178

'Please Mr Editor, what computer should I buy?'

ON A GOOD DAY, the phone will ring only once with this insidious question: "Please Mr Editor", the unknown voice will say, "What computer should I buy?". It is so regular, though from many an unknown tongue, that I can hear the music tinkling in my head. 'Ring Ring. Please Mr Editor . . .'

But since we are a fully interactive hands-on magazine we ought to have some sort of answer for these good people, who turn to us in their understandable complexity. 'Well,' I say cagily, 'what do you want it *for?*' To begin with, this seems a good question; but now it is only stalling for time, because without listening I can hear the answer: 'Small business — fascinating — wonder chip — transform our lives — fascinating — son of a friend of mine — VAT sort of thing — absolutely fascinating.'

Having thus thoroughly explained his requirements and put the Editor in possession of all the material facts, the invisible caller sits back and waits for words of wisdom.

It might seem that the brief is somewhat skimpy. Yet, not long ago, I was sent a three-page questionnaire by a gentleman employed by a large and highly technological company to look into the whole micro-computer question. These were the questions he proposed to ask persons who wanted to supply him with micros. But, at the last moment, he asked himself: 'Have I perchance left some pertinent question out?' To make sure, he sent it all here and asked whether we could think of some tricky number that would utterly floor the wily manufacturer.

Well, I was baffled. I looked at his questions and wondered what sense one could make of all the answers if and when one had got them answered. There is such a thing as knowing too much. It was as if he were thinking of buying a car, and asked the dealer whether the crankshaft bearing journals were cyanide — or radiation-hardened.

The answer is: it doesn't really matter. Cars run; computers compute. If yours does not, then you send it back and get another.

We have got to the stage in micro-computers where hardware is not really a problem. The stuff does actually work most of the time. True, we have a hundred-odd different machines in our hardware buyers' guide (published alternate months with the software guide) and in some cosmic sense, one must be 'better' than all the others. But that cosmic sense is quite inaccessible to our coarser perceptions.

Broadly speaking, you get what you pay for. You won't get a system with a megabyte of disc and a good printer for £300; and anyone who offers you such a bargain should be carefully scrutinised. It is true, too, that the very cheapest computers get that way because their manufacturers use sub-standard chips, sold as unbranded seconds by the semiconductor houses. If you open the beast up and find a lot of anonymous-looking chips inside, be wary.

But apart from that, the only hardware thing to worry about is perhaps high-definition graphics. If pictures are what you want, then the choice is somewhat limited. But that aside, the available computers are all much of a muchness.

There are really only two questions. The first is: what do you want it for? Do you want to write your own programs or run someone else's? If the first, then you can skip this part. If the second, then our problem is not so much hardware as software. If you need some large, competent program, then that is what you have to look for.

Having found it, you ought to see it running in some other customer's premises. You should talk to him and find out how many nervous breakdowns it gave him and his staff. Do not be content simply with a dealer's demonstration and assurances of the program's surprising competence and crashproofness. Unless you have an iron constitution, do not be the first to buy.

The second question is: once you have found some software which seems likely to do what you want, on what machine will it run? Having chosen a machine in this unadventurous way, you look very closely at the chap who sells it to you, because you may well find yourself in a more intimate relationship with him than with your wife.

If things go wrong, you will be seeing a lot of him and you will need his skill, intelligence, patience and good humour. Study his profile carefully. Is there a hint of petulance in the mouth? Is the jawline stubborn? The forehead weak? These are far more important questions than the capacity of the X register, or the read-write time of the RAM.

The fact is that all computers have some virtues and all have some faults. Whatever the particular virtues of yours, you will come to cope with them without a thought. It is like husbands and wives: you look at other people's and ask yourself 'How could they!' Much more important than the texture of your beloved's cheeks is the dowry of software she brings with her and the readiness of her in-laws to pick her up if she falls over.

So when the phone rings and another trusting voice begins the litany: "Please Mr Editor . . ." I'm afraid I talk less about bits and bytes than trying to indicate — subtly, of course — the sort of person one wouldn't want to buy a computer from — ever.

It may look like the white-hot technological revolution at first, but like almost everything else in life, it all comes back to people in the end.

At last! The Software Buyers' Guide

FOR A LONG TIME now we have been giving enquirers the advice sketched out above: hardware is less important than software. 'Very well,' they reply petulantly, 'kindly advise us. What software should we buy?' And then, after a pause, they start to explain about unhelpful magazines who don't tell you what you most need to know.

Well, there was a reason for the pause, and that was until the last few months, there hasn't been any software for small businesses, worth the name. Although the micro-revolution burst on us quite quickly, it burst a lot less fast than the more ecstatic publicity.

And so often in computing, the innocent bystander is left with an impression that things can be done which leave computer professionals gasping and wondering just how many years it is until 2001 and whether someone hasn't torn several important pages out of the handy desk-top century-planner.

So, now we start to catch up with ourselves. On page 133 you will find Mike MacDonald's analysis of the small business software scene, followed by 10 tightly-packed pages listing the packages we know about. We guarantee nothing about them, except that their proprietors say they exist. Later on, we shall be reviewing them in merciless and cynical detail.

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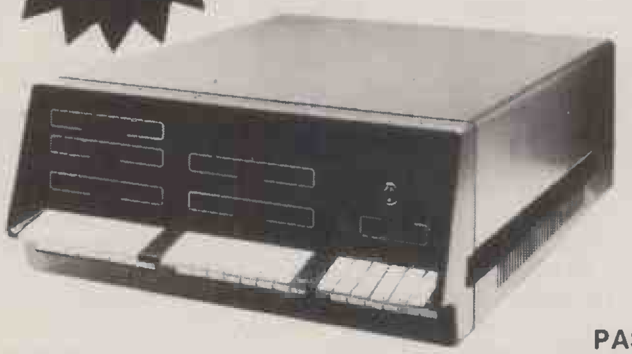

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- 8K Static RAM board (250ns)
- 16K Static RAM board (450ns)
- 16K Static RAM board (250ns)
- 64K Dynamic RAM board (250ns)
- Z80 cpu board (2MHz)
- Z80 cpu board (4MHz)
- 2708/2716 EPROM board
- Prototype board (bare board)
- Video display board (64 x 16, 128U/L Ascil)

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College software contest

A SOFTWARE COMPETITION for schools and colleges is being organized and financed by the Computing Laboratory of the University of Kent. The winner will receive a Kent Software Trophy and £300 in cash. There will be 20 merit prizes of £10 each.

Entrants must submit a computer program of practical use in commerce or industry, not for education. Short programs, however, are acceptable and the organizers believe that a program of only 20 lines, covering some imaginative application, could well win a prize. Anything written after September 1979 can be accepted.

The competition is divided into two classes — under 17 and under 19 on the date of entry. Groups can enter in each class, but each member must be a full-time student at a school or college. Universities and polytechnics are excluded.

Entry forms are available from Kent Software Trophies, Computing Laboratory, The University, Canterbury, Kent CT2 7NF. The final closing date is February 16th, 1980.

By Jupiter! Have no fear

PROBLEMS with lightning? Lighting Elimination Associates (LEA) have had years of experience in its elimination — "a full consultancy and design service on lightning eliminators is offered to manufacturers and distributors."

Though not the 20th century's answer to repentance, the company does manufacture units to protect logic circuits from lightning-induced surgest which can damage logic circuits many miles from the strike.

The LEA 'Kleanpower' power-line filters are designed to provide a very 'clean', interference-free mains supply to sensitive computers.

Contact LEA Ltd, Vine Cottage, Moreton, Thame, Oxon, tel: (084 421) 3204.

Now a laser network?

AMERICAN oil giant Exxon is reportedly planning a private communications network based on laser light transmitted through fibre-optic cables.

- See Networks cover story, page 72.

Talkback Tina won't keep you waiting

A COMPUTER system which can be programmed in plain English has made an appearance.

Called TINA, it will be marketed by Unilever through its office equipment distribution chain, BEAM, and is manufactured by Logical Machine Corporation (LOMAC). TINA is aimed at the small/medium business market.

Programming in English is not as easy as it sounds. TINA starts with a vocabulary of only 40 verbs, many of which are similar to Basic commands such as SAVE. But the operator can enter as many nouns as he requires, to use with the verbs, and can build up his own files.

Any line of a 'program' can be altered with a few keystrokes and if the operator loses his way all the verbs, nouns and files created can be recalled on the screen.

After each entry is accepted, TINA returns with the question "What do you want to do next?" There is no direct guidance on how to use the system and clearly training will be needed. Even so, BEAM hopes that TINA will help eliminate the mystery surrounding data processing for the average businessman.

The company is reluctant to divulge technical details, but says of TINA's response time: "You won't be left sitting at the keyboard waiting for TINA."

With training, the system may save the businessman the cost of more conventional programming, but to create any major files is certain to be a time-consuming task.

TINA is priced at £11,500 and includes a VDU, keyboard and a dual floppy disc drive, each with capacity of 1.25MBs. One disc stores the vocabulary while the other stores the file data. An unusual feature in the disc drive is a rechargeable battery which powers the transfer of all screen data to the discs in the event of a power cut. When power is restored, the system returns to its previous status.

TINA already has a larger brother, called ADAM, and LOMAC is planning a baby version, called ABEL, which could be ready for launching in about nine months.

Further details: BEAM, Centurion House, 129 Deansgate, Manchester M3 3WL.

- **We hope to review TINA within the next few weeks.**

Beginner's guide to Level II

DR DAVID LIEN, the well-known author of the TRS-80 Level I Users' Manual, has unveiled his new book, *Learning Level II*, which covers all Level II Basic. It is written for those who have not yet learned Level I and guides readers, step by step, through the fundamentals and special characteristics of Level II, beginning with setting up the system.

The manual explains how to use the Editors, both while learning and when custom-writing special programs. One section is devoted to showing how to convert Level I programs to Level II, including all the users' programs in the Level I manual.

The new guide also explains the complete range of Level II TRS-80 features. These include dual cassette operation, using the expansion interface box with the real-time clock, printers and other peripherals.

Learning Level II can also be used with other computers since the Level II Basic interpreter was written by the same organization that wrote the interpreters for the PET, Sorcerer and the OSI. There are many similarities.

Learning Level II ($15.95 + $1.45 pp) may be ordered direct from computer Books Division, CompuSoft Inc, 8643 Navajo Road, San Diego, CA 92119.

End of the line for QWERTY?

THIS ERGONOMIC KEYBOARD, called the 'Trolley System', is claimed to increase typing speeds by up to 40% — fast enough to allow dictation to be typed directly.

Developed by PCD Ltd, it is a mobile word-processor unit, complete with VDU and floppy disks. Ten of the systems, priced at around £7000, have been ordered by the Department of Trade and Industry through their pre-production support scheme and will undergo proving trials this year with local authorities, a patent agent and a secretarial bureau who will be arming one of their temps with it.

Efficient keyboard layouts have been available ever since QWERTY was adopted afer erroneous calculations of letter frequency by a school maths teacher, but they have never caught on. Perhaps this time will be different.

PCD Ltd is based at 42 Queens Road, Farnborough, Hants, tel: (0252) 511001.

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The ALTOS Sun Series ACS 8000 BUSINESS/SCIENTIFIC micro computer creates a new standard in quality and reliability in high technology micro computers.

HIGH TECHNOLOGY

The ACS 8000 is a single board, Z80 disc-based micro computer. It utilises the ultra reliable Shugart 8 inch, IBM compatible, disc drives, double density – single sided, and providing 1 M. byte of data storage. The ACS 8000 features the ultimate in high technology hardware: a fast 4 MHz: Z80 CPU, 64 kilobytes of 16 K dynamic RAM, 1 kilobyte of 2708 EPROM, an AMD 9511 floating point processor (OPTIONAL) a Western Digital floppy disc controller, a Z80 direct memory access (OPTIONAL), Z80 parallel and serial I/O (two serial RS232 ports, 1 parallel port), and a Z80 CTC Programmable Counter/Timer (real time clock).

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The ACS 8000is a true single board micro computer. This makes it extremely reliable and maintainable. The board and two Shugart drives are easily accessible and can be removed in less than ten minutes. All electronics are socketed for quick replacement. Complete diagnostic utility software for drives and memory is provided.

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Unlimited versatility. The ACS 8000 supports the widely accepted CP/M disc operating system plus basic (Microsoft and C Basic), Cobol, Pascal, and Fortran IV. All available now.

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• Circle No. 180

Bar code labels for hobbyists

WITH A GROWING number of bar code products for microcomputers, we have been asked where the hobbyist, or small businessman, can print small quantities of bar code labels.

Plessey run a bureau service, from Sopers Lane, Poole, Dorset, which charges £20 per thousand labels if the numbers are sequential. There is a minimum order of £15. Random numbers are likely to be more expensive. To check, by telephone, try Mr Armitage on (02013) 5161 ext 2318.

Libraries have often been suggested as an alternative source. Many have their own printing machines. No library, however, appears to offer this service already, despite the extra revenue the service could earn

One reason is that they have simply not thought of it. Several libraries seemed sympathetic to the idea but would have to ask for a policy decision by the library director if there were a formal request.

It is likely, however, that most libraries will reject any request, as labels printed for hobbyists could be used to side-step the library's book security and control systems.

Expandable system

A 16-BIT MICROCOMPUTER which will accommodate 8-bit microprocessors has been developed by a small London company for systems builders and software houses uncertain of the hardware for future application software.

It can use either 8 or 16-bit microprocessors and is not dependent on one manufacturer's chip. The system can be expanded either as a single unit or multiprocessor configuration.

The Microflex 1001, developed by Quinnebal Data Systems Ltd, starts with 48K RAM, 16KPROM, a dual floppy disk unit and two serial and two parallel ports. It has a dual bus DMA structure, CRT mapping module for word-processing and can be expanded to control up to eight disk drives.

Contact: QDS Ltd, Regina House, 1-5 Queen Street, London EC4 1FP. Tel: 01-248 7421.

● PHILIPS have entered the same market as Currys with G7000 computer video games system which plugs into a television. It has an alphanumeric keyboard and joysticks, and can be programmed, with cartridges, from 'golf' to mathematics, spelling and logic. There is now also a cartridge course in basic computer programming.

High Street retailer jumps on bandwagon

A HIGH STREET retail chain believes that over one million home computers will be sold by 1985 — and is backing its belief by setting up a subsidiary to handle sales.

After more than 12 months of discussions, electrical goods chain Currys will market microcomputers and applications packages in 40 of its branches during 1980. It also intends to set up specialist retail outlets.

The new subsidiary is headed by former GEC chief Derek Moon and Robert Webb, formerly of Commodore Internaional.

Currys managing director Terry Curry told *Practical Computing* that he intends to "dominate the market" and his move is likely to threaten many smaller independent outlets.

by Duncan Scot

Prime targets for the microcomputers and software packages will be small to medium businesses and industries, commercial and educational outlets and professional practices. The domestic market is also considered important but Currys does not see the hobbyist as a key target.

The philosophy behind the move is very similar to Radio Shack's when they launched the TRS-80. By selling and promoting microcomputer systems, Currys hope that a high-technology image will rub off onto the rest of their product line.

Software has been commissioned from outside sources. Every product will be tested independently before going onto the market, and most bugs will be eliminated, claim Currys. It is not so clear how they intend to support the software.

The new company is cagey about which systems will be sold and where the software is being written, or adapted. But since Robert Webbian ex-vice-president of Commodore's computer division, and Kit Spencer, of Commodore UK, were involved in some of the early discussions, the Pet, with over 20% of the UK market, must be the prime candidate.

At the upper end of the market, there is room for more speculation. Currys expect Japanese and other Far Eastern manufacturers to become major competitors of American manufacturers during 1980 and although there will be little software immediately available, it is unlikely that this important source will be ignored.

In the short term, with over 18,000 Pets already installed in the UK and with a wide range of software available, the temptation must be to look for systems upward-compatible with the Pet.

This raises the possibility that the CompuThink MiniMax could be under consideration — it uses the same disc drives as supplied for the PET through ACT Petsoft.

The Minimax will also be sold by ACT under the names of ACT 8/08, ACT 8/16, ACT 8/24 and ACT 8/48. The last two figures refer to the storage capacity (ie 800KB, 1.6 MB etc). If this is the case Currys might only sell Pets with the CompuThink disc drives, supplied by Petsoft.

But no firm decisions appear to have been taken yet and it is unlikely that any contracts have been signed. Eventually Currys may prefer to sponsor independent evaluations of systems, and possibly software. One venue where the idea has already been discussed is the Polytechnic of the South Bank, in London, where a 'Microcomputer Advisory Centre' to be run by Sue Eisenbach is under consideration.

See Minimax review, page 61.

● HIGH STREET retailer, Dixons, has set up a subsidiary, Advanced Consumer Electronics, to market and manufacture electronic equipment. Its first product is the Acetronics programmable video game and the first computers will follow later this year.

Industrial interfaces

BELGIAN COMPUTER manufacturer, Data Applications International, have launched a new 'personal' computer with a range of over 20 industrial control interface cards. The company hopes to by-pass the need for custom-built interfaces for industrial applications.

According to Data Applications (UK) Ltd, the computer is, in all other respects, very similar to the Apple, even though the DAI Personal Computer is based on the Intel 8080. The system can grow from 8K to 48K of ROM and has 24K of ROM (Basic). Prices range from £500 to £1000.

Data Applications (UK) Ltd, which has been formed to market and support the microcomputer, is based at 16B Dyer Street, Cirencester, Gloucestershire, GL7 2PF, tel: (0285) 2588.

Heath turns on the heat

A MORE AGGRESSIVE line in marketing is planned for Heath Electronics by its new parent organization, the Zenith Radio Corporation. A new marketing company, Heath Electronics (UK) Ltd, has already been established for the Heathkit, the Zenith Data Systems range of assembled microcomputers and computer peripherals (previously Heath Data Systems) and the Heath education courses.

Managing director of the new company is David Taylor, formerly international marketing manager of the Telequipment Division of Tektronic. The company is based in Bristol Road, Gloucester, GL2 6EE. Tel: 0452 29451.

Exponential market

THE SEMICONDUCTOR market in Europe is expected to grow by over 10 per cent by the end of 1980, predicts a recent survey.

This compares with a nine per cent expansion in the US and 12 per cent in Japan. These figures reveal semi-conductors as a boom area, for the gross national product of Western Europe is expected to increase by only 2.4 per cent in that time and to decline by about half a percent in the UK.

The survey, by Motorola's market research people, also compares the sums of money spent in various markets per head of the population.

The Japanese spend over $24, the USA $20, while Europe lags a long way behind with $7.5.

In the Western European countries, West Germany sets the pace with $18.3 per head, the UK $11 and France $8.7. These proportions work out very similarly when calculated as a percentage of GNP.

To make matters worse we can expect growing Japanese influence on our TV sector during the year, with the likelihood that some Japanese companies will establish bases here to offset possible trade embargoes. And, unlike the rest of the world, Britain is unlikely to incorporate semiconductors, into what is left of its car industry, fast enough to complete effectively.

The language debate

YOUR NOVEMBER EDITORIAL was clearly intended to stimulate discussion concerning the suitability of different languages for programming microprocessor systems.

Before pronouncing a language to be suitable or otherwise, one should bear in mind who the user (the programmer) is. Your readership presumably includes the first-time user (probably a small businessman), the hobbyist who may be more interested in hardware than software — or vice-versa, the enthusiastic full-time programmer who is becoming more skilful by the microsecond, and even a few academics.

Each of these individuals has different expectations of his hardware, his software, and his own programming abilities. Moreover, these expectations will change as they gain experience. So whereas it is true that one rarely hears of Basic programmers sighing for the more powerful Pascal (just as a few years ago one never heard Assembler programmers sighing for Basic), so one never hears those who have really used Pascal longing for the "good old days" of basic, or those who have learnt Basic reversing to Assembler (unless it is to write device handlers or to compensate for a slow interpreter).

As one learns to use three or four languages, one learns to appreciate that each has a role. We should remember that the acronym Basic stands for "Beginners' All-purpose Symbolic Instruction Code", and that is why it is so popular with first-time users. Since it is often the only alternative to Assembler, it is understandable that experienced programmers also use it, as the figures you quoted show. However, your figures only indicate what languages people used — they said nothing abut how many were able to choose from a selection — how many were using Hobson's choice?

I would be interested to see a similar set of figures published each year, distinguishing between hobbyists and business users, as more people discover that the true cost of software is not in getting the Mark I version of one program to work after a fashion, but in getting several programs to work together reliably over months and years, keeping them up to date and growing to meet changing specifications. And not by one person, but by a succession of programmers who must be able to comprehend what their predecessors have done. Those readers who have experience of program maintenance will know what I mean!

David R. Gibby,
Fleet, Aldershot,
Hants.

Pascal proponent

IN YOUR NOVEMBER editorial you invited your readership to comment on the relative merits of Pascal and Basic. I find that I must side with Pascal, and I suspect that many others with experience of both languages would agree with me.

You say that everyone admits the most serious disadvantages of Pascal is the difficulty of learning it. I agree that Pascal is syntactically more complex, but I would suggest that in learning one's first computer language, the main problem is getting to grips with the programming concept, and in fact Pascal tries to emphasise just this in its syntax.

The superior data structures and control constructs may seem daunting at first, but nobody jumps in at the deep end, and I am sure that a subset of Pascal with a direct analogue in Basic would not be significantly more difficult for the beginner to grasp. There is no need for a beginner to use the more sophisticated aspects of Pascal at first, but it would seem sensible to start programming in a language in which they exist already, rather than having to change language if the need arose.

You do not seem to have a very high opinion of computer science academics, nor with their belief that any hard work expended in learning Pascal is imposed not by the language but by the principles of clear thought which it embodies. To me the whole point and beauty of Pascal is that it embodies these principles.

Even at the simplest level, Pascal is geared towards readable and reliable programs and the problems of producing reliable business packages on micros illustrates the usefulness of this. At the higher level, such things as tree structuring, which would be a headache in Basic, are dealt with quite naturally in Pascal.

So, in conclusion, I maintain that Pascal is quite capable of catering for both the beginner and the advanced programmer.

Ian Glendinning,
Crumpsall,
Manchester 8.

Limited Basic

A MAJOR HANDICAP to programming on micros is that there is a present no language suitable for amateur micro users.

The most readily available and most used language is Basic. To many users, especially those who have never used a high-level language before, Basic may seem like God's gift to computing but it has some serious limitations.

The first of these is it has no major data structures other than arrays and subroutines, and routines are of a very limited nature. And although Basic itself was designed to be an interpreted language (which is a great advantage to the amateur) it was developed from Fortran which is a language designed for batch use.

As a result it is difficult to write elegant and clear programs in Basic. This can lead to all sorts of debugging problems. Basic's other main disadvantage is that it is too simple to allow the programmer to use the full power of his micro.

The fact that Basic is so simple has, however, been one of the main reasons why it has been so successful, but as more users become less concerned with hardware and more with software, they will begin to demand more powerful languages. Micro firms are, I think, now becoming aware of this. One of the indications of this is the recent introduction of Pascal to micros.

Pascal itself has its own disadvantages and although it certainly has a much richer supply of data structures (ie record) it suffers from being a language far more suited to larger machines.

This is reflected in the size of the Pascal compiler (Pascal is a language far more suited to be compiled than interpreted). As a result I cannot see many amateurs using Pascal and those that do must have more memory than sense.

A better language to implement would be Lisp. But even Lisp has its disadvantages and is rather wasteful in the amount of memory it uses. I think a far better solution would be to develop a language designed to be run on small micro systems and the sooner this is done the better.

Even if you do not agree with any of the above, I hope it will enable you to start to think about the software situation. It seems to me that micro users are usually more concerned with the hardware than the software of their systems and the sooner this situation is reversed, the better it will be for all.

G. Hart,
University of Essex,
Colchester.

Adaptable Pascal

AS A PROGRAMMER, I would like to comment on a few points raised in the November editorial on languages. Surely, for the personal computer user (or any programmer) the most important feature of Pascal is not its elegance, compactness or speed of execution, but that you can write substantial programs more easily and quickly than in Basic.

The programs are likely to have fewer bugs and be far more readily understood by others (also by the author, when modifying them a month later).

The degree of standardisation is another attraction. Programs can be moved from mainframes to 8080s and then run perfectly with no modification.

There are Tiny Basics, Scientific Basics, Business Basics . . . If you are going to go to all the trouble of making Basic into a universal language (even Pascal is proving difficult to standardise fully) is it not better to start afresh with a more suitable language?

Is Pascal so difficult to learn or use? Like anything else it can be learned gradually, starting with programs as simple as:

```
begin
        write ('Hi everybody')
end.
```

Just type R to run and apart from a slight pause for compilation (done automatically on the first run) it's exactly like learning Basic.

It did not take long for Basic to make an impact on the personal computer market and with Pascal's growing popularity in industry and teaching, the proportion of *Practical Computing* readers who use it can only increase.

True, Pascal has neither the generality nor the interpretive style of Lisp. I would be the first to concede that Lisp is a superb language — one of the most exciting yet devised. It is an essential tool for Artificial Intelligence, but not for most other programs the personal computer user is likely to write, including systems programs.

I have found that the simplicity of Lisp's syntax can be a positive hindrance to understanding, let alone debugging programs.

Hours can be spent counting parentheses and drawing pictures of lists. After all, when a language will allow you to write almost anything, it cannot tell you so easily if you are doing something wrong!

In conclusion, I feel that there is plenty of room for Pascal alongside Lisp (and Basic) as a valuable programming standard. There has certainly been a large priority placed on producing a Pascal for market leaders such as Apple and TI computers. Has the vote already been cast?

Keith Frewin,
TCL Software,
London N.W.1.

The Dream Machine

I ENJOY reading *Practical Computing* and purchase nearly every issue. The Buyers Guide is very useful, but an addition could be useful. My other hobby is hi-fi. Here separates are known to be better for many reasons as well as that you can start from a basic system.

I see microcomputers in the same light. A section on VDU, printer terminals, printers, floppy discs and other storage devices would be useful, even if you printed only one extra section per month. When I find the right set-up I will buy a computer of my own, until then I will 'borrow' computer time.

The set-up as I see it is as follows:—

VDU: 132 × 30 lines; user-specified characters, multi-lingual, graphics, plitter, mathematics and Greek, full upper and lower case, printer interface (something like those from DELTA and LOGICA).

Printer: 7 × 9 dot matrix, 150-180 cps, capable of printing all the VDU characters.

Printer terminal: Daisywheel 55cps, typeface to include Greek, maths, plotting, formulae, graphics etc. Friction feed for single documents, pin-feed, 12 characters per in (eg Qume from Access Data Communications).

"Computer" central processor: Basic, Pascal, Algol 68, Fortran, Graphics, colour, games. 64K with units to 512K. Two terminals, cassette, floppy disk, disc drives, interfaces.

Graph plotter: Four colours. For starting, 64K processor with the VDU.

This system would cost about £4000 (I think). So far I have not found the computer that can be built up like that.

Gerald McMullon,
Manor Park,
London E.12.

Mr McMullon's ideas sounds a good one, but it does raise the dread question of compatibility. Organising the information to cope with it might be difficult. But anyway: that's his ideal system — have any readers other ideas? Why not let us know about them? — Ed.

Teenage triple threat

FIRSTLY I would like to say how much I enjoy *Practical Computing*, and I think that it is certainly the most interesting and well put-together magazine on this subject, and it has improved even more since it was taken over by IPC Business Press *(Honestly, I never met this man in my life! — Ed.)*.

I do not have a computer, but I have access to an ITT 2020, a PET, an ICL 19045 Computer and a CDC Mainframe (the last two through my school). I know Basic, Fortran, Plan, Logo, and 6502 machine code programming and have been computing for three years.

I am writing regarding Trevor Lusty's AI Noughts and Crosses program. Two readers suggested some improvements. However both seemed to be under the impression that L$ is a string array, when in fact it is a string variable of three bytes.

Thus K. Lundy's suggestion for line 3660 is incorrect; the original line 3660 should work. Also Mr Lundy's line 2340 seems to have been misprinted. I have not entered the program, but when I looked through it, I noticed a mistake in line 2340, and amended it to read:

```
2340 LET T2 = T2 + T1 * (10 (2*(3-N1)))
```

which should work.

Also in the section to decide who starts, I have changed it so that M7 is either Ø, 1 or 2 (Ø M7 2), otherwise M7 increases by one every game, which after many games would cause memory problems. I have also changed line 1540 so that the computer can move first when starting the first game. The INT (RND(0) *2) chooses either 0 or 1, although for different Basics the RND function gives different effects:

```
1540 LET M7 = INT (RND(0) *2)
1860 IF M7 = 1 THEN 1880
1870 LET M7 = 0
1875 GOTO 2280
```

I have also changed the program so that you can choose whether or not to play again if you draw to win, but as this may not be of any use to some people, I have not written it here. However if you would like to stop a game at any time by typing "—999" in your turn, add:

```
1901 IF H = —999 THEN 3080
(1481 PRINT "TO STOP IN A GAME
TYPE '—999' IN YOUR TURN")
```

B. M. Graham (age 15),
Chigwell,
Essex, IG7 5QS.

Inchbald's defence

We had this letter from reader Andrew Bardsley:

HAVING READ Mr Inchbald's article 'Getting to grips with the MK-14' (p84 Dec '79) I have a feeling he is not very enthusiastic about this kit.

As I am considering buying my first kit, I would be grateful for his views on the best buy around this price.

I am only 15 years old and still a student and therefore cannot afford to waste my money on a kit such as the MK-14 which sounds to me totally unreliable.

I read your book every month and find it most interesting though it would be even more interesting if I had a computer and could program in the great programs from your book.

It is my intention to take a degree in computer science.

Andrew Bardsley,
Swinton, Malton,
N. Yorks.

Guy Inchbald replied:

I AM SORRY to have given you a bad impression of the Mk 14.

Microcomputers are complicated beasts, and unless everything is just so they are apt to go bananas. They are also fiddly things to assemble, and however well-designed, a kit is only as reliable as its builder. My article was aimed mainly at the inexperienced newcomer to electronics, and as such is full of warnings to the unwary. But this is no reflection on the basic Kit, which is as good as any other.

The Mk 14 is well-suited to electronics hobbyists who want a cheap introduction to microprocessors. If your main interest is confined to programming, the Newbear 77-68 and Acorn 1 are more expensive, but more easily expanded later. Remember, you get what you pay for.

And if computers take over your head, your wallet and your soul, then you'll be just like the rest of us.

Backchat

THE FOLLOWING ROUTINE is useful for brightening up interactive sessions:

```
 10 PRINT "HI THERE! HOW'S
    THINGS";
 20 INPUT A$
 30 FOR I = 1 TO 7
 40 READ B$
 50 IF POS (A$,B$)    0 THEN 70
 60 NEXT I
 70 IF I    3 THEN 110
 80 IF I    = 6 THEN 130
 90 PRINT "NO COMMENT!!"
100 GOTO 180
110 PRINT "DON'T WORRY, THEY'LL
    GET WORSE!!"
120 GOTO 180
130 PRINT "GLAD TO HEAR IT!";
140 PRINT "ALL YOUR NEED IS A
    SYSTEMS CRASH!"
150 GOTO 180
160 DATA BAD, TERRIBLE, RUBBISH
170 DATA OK, GREAT, SUPER, XYZ
180 RESTORE
190 . . . . . .
```

Not as flexible as the MATCH statement in PILOT, perhaps, but it demonstrates the usefulness of POS in BASIC for detecting unspecified input.

This kind of routine can be useful for teaching purposes, giving the pupil the opportunity of responding to a question without the usual prompting by an MCQ. If no match is found then an MCQ could be supplied. If B$ is read to an array, to ensure that each complete set of DATA items is read in turn, then with suitable replies (also read from DATA statements), this type of routine could be nested as a GOSUB, needing only an extended DATA set to be powerful and flexible.

Dr. Barry Clark,
Department of Biochemistry,
Western Infirmary,
Glasgow G11 6WT.

A Dutch conspiracy?

AFTER READING the letter in your December issue from Mr Van Lew, I thought that if a computer had 1 memory for each line of win, then added —1 if its move was in the line and +1 if your move was in the line, then when the line total was +2, there would be a threat; conversely if the total was —2, then the computer could win the next move. If the line is ade up of +1, —1, and +1, the total is +1, so there is no longer a threat.

The only computing capability I have is a T.I. 57 and so can not use this idea but I thought that Mr van Lew, and others, may be interested.

Nicko van Someren (age 12),
Bottisham, Cambs.

Mind-fodder for the captives!

AN INMATE writes to us from Ford Open Prison to say that many of his fellows are very interested in micro-computing and although they can't get their hands on any hardware, they would be very grateful for second-hand manuals, and text-books. Send them to *Practical Computing* marked 'Prison'.

Recording variables

AS A NEWCOMER to the computing game using a UK101 I have met two difficulties for which I cannot find good solutions.

How can I record on tape the values of the variables and strings as calculated by the program? I have been using rather a weird method. If each statement such as "X = " is preceded by a "spurious" line number in " ", out of range of those in the program, the tape recorder will be fooled into thinking these are program lines. Hence they may be taped and played back into the computer.

I find that if I run the recorder while executing the program in slow motion on SAVE, I can get out a picture of the format, with variables as entered.

I can find no enlightenment on these points, and feel there must be better ways . . .

Since there is no assembler for the UK101 — I don't know about its relation, the Ohio Superboard — I would have to write I/O routines in machine code. Although I have a chart of the codes, and a 6502 book by Rodney Zaks, I'm not getting on very well, and ask if you have in the past published a more gentle approach. Anyway Zaks speaks as if everyone had an assembler program.

I should like to thank you belatedly for "Zombie", which is very amusing for children, especially since one can get from the extensive UK101 graphics some realistic potholes and sufficiently terrifying Zombies.

R. J. Newman,
Chesham, Bucks.

● **A friendly voice at Comp Computer Components recommends that you use a machine code subroutine to dump the contents of memory to tape. This will automatically include all the variables and their pointers, flags and general gubbins. To speed things up, you could find out where the program was in memory and not bother to dump that, since it won't change.**

The alternative, the voice went on with slightly less assurance, is use the Monitor subroutine at FCB1 which loads a byte from the Accumulator to tape. Naturally they have to load the good news into the Accumulator first, using the appropriate machine code instructions.

We intend to start a series soon on writing machine code and assembler which may be some help. Otherwise, the cheering word is that it's hard work, but fearfully good for the soul!

School troubles

I ALWAYS FIND the technical brilliance of the various microcomputers described in the text or advertisements very fascinating. I am able to dream of the many applications I could find for such hardware in the school science department where I teach — simple data retrieval, pupil self-test programmes, programmed learning, and so on.

At the polytechnic which is encouraging my research into the application of a microcomputer program to a particular part of a school science curriculum, I am able to use a system. What I am not able to do is actually to get a real, live, and working microcomputer in my classroom.

Considering the plethora and the cheapness of such units, I find this difficult to understand, considering all we hear about the impact of such technology on children in the near future. What I want is not to talk, theorise, and speculate, but to have a microcomputer *now*, switched on, in the classroom, with the kids using it.

The school is short of money and the effect of cuts and expenditure are thwarting the best efforts of the L.E.A. science adviser. This is all happening at a time when children are being told about the effect of computers on their society.

Can anyone help?

Malcolm C. Barker,
Baynham Court Farm,
Wick, nr. Dursley,
Glos.

. . . and a success!

LAST YEAR, just after Christmas, I wrote a letter to your Feedback column concerning the purchase of a computer for my school. In the letter I received from *PC*'s former editor Mr Jarrett, I read of the many possibilities of raising money and he told me to "keep in touch" and "gave me the best of luck".

Well, fortunately, that luck came, and a few weeks ago the school obtained a Horizon computer with one disk drive and 32K of RAM. Now I am learning Basic extremely fast and so are all the other members of the computer club. We have begun to write many programs for the Horizon and I am now very happy and content.

Thank you for printing my last letter, and I am now told that because of its appearance in your magazine it was a form of prompt, indeed we have got far more than I would have expected.

R. J. Fiddick,
3 Hannafore Lane,
Cornwall, PL13 2DT.

Any answers?

THIS DEPARTMENT is carrying out a survey into the development of microprocessors and their applications in the community, with particular reference to the ways in which this new technology will assist the disabled and in education.

Our aim, in brief, is to collate all available literature and documentation from research bodies, manufacturers and suppliers, in order to produce a catalogue of materials available.

We should be pleased to hear from any of your readers who feel they may have a relevant contribution to make to our survey, and ask them to contact us at the Department of Mathematics and Computer Studies, Sunderland Polytechnic.

Mrs. J. Winton,
Sunderland Polytechnic,
Green Terrace,
Sunderland SR1 3SD.

Micros in the library

WE ARE beginning research the possible applications for microcomputers in special libraries and information units. As a preliminary to our investigation we would like to establish the exact state of the art of such applications in this country.

By utilising the personal contacts of the members of this division, we have already been able to gather a few names, but further information would help us tremendously.

R. P. Winfield,
Aslib,
London SW1.

Poetry corner

THIS LITTLE GEM appeared in Feedback's mailbag. Is this the start of a new age of enlightenment?

The Hierarchy of Power Semantics

In the beginning was the Plan and the Specification.
And the Plan was without form and the Specification it was void.
And darkness was on the face of the implementation team.
And they spake unto their leader, saying,
"It is a crock of shit and it stinks to high heaven."

And it was the leader and it was the project head.
Now the leader spake unto the project head, saying,
"It is a crock of faeces and intolerably malodorous."

And it was the project head and it was the department manager.
Now the project head spake unto his department manager, saying,
"It is a container of excrement and its effluvium is very strong."

And it was the department manager and it was the product manager.
Now the department manager spake unto his product manager, saying,
"It is a vessel of fertilizer of overpowering strength."

And it was the product manager and it was the centre manager.
Now the product manager spake unto his centre manager, saying,
"It containeth that which aideth the growth of plants and strong it is."

And it was the centre manager and it was the director.
Now the centre manager spake unto his director, saying,
"It promoteth growth and it is very powerful."

And it was the director and it was the vice-president.
Now the director spake unto his vice-president, saying,
"This powerful new product will promote the growth of the Company."

And the vice president looked on the product and saw that it was good.

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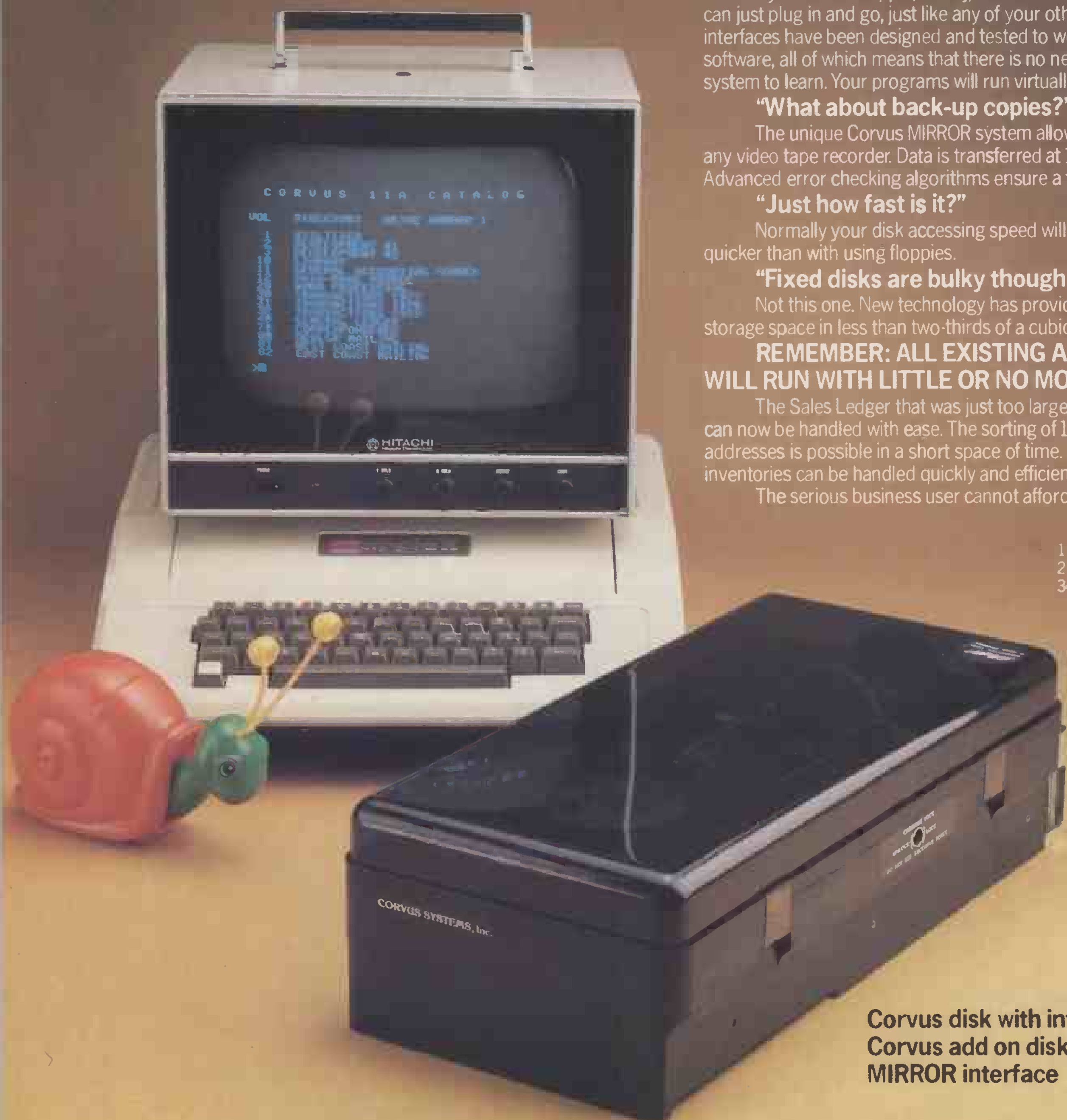

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Minimax makes the most of user program space

by Jim Wood

A NEW ADDITION to the ever-growing range of microcomputers available in this country is the Minimax II, marketed in the UK by ACT of Birmingham.

ACT are the sole agents for the British Isles and aim to provide a system both as stand-alone machines and as an alternative for those PET users who run out of processor power and disc storage. There are seven regional dealers and ACT are expecting to announced shortly a new agreement with a major High Street electrical retailer (Currys) involving both the Pet and Minimax.

Equipment

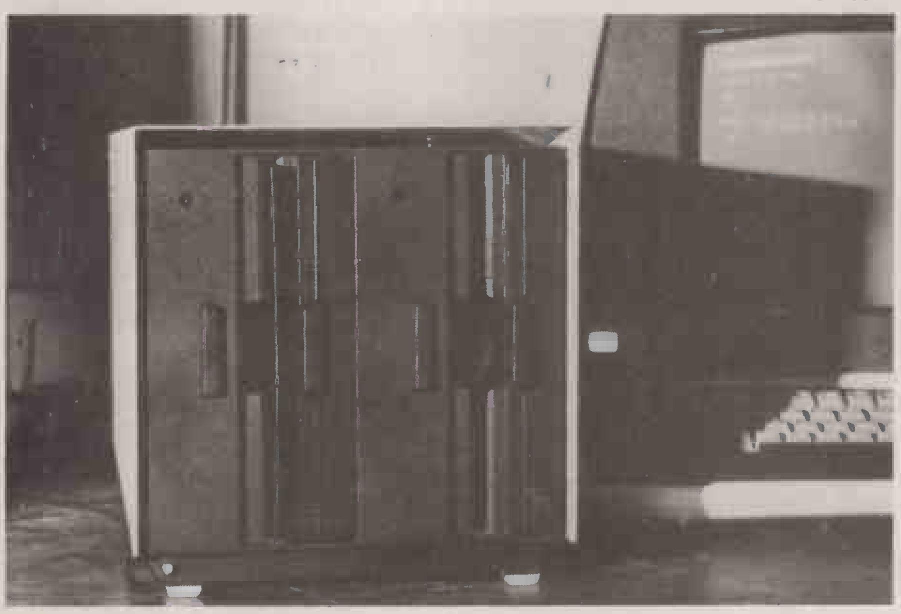
The Minimax is a complete diskette-based video computer system built around a 6502 microprocessor running at 2mHz. The system has 106KBytes of semi-conductor memory, of which 45KBytes are available as program RAM.

The remainder of the memory is split between a resident monitor with TINY assembler, ROM-based MDOS operating system, a Microsoft Basic interpreter, a basic Fifth interpreter and I/O registers.

The disc drive used is the Computhink PET compatible twin mini floppy drive, available with either 5in or 8in floppy diskettes. The diskettes are double-sided double-density, giving a formatted storage capacity of 400KBytes for a 5in diskette and 1.2MBytes for the 8in diskette.

The system provided for review comprised the standard Minimax and an 8in dual, double-sided, double-density drive. Putting the system together proved simple: just plug in to two 13-amp sockets, connect the disc drive and turn on. The Minimax has a separate on/off switch located at the side of the screen; the drive is turned on at the mains. There is a multi-strand flat cable to connect the drive to the computer.

If the drive connector cable is plugged in upside-down (quite easy to do), both drive lights come on when the Minimax is turned on. This useful hint is mentioned right at front of the well-written user's guide.



Turning the system on takes the user into the Microsoft Basic interpreter and displays the available program memory, 46079 bytes.

Apart from the disc connection, there is an RS232 serial port and a standard parallel printer port, implemented with an Intel 8255 programmable peripheral interface. All are well-marked and easily accessible at the back of the machine.

Keyboard

The keyboard is arranged with a standard QWERTY layout and has three separate keypads. The left-hand keypad has a set of eight punctuation characters. Those to the right are a standard numeric keypad and eight separate cursor manipulation keys, including cursor up, down, right, left, clear screen and delete character.

The layout of the keyboard is rather spoilt by having the two RETURN keys unseparated on either side of the space bar and the two shift keys above them. Coupled with a cramped keyboard, this tended to increase the number of accidental RETURNS.

There is a shift/lock key, which has a small red light which shows when the key

continued over page

From previous page

is depressed and locked and enables the user to change the function of 63 keys to 63 Pet-style graphics characters. The keyboard has no lower-case alphabetic characters.

Display

The display provides 30 lines of 64 characters and incorporates a rectangular flashing cursor. The cursor does not flash on and off but appears continuously to roll over, giving a whiff of sea-sickness if one concentrates on the screen for any length of time.

The character representation is adequate when using normal white on black, but with reverse video, a very low screen brightness is needed to avoid some characters being swamped by the white background; it was rather difficult to arrive at an acceptable compromise.

When the Minimax is turned on, the screen is set into a locked-page mode of operation and it is necessary to use a POKE command to enable scrolling. Unfortunately this command is buried deep in the programmer's Technical Manual and does not appear in the Beginner's Guide.

The display can be used for high-resolution graphics and provides 122880 addressable points in 240 rows by 512 columns. The graphics commands are provided with the Basic interpreter, thus avoiding the direct use of PEEK and POKE statements.

But I have several major criticisms of the display screen and its use. The screen facia, which is plastic and is stuck on, tended to fall off at inappropriate moments. This is rather cheap and nasty considering the price of the system.

There is no direct cursor addressing available in the Basic — it is necessary to print a string containing the required sequence of screen-control keys. The Basic interpreter does recognise a quote followed by a cursor key as having a separate function, for instance having a statement with a clear screen in quotes will not effect a screen clear while the keys are being hit.

This seems to be a rather cumbersome approach to providing cursor addressing and tends to impose rather larger programs than would be expected otherwise.

When entering in page mode, it is necessary to list a screen clear once the bottom line of the screen has been used. If this is not done, a subsequent bottom-screen line that is shorter than the previous one will be found to contain all the remaining characters, regardless of the use of the RETURN key. This is particularly annoying as the Basic interpreter-only syntax checks statement lines on entry in Command (or Immediate) Mode.

The final criticism is the lack of a true delete key. To remove an erroneously typed character, it is necessary to back the cursor down the line and use the delete key to delete forwards.

These criticisms must be weighed against the ability to edit a section of code either by retyping a new line (as is common in most Basics) or by using the cursor control keys to achieve page editing, in a similar fashion to some text or word processors.

This does away with the requirement for some of the Basic functions that would be availble in an editor, which is just as well since no editor is provided.

Disks

The system treats each side of a floppy diskette as a separate drive unit, giving four drives for a standard system. Formatting a diskette takes about 20 secs and is surprisingly noisy. One minor criticism — which applies to many other micros as well — is the lack of an error message when trying to address or format an emptry drive; this system hands and has to be reset.

The transfer rate is quoted as 15,000 characters per second, but we were unable to verify this as all the diskettes provided for the review were software right protected. The system provides a fairly fast disc directory look-up which indicates file names and sizes (by tracks).

Two major restrictions that are apparent in the file-handling side of this Basic — we think they are caused by MDOS — is that it is possible to have only one program file open at any one time and second the fact that you are not allowed to write beyond the initially declared size of a write sequential data file.

This combination will place severe restrictions on the ease of programming for commercial usage and must impose an overhead on any multiple file-handling applications.

MicroSoft Basic

The Basic provided is a resident MicroSoft Basic interpreter which proved to be one of the better versions of Basic that we have looked at, even allowing for a number of minor quibbles.

Plus points

Points we liked about the Basic were:

- ☐ True string arrays
- ☐ Multi-dimensioned arrays (up to 225 dimensions, but the screen will effectively limit this to 26)
- ☐ Multiple statement lines
- ☐ A line number range up to 63999
- ☐ SET and RESET graphics statements
- ☐ The ability to call assembly language subroutines
- ☐ Shorthand PRINT character — '?'
- ☐ Dynamically defined arrays
- ☐ CETC, V — this statements get the ASC II value of the reset key depression and places it in the named variable
- ☐ Separate variable names and storage for integers and floating-point numbers
- ☐ 962 variable names for each of string, integer and floating point, can have A,AA and A1
- ☐ Can load and run a new program directly
- ☐ Full range of mathematical and algebraic functions, including a number that are not normally provided
- ☐ On screen statement editing, the Basic is fairly straightforward to use and is definitely helped by the Beginner's Guide, which takes a step-by-step approach to mastering the system.

Minus points

Our major criticisms are these:

- ☐ No syntax checking on entering statements
- ☐ One file only open at any time

MINIMAX II (ACT 824)

ACT dealers

Scotland: ROBOX
North-West: Stack Computers (Lincoln)
North-East: No dealer at present
East Midlands/East Anglia: HB Computers (Kettering)
West Midlands: Taylor Wilson (Birmingham)
South: PETALECT (Woking)
London: Micro Computer Centre

Prices

These prices were quoted by ACT and are exclusive of VAT.

Hardware

ACT 808 (£3450): Minimax II, Computhink 8in twin mini floppy drive with 2.4M bytes.
ACT 816 (£4500): as 808 but with second 5in drive, total 1.6M bytes.
ACT 824 (£4450): Minimax II, Computhink 8in twin mini floppy drive with 2.4M bytes.
ACT 848 (£6000): as 824 but with second 8in drive, total 4.8M bytes.
Centronics printers — from £950.

Software: (all disc-based)

Languages:
Extended Assembler
Extended Fifth
PLM (Algol-like)
Fortran
Pascal
MLI compiler
— prices on application

Application:
PET Sales Ledger, Purchaser Ledger Invoicing: prices on application

Fully integrated sales order processing, stock, purchase and nominal ledgers, payroll and word processing available in the New Year.

Memory breakdown (in HEX)

0 — 400
Resident Monitor (with TINY assembler)
401 — B7FF Program RAM (45K bytes)
B800 — BFFF Fifth Interpreter
C000 — EIA9 Microsoft Basic Interpreter
EIAA — FFC0 MDOS
FFCI — FFFF I/0 registers

Practical Computing evaluation

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

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

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

- ☐ A single direct input buffer from file, for instance if you: INPUT$, A$ and then INPUT$, B$ will overwriteA$. It is necessary to write:
  INPUT$, A$
  A$ = A$
  INPUT$, B$
  B$ = B$
  This moves A$ and B$ out of the buffer into memory.
- ☐ There is no PRINT USING statement
- ☐ All spaces are automatically removed when a line is entered and then displayed
- ☐ The cursor disappears when listing a program and RETURN must be hit before it comes back
- ☐ A program may be listed in its entirety or from a specified line number to the the end only
- ☐ The number of records in a data file must be a multiple of 21 and the number of characters in a record must be a multiple of 60 — thus the smallest file size is 1260 characters.

Manuals

The system documentation consists of a Beginner's Guide, a programmer's Technical Manual, a list of disc errors and instructions for using and attaching a printer. All are well-written and fairly easy to follow, the above criticism excepted.

The Beginner's Guide will certainly get someone started on the system with a minimum of fuss and the Technical Guide is very comprehensive, covering Basic, assembler usage, Fifth and detail on the machine operation.

Further systems and expansion

The system comes complete with a TINY assembler and a language called Fifth. Fifth is a simple register-to-stack register assembly language, and uses 84 operation codes. One particular improvement over similar languages is the fact that the op-codes are defined as strings of up to seven characters in length as opposed to having numeric op-codes. The language is designed to be portable. The system also has 64 microprogrammable op-codes and is designed to recognise all 6502 microprocessor op-codes.

The memory on the system is not yet expandable. Both Fifth and the assembler are provided on disc in an extended form, along with Fortran, Pascal and PLM (an Algol-like language), but none of these was provided for review.

Speed and software

The system seems relatively fast. A simple benchmask, the loop FOR I = To 10000 takes 7½ seconds, which is 3½ times faster than a TANDY TRS-80 and between 2½ and 3 times faster than a PET. ACT will provide the PET-based Sales and Purchase Ledgers and Invoicing to run on the Minimax and the system will support files written for PET on the Computhink drives. Finally, the screen may be split into individual sections and referenced directly through the 8K RAM video memory.

Conclusions

- **Minimax is a fast worthwhile upgrade to an existing PET system with Computhink drives. The Basic tends to be better than most currently available systems, even allowing for the obvious criticisms; an extra plus is its ability to call assembly language subroutines.**
- **From a Basic system of 800Kbytes, the disc storage can be extended up to 4.8Mbytes.The system is fairly easy to use and the documentation easy to follow.**
- **It provides a larger user program space, greater than most comparable systems.**
- **The restrictions on file opening and extenion will make commercial use difficult.**
- **At this price for a Basic system, the Minimax is moving well out of the personal computer market.**
- **The memory system can be extended.**
- **The screen and keyboard are in some instances poor for a system of this price.**

The ten commands: will they change your life?

There's no need to step through fire to bring the tablets down from Sinai. John James takes a sceptical look at ten (or is it nine?) new add-on machine-code subroutines for the PET, holds them nervously in the palm of his hand, and concludes they may change your life, too.

WHAT EXACTLY is the Basic Programmer's Toolkit? Well, answering physically, it'll depend on whether you have an 'old' or 'new' PET. And how do you tell? If you have one of the small keyboards, then for our purposes you have an 'old' PET; a big keyboard (and therefore a separate tape cassette unit), and you have a 'new' PET.

The only effect this has on the Toolkit is on the type of Toolkit you get.

For an 'old' PET, you get a small printed circuit board, with a chip and some other bits mounted on it, and a connector loose-wired to its edge. The board has another connector mounted directly on it, which lets it be plugged straight into the memory expansion board port on the right-hand side of your PET. The loose-wired connector is then plugged into the second cassette port, just round the corner, at the back.

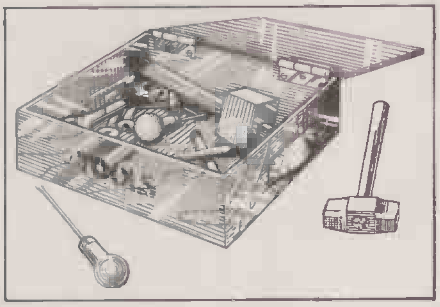
For a 'new' PET, you simply get a chip. This you take in nervous fingers (try holding a chip that cost over sixty quid, and see if you aren't nervous), to plug straight into an empty socket on the main board inside your PET.

Obviously, installation on an 'old' PET couldn't be easier, so there's no point in covering the question 'can you do it simply?'. Fitting a 'new' PET sounds a bit more tricky, so how hard is it?

Nothing could be more straightforward, thanks to one of the best instruction books I've seen in many a day. If you follow the book, you really can't go wrong. It's worth saying here, for the knowledgeable, that the book also covers all the things you'd expect, like avoiding static discharge, bent pins, and so on. In other words, fitting should be no problem at all — except if you've had expansion memory fitted to your PET. Here, the book recommends that you 'contact your dealer for installation information'.

Now there is room for criticism here, since you won't be reading the book until after you've got your Toolkit. Have you ever bought a super-gadget-gizmo, hurried home in high excitement, torn the wrapper off, and then found you hadn't got the necessary battery because nobody said you'd need one? Familiar with the frustration this causes?

Then be warned. If you have got expansion memory, tell your dealer at the time of buying, and make sure that he can advise you.



Once you've fitted the Basic Programmer's Toolkit, what will it do? Here, I'd like to come back briefly to the instruction book that comes with the Toolkit. It's 34 pages long, nicely printed, totally explicit, clear as crystal, loaded with example programs, and best of all, originally written by Gregory Yob.

The cognoscenti will have twitched at that magic name; others should know that Gregory has not only been in personal computing since Heaven knows when — to many, he *is* personal computing.

This means that you'll get the best out of the Toolkit right from the word 'go', and the best can meant quite a lot. Yet there is room for another criticism. The Toolkit is widely advertised as adding '10 powerful new commands to PET's Basic', which I think is not entirely fair.

In fact, you get nine new commands (we'll have a look at how powerful they are in a moment); the tenth isn't really a command, in my view, since it simply switches off a couple of the other nine.

So what are these nine powerful commands? The best way of answering that is to look at them one by one, but before we do that, let's return to that magic moment just after you've fitted Toolkit, and you're about to start trying it out.

You have to turn it on, and this you do very simply by entering SYS 45056. PET should respond immediately by displaying (C) 1979 PAICS.

From that point on, all nine active commands are available until you switch PET off. You get them back, after powering down, by entering the SYS instruction again.

Reviewing the nine commands gives me a choice: I can tell you about them alphabetically, or in order of personal favouritism, and I'm going to opt for the latter.

Let's start with RENUMBER.

Now this one is really good (not that the others aren't, but I said I'd start with my favourite!). The major point to make immediately is that RENUMBER is fully professional.

In other words, forget about those previous methods, using add-on subroutines, which required you to go right through the program, looking for line numbers, to make sure each one had enough space before it for whatever it might become when renumbered.

The Toolkit RENUMBER expands or contracts line numbers, and closes everything else on the program line up tight to the new number, whatever it might turn out to be.

You activate RENUMBER by typing the word and entering it. If you do this, Toolkit assumes you want to start at Line 100 and go in steps of 10.

If you want to start at any other line number, and/or go in other increments, you simply say so and it happens — and pretty fast too. I linked four programs together, all about 6K long, and renumbered the lot in less than 15 seconds.

Of course, it depends on the number of renumbers (if you get my meaning), but you shouldn't have any complaints about the time you hang about.

There are two other goodies in RENUMBER.

First, if renumbering will take your line numbers over the maximum permitted, the routine aborts, and no renumbering takes place. You'll like that if you've ever 'crashed' with other methods!

Second, if the routine comes across a line number that doesn't exist later in the program (as in GOTO X, and X isn't there, for instance) then it quite deliberately renumbers that to 63999.

This ties in nicely with my next most-liked command, FIND.

FIND locates all lines that contain absolutely anything you like to specify. It's important to be clear about this, because the advertising for Toolkit isn't. The advertisements say that FIND locates

lines 'containing a desired character string'. That's quite true, but it's misleading, in that you might well think that all you can ask FIND to do is look for strings.

Not so. FIND will do much more than that (which certainly means the advertisements err on the right side!). FIND will find anything. If you want to know which lines have the variable 'G' in them, and you enter FING G, then every line with the variable in it will be found and displayed.

Note that FIND G won't find GOTO or GOSUB, just because they have a 'G' in them, which saves a lot of confusion. To find GOTO statements, you need to enter FIND GOTO, and the same holds good for any other Basic statement. If, on the other hand, you enter FIND "G", then every quoted string that contains the letter G, whether it's on its own or contained in a word, will be found and displayed, which is not only useful, but fun.

Now you'll see the point of renumbering non-existent lines to 63999. All you need to do to find them is enter FIND 63999, and presto! there they all are, displayed for your pleasure. And, what's more, you can then go right ahead and edit them on screen, which helps resolve little local difficulties quite quickly.

Keeps on adding

I think my third favourite must be APPEND. This one adds program to program to program, for just as long as you have memory available to keep doing it. You only have to keep one thing in mind: APPEND does not replace program lines in memory with new similarly-numbered lines from the material you're appending, not does it interleave program lines. Quite simply, it does exactly what it says: it keeps on adding program lines to the end of whatever might already be in memory.

It does this from tape only, however, and will not append from disk or other devices. I don't see this as a very great disadvantage, but perhaps some people will.

All I can say is that I've already found the command incredibly useful, in only a few days of playing about. If I have a favourite subroutine or whatever on disk, I don't really feel it's a great hardship to off-load on to cassette so that I can use the APPEND facility.

My fourth favourite? Well, we're getting to the photo-finish stage now, but maybe a whisker or so in front is HELP. You use this when that lovely point comes, as you finish typing the world's finest program, which of course is totally error-free, and run it, when everything judders to a standstill halfway through, with PET beadily blinking ERROR at you.

You look at the line allegedly in error, and it seems perfect, just like the rest of the program.

Fret not; if you'd like to know where that little but is lurking, enter HELP. Up comes the line again, but this time a bit of it will be in reverse field. This, says the manual, is where the error is. Well, I found this wasn't strictly true, but it was close enough to make no difference. Sometimes the reverse field is to the left or right of the error, sometimes a character or so distant, but it's never far away. After all, if the error was something missing, it'd be hard to put a reverse field on what wasn't there!

Mounting panic

The fifth and sixth commands are similar: TRACE and STEP. Both put a little reverse-field window on the top right-hand corner of the screen, which displays up to six line numbers. With TRACE, the program runs steadily, and the line numbers being executed whip up the litttle window at a high rate of knots.

The manual says that TRACE slows the running of a program considerably, and that pressing the shift key slows it still more, to around two lines per second. Even at that, though, it's still moving fast, and I haven't so far found TRACE overpoweringly useful. The only effect it's had on me to date is to induce a mounting panic as I tried to keep up with what was happening. These are early days, though.

STEP seems rather more sensible, but to be harsh, it's merely an extension of TRACE, in that it displays one line number only, and that's the one that's just been executed.

For debugging, my vote goes to STEP, however. Not that my programs ever have bugs in them, of course, but I can always offer my help to those less fortunate!

One smart thing about both TRACE and STEP: the reverse-field window overrides any screen display, which avoids peering at line numbers through overwritten screen characters. This is a disadvantage too though, because it's possible (but, to be fair, odds-on unlikely) that a bug you're trying to spot will be right under that little window!

DUMP comes next, and I have a feeling that I'm going to love it more and more. You use it most often at the end of a program, and entering it causes every single variable (excepting arrays) to be printed, with the value each has at that time.

Now I'm a messy programmer: in other words, I like to program straight on to the screen. Not for me the clean, aseptic approach of writing everything out beforehand.

Thus I often get to a point where I'm uncertain which variables I've used, which I haven't, and what values I've given those that I have put in. I'm sure that you, gentle reader, never do this, but just in case there's someone out there who does, DUMP could be exactly what he or she needs.

Family resemblance

The final two commands — AUTO and DELETE — have a family resemblance also. Their names explain virtually all. AUTO provides automatic line numbering, in whatever increments your heart desires, as you type furiously through your program-entering process. DELETE wipes whole blocks of lines out, between whatever numbers you specify.

That, at least must save wear and tear on the Return key but, ironically enough, the other commands available in Toolkit tend to lessen the usefulness of DELETE for me. I'd have loved it in those not-so-far-off days when I used subroutines tacked temporarily on to the front or rear of the main program.

And there it is: the Basic Programmer's Toolkit, with 2K of ROM firmware, consisting of a collection of machine language routines, all on one chip, adding nine (or 10, if you want to be finicky) new commands to your PET.

Is it worth £60? I would say yes.

Petsoft tell us:

- They are writing a British annexe to the Minimax manual with the intention of 'making a number of contributions aimed at the naive user.'
- This business software, available for the PET on Computhink mini-floppies, has been adapted and integrated for the Minimax. This means that programs from the suite can be run without having to 'bust through a series of complicated disc-to-disc steps.'
- Software titles which will be available early in the new year are Sales Accounting and Invoicing, Purchase Accounting, Stock Control, Word Processing and before the new financial year, Payroll.

Petsoft are also publishing a range of 50 utilities, languages and simple business routines. During the course of the year Petsoft will release some graphics packages supporting animated graphics, 3D plotting and a "small-talk" type package.

The CPU, in additiion to recognising all standard 6502 instructions, will also support 64 user programmable op codes. These can be used for Pascal and Forth operations.

CompuThink themselves have Pascal, a compiled Basic and Fortran under development for release early in 1980.

Conclusions

- **It's added a lot more fun to my programming**
- **It's made bugs much easier to find**
- **It's encouraged me to be a little more adventurous in trying out different methods, because I know, if they're not right, I'll be able to locate them and change them**
- **Maybe best of all, it has let me go back to half-finished programs from long ago, and tackle them again.**
- **Toolkit also makes conversion of old-ROM programs very much more simple.**
- **If you're any sort of 'hacker', what are you waiting for?**

"If you want what's best for your PET, choose Commodore software."

Kit Spencer
General Manager
of Commodore Systems
360 Euston Road
London NW1 3BL

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PET systems are simple to use and any normal advice or assistance you may need can be obtained from Commodore Dealers.

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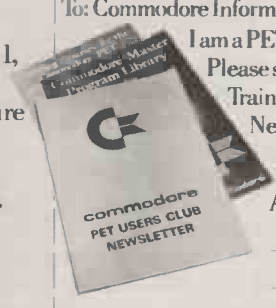

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Genie's missing magic

Your wish is my command – but only up to a point. We assess the first complete micro package offered in the UK.

VIDEO GENIE is the cheapest get-up-and-go microcomputer completely packaged with full facilities and adequate memory so far offered in the U.K. It is fully-compatible with one of the three most popular existing micros in its class, so there is no shortage of instantly-available software.

Essentially it is an all-in-one improvement of the Tandy TRS-80 Level II 16K. The Genie case includes the keyboard, integral cassette player, and both video and UHF modulator outputs. The price is £425 including VAT, compared to the official Tandy recently-discounted offering at nearly £600 which, however, includes a video monitor. Even if you manage to secure one of the keyboard-only deals — you supply your own cassette, TV and power supply unit (psu) — at £150 plus VAT the Genie is attractive. A year ago the TRS-80 Level II 16K would have cost £807.

At this price, should one be criticising at all? I think so. The micro is not longer a novelty and while the earliest models on the market were entitled to a tolerant reception, each new entrant has to offer better value than its predecessors if it wishes to survive.

Better value in this context is not only a matter of pricing; the public will look also for reliability, freedom for clearly-avoidable design mistakes and first-rate documentation.

In many respects the Video Genie is an improvement on the TRS-80 but a number of irritating features remain. It is also not entirely clear for whom it is intended — small business, education, hobbyist; the Tandy answer to that has always been 'All three' and the manufacturers of the Video Genie say the same.

Overall, the package is neat and portable. There is a minimum of trailing wires and even two hooks at the back to store flex not required immediately. The construction is semi-modular.

The keyboard is well-spaced and features 'roll-over'; I doubt, however, whether it is tough enough for day-in-day-out usage. My clumsy fingers found stuttering easy.

The cassette player is to the right of the keyboard. That has certain advantages for the beginner but might be a nuisance once interest has progressed to the point where discs are added; at that stage the cassette drive merely occupies space which could perhaps have been given to a separate numeric pad. There are provisions for a second cassette player controlled via a

DIN socket at the back; the lead is supplied.

There are some curious design decisions, though. The power, re-set, video-cut—32-character half-page option for use with a poor monitor — are all located at the back of the box, though the special key (PAGE) to select which half you view is on the front. Another key (F1) de-activates the 'remote' on the cassette interface so that Fast Forward and Rewind can be actuated without the jack-plug juggling necessary on the TRS-80. If you use the second cassette player you are back to all the fiddling.

All those problems could have been solved by clearly-marked keys on the front of the case; in fact, when you remove the ABS outer case — a kind of straw colour with pseudo wood end-pieces — you find that the keyboard holder appears to have spare locations which are not in use.

One control all too familiar to TRS-80 owners, the cassette volume pot, is absent. Video Genie claims to have solved the problem of automatic gain control, so that the model is now in line with what all manufacturers, apart from Tandy, seem to have been able to achieve.

The claim is justified, except in one respect. Because of the CLOADing problems on the TRS-80, packages available from various software houses catering for the Tandy vary in their volume setting. There is an even greater variety in the setting adopted by home software programmers.

The Video Genie automatic gain control appears to be insufficiently flexible to cope with everything. I picked up a clutch of software from the office from some of the most prolific commercial outlets and a few cassettes from readers. Many of them failed to CLOAD properly, the VDU reporting SN (syntax Error) or UL (undefined line) which, on closer examination, showed that loading had stopped before completion.

After uncasing the machine and removing the cassette drive to examine the board below, I identified the variable resistor which needed tweaking. If I pushed it too far, I could not CSAVE and CLOAD. The pot is clearly not designed for much more than initial alignment and the occasional attention during services, and it would not be wise to fiddle with it too often. So, whether there is some inherent fault in the Genie, which I doubt, or whether it is suffering from the legacy of TRS-80 problems, a semi-accessible volume control is essential if advantage is to be taken of all the available TRS-80 software; it would be easy to provide.

The strengths and faults of the TRS-80 remain. There is no direct cursor control, which is attractive for beginners, but you have to type-in EDIT, at which point various subcommands — insert, hack and insert, cancel and re-start, change, become available on pressing the right single key. The trouble is that they take a time to learn and must be understood before you can do much in the way of writing your own programs.

THE PET

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Camden Electronics
021-773-8240

CPS (Data Systems) Ltd
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Matlock
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Preston Computer Centre
0772-57684

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CSE Computers
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Woking
P.P.M. Ltd
Brookwood 04867-80111

Petalect Ltd
04862-69032

Yeovil
Computerbits
0935-26522

North Scotland
Thistle Computers
Kirkwall 0856-3140

Northern Ireland
Medical & Scientific
Lisburn 08462-77533

• Circle No. 185

Not all the facilities are useful; e.g., nD tells the computer to delete n characters to the right of the cursor, so that you don't have to space-bar your way through and you don't appear to have the one thing which would be helpful, the opportunity to delete three characters, say, and replace them with five.

Compared to the Pet and Apple — and a number of other machines — the graphics are fairly limited. You can locate a character anywhere on the screen with ease, but essentially you are limited to bars, asterisks, brackets and punctuation marks. You can have histograms but graphs are a trifle tiresome. Also, there is no built-in lower-case character set.

There is a standard modification for the TRS-80 to accomplish this, as the Z-80 cpu has no problems with handling such a facility if the appropriate character generator is hooked-in; it would be handy clearly in such applications as word processing, to which Tandy Basic adapts easily.

In addition to the DIN socket for the second cassette, there is a S100 bus which could go on to an expander board for hooking-up discs, printers, modems, and whatever. All the Tandy add-ons should work. The Video Genie importers, Lowe of Matlock, hopes to provide its own semi-dedicated add-ons. I understand that there will be a colour card soon.

I was supplied with a loose-leaf folder as the manual had not been printed at the time I received the review machine. Video Genie seems to be leaning heavily on the Tandy Level II Basic Reference Manual.

Tandy assumes you have worked through Level I — with its justly-famed idiot-proof manual — and that you approach the senior machine with some knowledge of Basic. If the Video Genie is your first machine, the lists of functions will not be much help. Further, because Tandy/Genie Basic is slightly different from Microsoft Basic, it is not much use suggesting to novices that they work with one of the standard guides like *Illustrating Basic*. No general book, for example, will help with the simple problems of line editing, which are so often discouraging to the beginner.

Again, a number of the commands are obtained in a slightly unusual manner, picked-up easily by the experienced programmer but confusing to the individual who thought he could be writing and running programs within an hour of unpacking the machine.

There is also a demo cassette which has some simple graphics, some very obvious statistical programs, a biorhythm calculator, and the inevitable space game.

The importers, Lowe Electronics, one of the biggest importers of Japanese amateur radio equipment have an excellent reputation among hams. It claims to turn round most repair jobs within 24 hours and that half of its staff is concerned with servicing as opposed to selling. It tells us that part of the deal to take the Video Genie from Hongkong is a guarantee of necessary spares.

Conclusions

- **By present-day prices the Video Genie is welcome and, as a general-purpose micro, is good value.**
- **The compatibility with the Tandy TRS-80 means that there is already a substantial body of software available.**
- **The machine is tough enough for home use but probably would not take persistent pounding in a small business or educational application.**
- **Expansion should be relatively easy, using add-ons from a variety of sources.**
- **Some attention to minor items of detail, the placing of switches, and the provision of a volume control is needed. It would require little thought to accomplish this oneself, but doing it neatly might be another matter.**
- **We do not regard the TRS-80 Basic as the easiest with which to start, though its good qualities appear a little later.**
- **The documentation is satisfactory for programmers with some experience but needs smartening if the machine is to make a big impact on first-time buyers.**

Video Genie is imported by Lowe Electronics, Matlock. Only the 16K model will be imported to the U.K. through a 4K version is also made. Price £425 including VAT.

Practical Computing evaluation

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

	Yes/No N/A	1	2	3	4	5
Assembly languages	Y					
Basic language	Y					
Other languages	N					
Compatability with other systems	TRS-80					
Reputation of manufacturer	NEW					
Appearance					●	
Portability					●	
No. of software applications packages available						●
Hobby use						●
Business use						●
Educational use						●
Suitablity for Commercial applications						
Home applicatlons						●
Educations applications						
Ability to add printer(s)	Y					
Ability to add discs	Y					
Ability to add other manufacturers' plug-in memory	N					

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

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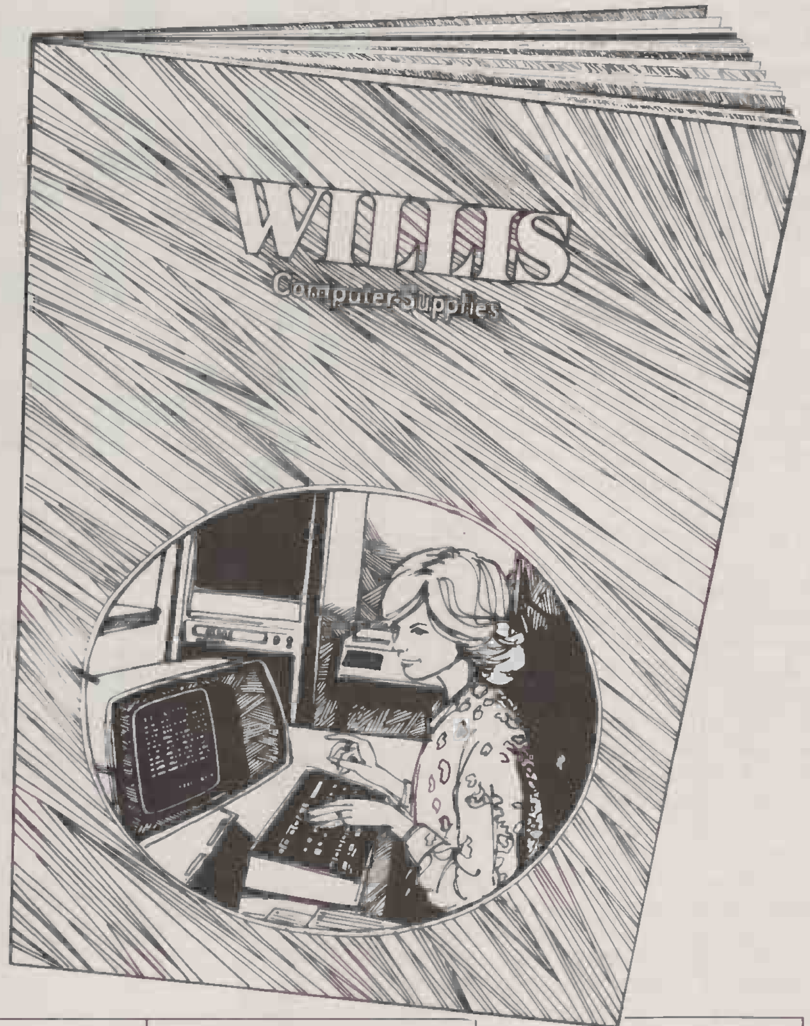

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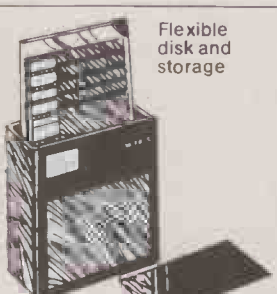

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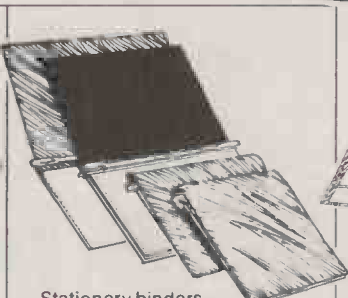

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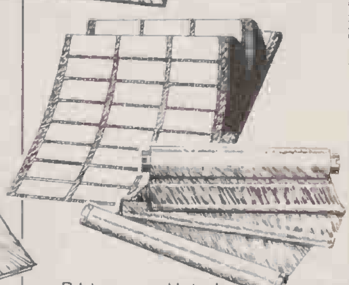

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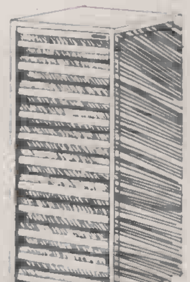

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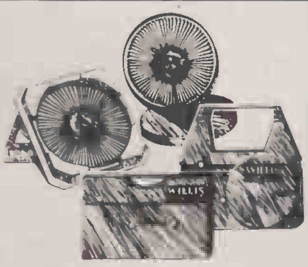

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Personal computer networks:
better than the next best thing to being there.

Home brewed computer networks may be changing the American way of life. As a preview of what may happen to us, we present a recent survey from the West Coast magazine *CoEvolution Quarterly* by Art Kleiner and Willy Davis.

ONE OF THE EARLIEST and most powerful computer dreams, the home electronic information and mail network, is now becoming available to the public in America. Unlike other countries, where telecommunications systems are often centralized, twenty or more separate systems are operating or plan to begin soon in the US.

Their sponsors range from AT&T, Xerox and Warner Communications to the National Science Foundation and Corporation for Public Broadcasting to grass-roots groups of computer hobbyists. Some computer networks were set up to experiment with the possibilities of the medium; others are limited forms of electronic text aimed at businesses or personal computer owners; still others will compete commercially for the chance to become the next Bell Telephone system.

The recent development of cheap terminals made the dream economically viable. Video-display terminals, most looking like video screens with keyboards, have become available for $500, and are expected to become cheaper. "Smart" terminals, or microcomputers, are generally not much more expensive.

From the horse's mouth

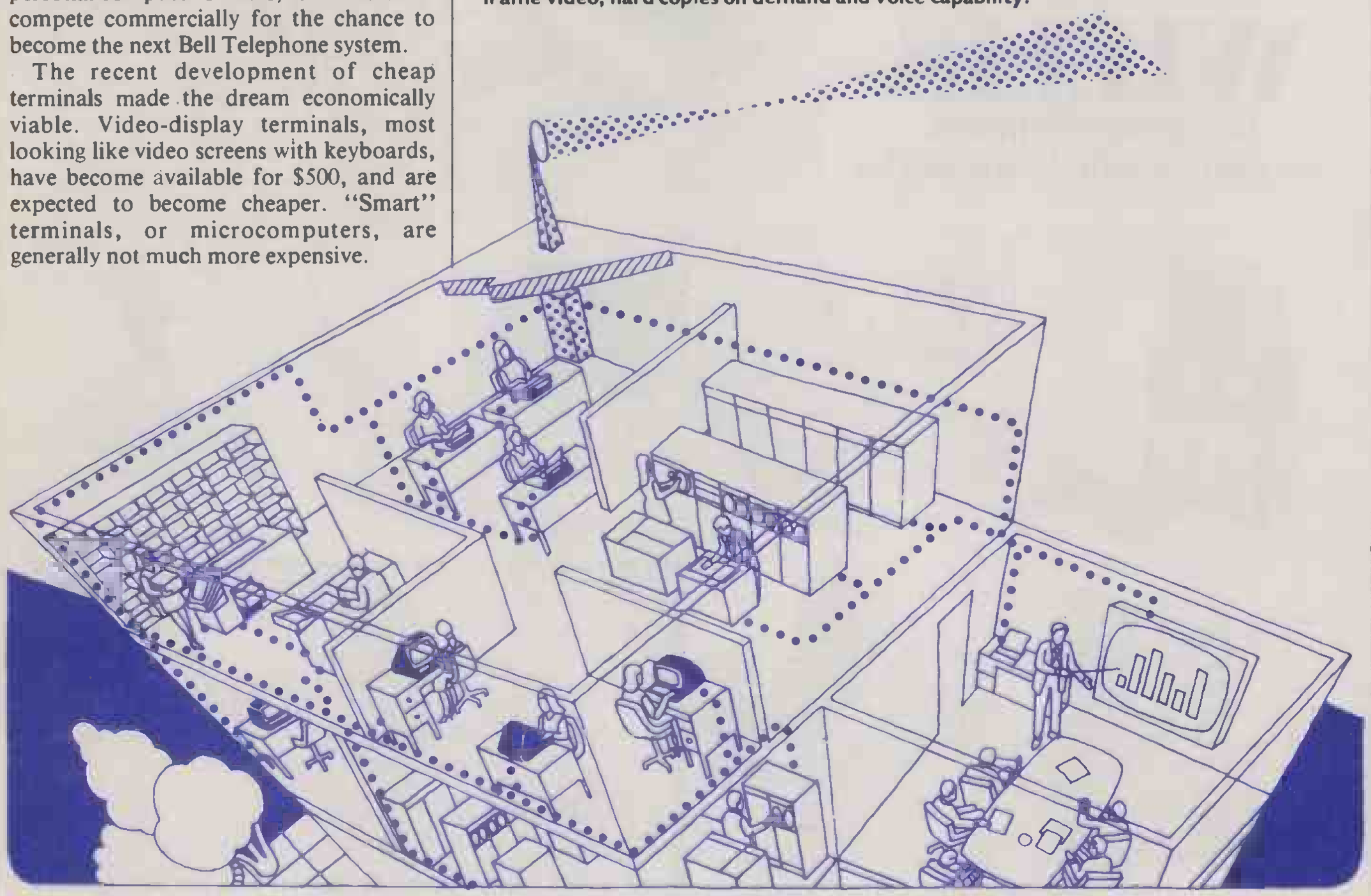
THE AUTHORS are writing magazine articles/masters' theses about how people are using two-way telecommunications systems. If you have first-hand observations or anecdotes, contact them at 4106 Emerald Avenue, Oakland, CA 94609 or 415 653 7710. They collect such items as these from Art:

"Eighty-five percent of the people who go to public access computer facilities are kids, 8-18 years old. There are a lot of teenagers around who are brilliant, creative programmers; they start computer consulting firms or get jobs with software companies. A 17-year-old manages the ARPA-NET hookup at Lawrence Berkeley Labs. At the Marin Computer Centre kids are afraid of obviously outclassing adults, so they deliberately play their computing talents down when their parents are around.

"CRT terminals are potentially dangerous sources of X-ray radiation and eye damage. This may not sound like news; but a National Institute for Occupational Safety and Health study in 1977 said computer programmers were safe from radiation. Now, the FDA (or a medical researcher at the FDA) told me they're not satisfied with the way NIOSH tested the machines. CRT terminals are especially dangerous sources of radiation because you peer into them at close range for hours at a time.

The communications workers (San Francisco Communications Workers Union: an example of alliance between labor and anti-radiation people), are investigating eyestrain and eye damage now because of complaints from Directory Assistance operators, who have to scan through all those numbers on the terminals. Researching this subject makes me absolutely delighted to be a computer typesetter."

Three principal applications of XTEN are shown in this cutaway. Document distribution: Sending and receiving terminals and work stations can be linked because of the network's compatibility. Advanced printing devices at mail distribution centres (left) allow rapid delibery. Data transmission: From interactive terminals (lower centre), data can be sent and received on request. Remote job-entry terminals can utilize broadband service to permit high-speed input/output operations. Processors and files can be located to the customer's choice. Teleconferencing: Conferences (right) will include high-quality, still-frame video, hard copies on demand and voice capability.



Terminals translate typed-in-words (and pictured input in a variety of ways) into binary code, which can then be transmitted over telephone lines, wire cables, fiber-optic cable or broadcast waves. The cost is often less than that of long-distance phone service.

Some of the most promising uses include news services edited by computer to people's personal needs; elaborate computer-aided fantasy games played with others through the system; computer conferencing; instant mail; and immediate access to groups of people or libraries of words and film, which are found by specific combinations of keywords. The possibilities were described more elaborately by Gene Youngblood and Paul Baran in the Winter, 1977 (Broadcast) issue of *CQ*.

As some of these networks evolve into versions of Youngblood's National Information Utility, the political questions are still unanswered:

- **Who controls the networks?**
- **Must they be centralized?**
- **Who has access to them?**
- **How are their contents chosen?**
- **How are they paid for?**
- **What technology is used to transmit messages?**
- **What services are offered?**
- **How do users interact with the system?**
- **What provisions exist for privacy?**
- **How to get in touch?**

This is *not* an exhaustive survey, but it should give some idea of the range of the leading contenders, plus some influential experiments.

QUBE. Columbus, Ohio; may soon be introduced to Boston and Pittsburgh. Started December, 1977. Sponsored by Warner Communications Corp. Contact: Leo Murray, V.P. Public Affairs, 75 Rockefeller Plaza, New York, NY 10019.

This widely-publicized, two-way cable TV station offers normal cable TV, pay TV and potentially interactive local channels. On interactive shows, viewers push yes/no/multiple choice buttons to respond to opinion polls or order products after commercials.

A central computer monitors each TV set every 6-10 seconds, recording responses and what channel the set is tuned to. The system is used for political polls, talent shows, university extension course exams, and commercials with built-in market research that seem to serve Qube's sponsors better than its subscribers.

Warner's research showed people wanted the simplest system possible — hence the limited amount of interaction. "Mrs Jones doesn't want to take the time to learn to be a computer expert," spokesman Leo Murray said. Qube warns viewers in advance when their responses are recorded, and does not release records without subscribers' consent, he said.

They expect to introduce video games, security systems and electronic funds tranfer directly from subscribers' bank accounts to stores. March 1979 articles in *Atlantic* and *Penthuse* go into more detail.

Last October over 3000 sets were tuned in to QUBE in Columbus to discourse on food labelling with Donald Kennedy, then head of the Food and Drug Administration. Kennedy was surpised at some of the results: more than half the audience wanted ingredients listed by percentage rather than weight; 70% wanted more nutrients added to foods; only 15% understood metric measures (Kennedy expected 40%).

To connect you need: a TV, $19.95 one-time installation charge, and $10.95 monthly rental. Pay-TV programs average $1-$4 each.

VIEWDATA. A British consumer system, available sometimes in 1979 in America as a business service. Sponsored by Insac Viewdata, Inc, a subsidiary of the British National Enterprise Board.

Viewdata is a type of interactive text system developed by Insac and operated by the British Post Office under the name Prestel. A Prestel terminal is an adapted TV set with a telephone connection and a remote-control switch-box that looks like a pocket calculator.

Viewers press numbers to call for pages of travel information, business information, retail advertising, or constantly updated news. Pages appear on the screen in bright colours and block letters; each page includes a list of 10 other pages that can be called up for more information, like a cross between a library and a chain letter.

Sometimes people must go through seven or eight pages to reaches the one they want. News agencies and advertisers pay the British Post Office for the opportunity to put their messages on the air.

To connect, British viewers need an adapted TV ($30-$50 more than a regular TV); plus the price of a phone call. Each page carries a charge, usually 1¢-4¢.

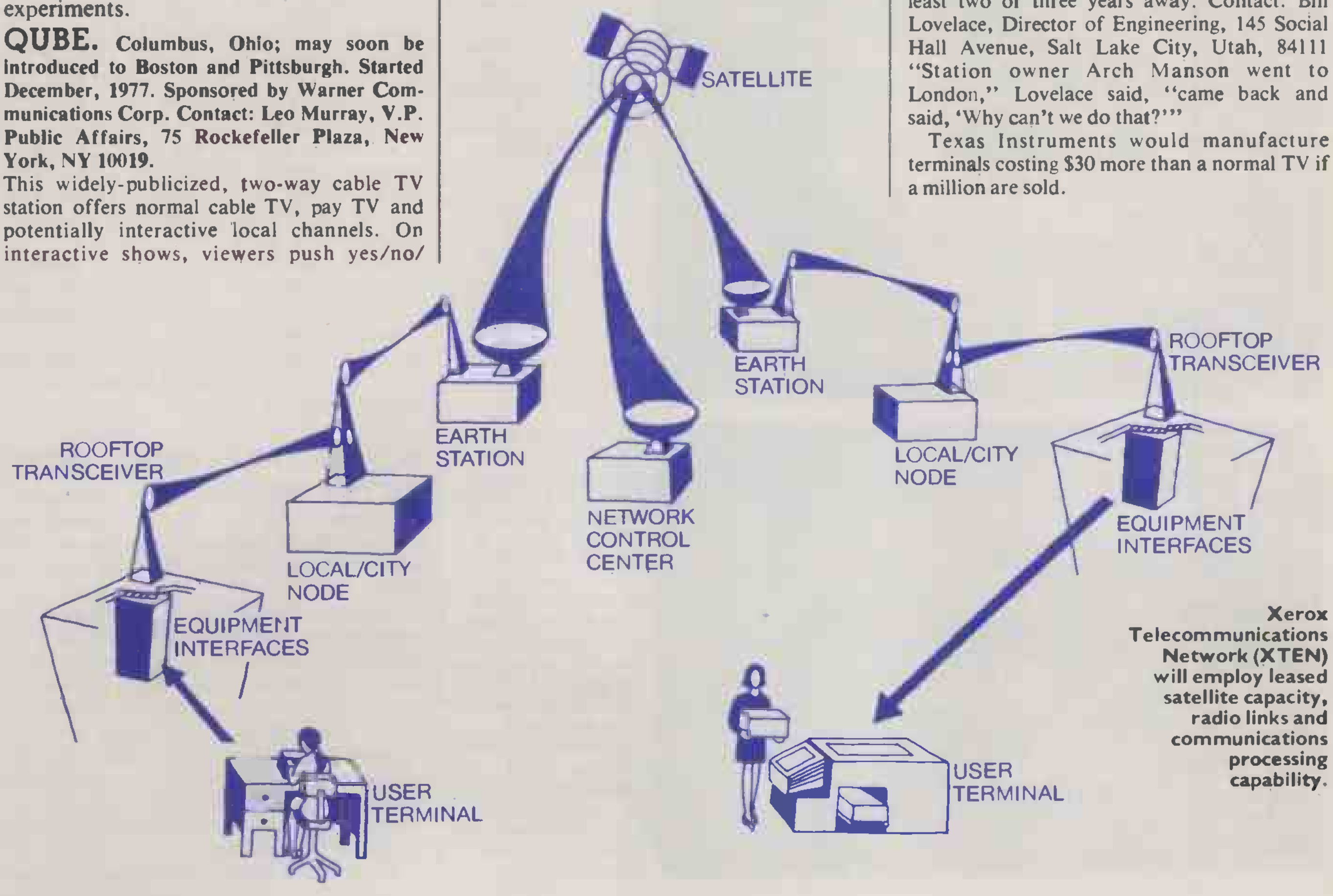
Several companies will offer variations on Viewdata in America.

Insac, the parent company, will not offer the service publicly, but hopes to find businesses or broadcast stations that will establish closed Viewdata systems for their members or clients. These groups will make all the decisions about what information to use, how to present it and how much to charge. For more information: Martin Lippman, VP, 277 Park Avenue, New York, NY 10017.

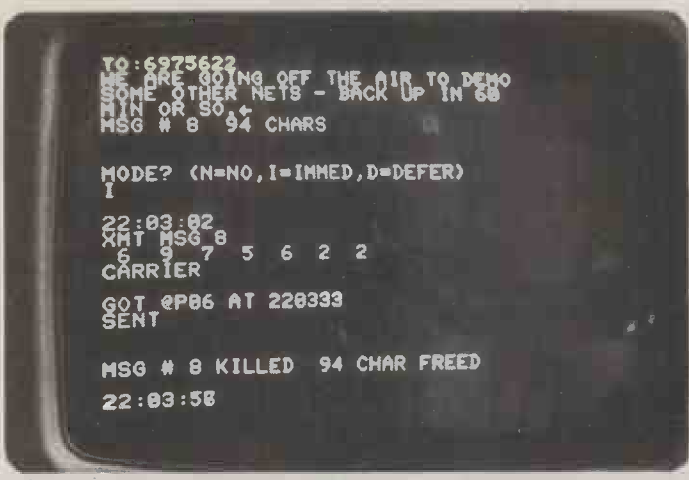
The Knight-Ridder newspaper chain will test a home Viewdata system in Miami beginning in 1980, spending about $1.3m to do so. Contact: Viewdata Corporation of America, One Herald Plaza, Miami, FL 33101.

KSL-TV, Salt Lake City, has an experimental demonstration system now; a public system is subject to FCC approval. Service is at least two or three years away. Contact: Bill Lovelace, Director of Engineering, 145 Social Hall Avenue, Salt Lake City, Utah, 84111 "Station owner Arch Manson went to London," Lovelace said, "came back and said, 'Why can't we do that?'"

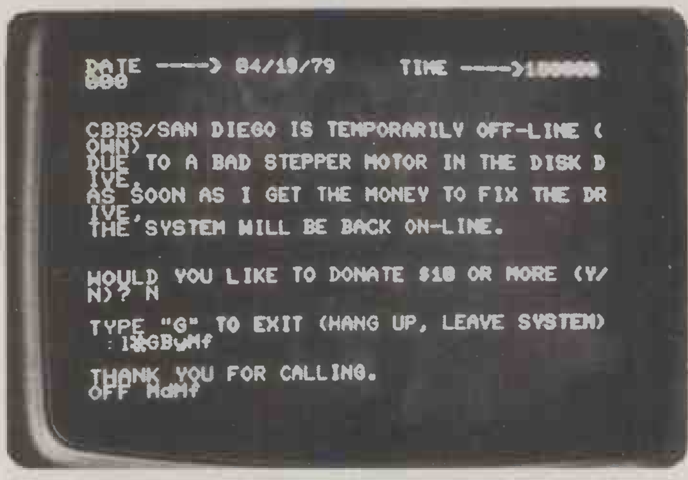
Texas Instruments would manufacture terminals costing $30 more than a normal TV if a million are sold.



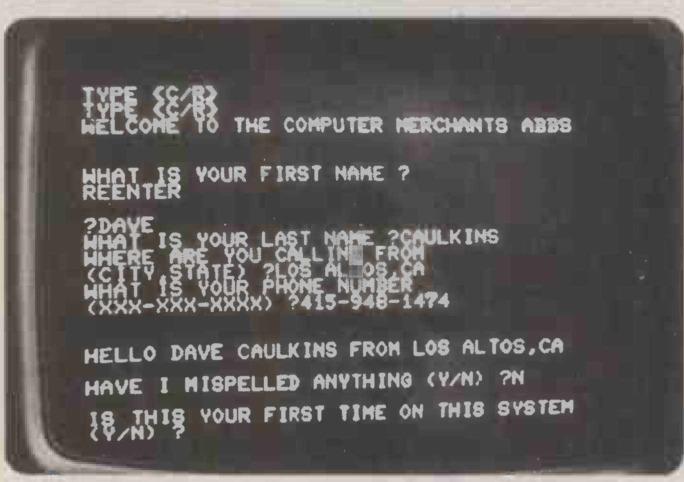
Xerox Telecommunications Network (XTEN) will employ leased satellite capacity, radio links and communications processing capability.



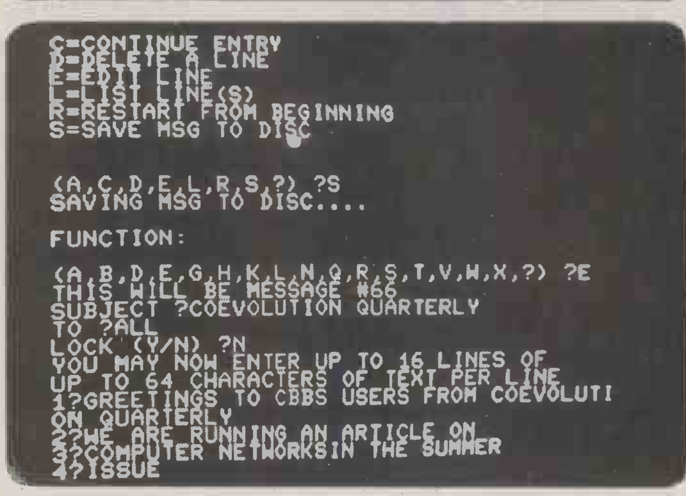
There are a number of computer bulletin boards in US cities where home computer owners can leave and take messages. Dave calls one in San Diego.



. . . and one in Chicago which is working . . .



. . . and leaves a message from CQ. Those codes at the top are the commands for using the bulletin board. The program types a question mark whenever the human is supposed to do something.



Step-by-step, Dave types in Bonnie's phone number and sends her a message. The program asks "Mode?" meaning: Hold on to it (N), Send it now (I), or Send it at a certain time (D)? As it dials her number, the program types those spaced-out digits. Then it tells Dave his message is sent ("Carrier") received ("Got . . .") and deleted from is own computer ("killed"). It always keeps track of the time at the very bottom.

ALTERNATE MEDIA CENTRE TELETEXT STUDY. **Funded by the Corporation for Public Broadcasting. Contact: John Carry, New York University Alternate Media Centre, 144 Bleecker, Street, New York, NY 10012.**

Teletext resembles Viewdata visually; but it's a constant stream of text and pictures broadcast over a TV station, each piece of information coded with pre-selected keywords. Users program their terminals to catch only those items of personal interest as they whiz by.

"We see our Teletext as a large-scale system for the public," Carry said. "Maybe four or five years from now the price will be low enough." In the meantime, the Corporation for Public Broadcasting paid for research into possible uses of Teletext for people overlooked by the mass media, such as neighbourhood associations and the handicapped.

Last year, Alternate Media Centre organised the highly successful Berks County, PA, community interactive TV system, in which senior citizens and community members use TV cameras, cable TV and telephones to make an electronic community out of their County. Now they hope to raise funds to demonstrate their Teletext system in Washington, D.C. some time next year.

Teletext systems are currently operated by TV networks in Britain under the names Ceefax and Oracle.

DIGICAST. **San Francisco, beginning sometime 1979. Proposed by the Digicast Project, an informal group of computer scientists, engineers and electronic manufacturers. Contact: Jim Warren, 345 Swett Road, Woodside, CA 94062.**

Like Teletext, Digicast will transmit words and pictures over broadcast waves in a steady stream. Using Sub-Carrier Authorization channels, which are unused FM frequencies linked to existing radio stations, Digicast will be a steady stream of news, financial data, real estate listings, classified ads, weather, computer programs and library resources.

To receive it, users will need a modified personal computer ($600-$1200) with a radio receiver ($100). As in Teletext, the computer will pull out only those items which it has been programmed to catch.

Digicast will be free; but project members will start businesses to make terminals, sell advertising, or produce the information. Organiser Warren is known as the founder/editor of several computer hobbyist magazines, one of which, the Intelligent Machines Journal, carries news about Digicast.

PCNET (PERSONAL COMPUTER NETWORK). **Nationwide. Available from the PCNet Committee. Contact: David Caulkins, co-ordinator, 340 East Middlefield Avenue, Mountain View, CA 94043.**

Caulkins wrote a CQ article several years ago when PCNet plans were still tentative; since then, his committee of volunteers have developed an electronic mail system for Commodore Pet personal computers over telephone lines. Most of the work involved developing a program which directs computers to dial each other's numbers to leave messages in other computers' file, and to correct the large numbers of errors caused by garbled phone-line transmission.

An ingenious method of bouncing messages from one computer to another helps avoid costly long-distance phone rates. Pet computers with telephone connectors (modems) cost about $1100; users feed PCNet programs (about $8) into their computers. There is no central switching computer.

"That's our political decision," Caulkins said; decentralized networks are harder to control. To protect privacy, users are encouraged to develop automatic message-encoding programs. Future plans include adapting other microcomputer brands and sending the message over short-wave radio. *Personal Computers* magazine's Oct-Nov issue carried a long description by Caulkins of how the system would be used.

THE COMMUNITY MEMORY PROJECT.

San Francisco, beginning sometime 1980. Sponsored by the Community Memory Project. Funded by contributions. Contact Sandy Emerson, 1814 Ward Street, Berkeley, CA 94703.

Convinced that computer networks should be decentralized, open to everyone, and service/communilty orientated, Community Memory put inter-connected terminals in Berkeley public places between 1973 and 1975. People used them as an electronic bulletin board for filing news, messages, classified ads and poetry. Others used the terminals to pull out information with the appropriate key-words, or to add comments to existing messages.

A new, similar system will be established in a San Francisco neighbourhood; up to 20 terminals will be placed in community centres and neighbourhood gathering places. all information in the system will be entered by the people who use it.

As an experiment, high-tech users accustomed to home terminals will find it limited and inconvenient, but it's one of the few systems that does not require people to own their own terminal in order to use it.

THE SOURCE.

Nationwide. Unveiled at the New York Computer Fair, June 2, 1979. Available from Telecomputing Corporation of America, itself a subsidiary of Digital Broadcast Company. Contact William Von Meister, chairman of the board, 1616 Anderson Road, McLean, VA22101.

"One of the most heavily capitalized ($34 million) companies in the history of this country," this is the first home-terminal consumer information network put on the market in America, and probably the most ambitious. People with home terminals will call for specific information, including any UPI article of the last seven years, programs in Cobol, Basic and Fortran, airline information and video games.

In addition, the source will offer electronic mail to other terminals, and a unique electronic mail system to people without terminals — for 75¢ your computer message becomes a Western Union mailgram dropped off at O'Hare Airport.

All this will be transmitted over Telenet, a private data communications cable network more suited than telephone lines to computer signals.

All information on the data banks is chosen by the company, based on customer demand. Some services are paid for by advertising. People can send one message to a group of others — everyone interested in alternative energy in Virginia, say — for 15¢ per recipient.

News services would be censored only because of "irresponsibility of editors — four-letter words," von Meister said. What about for political reasons? "You know we wouldn't." Records are kept of how much each piece of information is called up, but not of who is calling for what. DBC offers a $5000 reward to anyone who can break into someone else's private messages on the system.

To connect, you need a personal computer and telephone hookup ($1000) or a data terminal ($595 and up), plus $2.75 per hour of use. The service is limited to off-business hours and weekends, when Telenet rates are cheaper. The cheap cost is a big selling point; "There's no reason we shouldn't be within 10% of the nation's homes in five years," von Meister said.

ELECTRONIC INFORMATION EXCHANGE SYSTEM (EIES).

Nationwide, begun October, 1976. Funded by National Science Foundation; organised by Murray Turoff, New Jersey Institute of Technology, and Starr Roxanne Hiltz, Upsala College. Contact: Turoff/Hiltz, Computerised Conferencing and Communications Centre, New Jersey Institute of Technology, Newark, NJ. 07102.

Early government computer networks, such as Arpa-Net (Department of Defense) and EMISARI (Office of Emergency Preparedness), brought scientists and social scientists together electronically to collaborate on government research. These networks planted seeds for later, more experimental networks whose purposes centre around developing the form of computer communication itself.

Along with Forum/Planet (started at Institute for the Future, Menlo Park, CA; now managed as a business network by Jacques Vallee's Infomedia Corporation) EIES is probably the most influential in developing social contexts with which people will find each other through computers.

EIES messages travel over Telenet; EIES is a system of subnetworks, each centred around an interdisciplinary research topic such as Futures Forecasting or General Systems Research, each with 50 members. Members collaborate on research, send cross messages and immediate responses, introduce themselves to each other via keyboards that signal common interests, and gradually build up on-line libraries of relevant information.

A micro-processor is being programmed to search data bases at the request of EIES users, and the frontier seems to involve communication with or through computers that develop an independent identity — either terminals that act as extensions of their owners when they are at them, or computer programs that stimulate personalities and social systems.

To connect, you need to apply at the address given above. Limited funding is available for a three-month trial period; otherwise, people with a reasonable idea for using the system can buy membership slots in areas of special interest for $66 monthly and $3.75/hour (cost of Telenet). Groups can buy a slot co-operatively.

For $100,000, a group can buy the hardware to create their own EIES-like system. Software and maintenance is extra. More detailed information is available in articles by Turoff and Hiltz (the best perhaps, in the *IEEE Spectrum,* May 1977). or in their book *The Network Nation.*

One sub-network is actively exploring the possible uses of computer networks in neighbourhoods and local communities. Participants include former members of *Rain* magazine and the institute for Local Self-Reliance, as well as some members of Robert Theobald's Linkage System and Peter and Trudy Johnson-Lenz, EIES researchers, who helped organize a computer-aided neighbourhood resources network outside Portland, Oregon several years ago.

For more information contact: Johnson-Lenz, 695 Fifth Street, Lake Oswego, OR 97034.

PANALOG.

Started December, 1977. An informal group of information scientists based at General Telephone and Electronics Laboratories in Waltham, MA. Contact: Ed Houseman, GTE Labs, 40 Sylvan Road, Waltham, MA 02154.

Housman used excess computer time on the GTE computer to establish his own informal computer conferencing network. Members of the network, mostly members of the American Society for Information Science, have used it as a research bulletin board, for entering messages and responding to them, on the subjects of information theory and the office of the future.

Informal networks for the deaf and for teenagers were also set up on the same system. It was written up recently in the June, 1978 issue of *Basis,* the Bulletin of the American Society for Information Science.

ADVANCED COMMUNICATIONS SERVICES (ASC).

Nationwide. Subject to FCC approval.

"Pinwheel" being enjoyed by preschoolers in Columbus, Ohio on QUBE, Warner Cable's two-way cable TV service. "Pinwheel" is made up of original videotaped segments featuring puppets, mime, music and dance. "Pinwheel" will by distributed on Nickelodeon, Warner Cable's young people's satellite network, to cable TV operators.

Proposed by Xerox. Contact: Sandy Lanzarotta, 701 South Aviation Boulevard, El Segundo, CA 90245.

Xerox and AT&T are both proposing data communications networks on a grander scale than phone lines or private wire networks. Trade magazine *Datamation* described ACS as a giant amoeba, swallowing smaller networks in its path.

ACS signals would travel over a network of cable and switching computers; XTEN would use satellites to transmit radio frequencies of 10 gigahertz, near the electromagnetic border between radio waves and micro waves. Both propose elaborate systems which would accept many different types of terminals and computer hook-ups, provide electronic mail and conferencing, rent computer programs and store data.

XTEN would also transmit voices and facsimile documents. Both are aimed at businesses, which would establish their own closed sub-networks within the larger system, but both ACS and XTEN could be adapted to home use and presumably would be if there were enough demand.

Anti-trust regulations may prohibit ACS, because AT&T is not allowed to sell data processing. It is also not certain what effect XTEN's radio waves would have on public health. We found no non-technical articles about these systems, but trade magazines like *Datamation* and *Infosystems* have reported on them since last summer.

Regulatory questions

THE EMERGENCE of computer networks puts the Federal Communications Commission in the middle of a complex tangle of regulatory questions, including the uncertainty of its own survival. The 1934 Communications Act, which created the FCC, separated regulation of broadcasting from that of telephone communication, a decision evolved from the conflict between rail travel and the telegraph in the 1800's.

As computers developed, The FCC chose not to regulate them at all; and new digital technologies threatened the AT&T monopoly over person-to-person communications. Now the FCC is faced with the problem of defining what is communication and what is data processing.

According to Gary Rosch, an attorney with the FCC's International and Satellite Branch, FCC commissioners are concluding an inquiry into the relationship between computers and telecommunications. Their intention is to encourage competition and restrict communications networks from dominating computer services.

Based on this inquiry, the commissioners will decide which FCC-regulated computer/communications systems can offer which types of services. At stake is the choice between one, centralised communications system, or the growth of many smaller overlapping and competing networks. In the meantime, the Communication Act, currently being re-written, could abolish the FCC or reorganise its powers entirely.

The future

Willl computer networks make people happy? Their eventual effect on people and society is not certain, but there are some preliminary observations:

☐ Despite the enthusiasm of proponents, there's lots of doubt that the public is interested enough in two-way electronic networks to spend much time or money on them. No consumer computer network has yet shown signs of being a great commercial success. However, networks which see themselves as alternatives to "commercially generated and corporately controlled information" (*Community Memory* brochure) hit pockets of enthusiastic response from people who are not satisfied with the straight media.

☐ Lots of electronic mail ends up being as personal as face-to-face talk. People form friendships, have arguments, crack jokes. Good writers and more literate people have the same social advantage that good looking people have face-to-face.

☐ A two-way videoscreen is not nearly as hypnotic as one-way TV, because communicating back requires rousing oneself from the video trance.

☐ The old problem of computers being more exact and consistent than people makes it hard for people to find specific information sometimes. No index system can anticipate all the ways people can refer to something. Peter and Trudy Johnson-Lenz, researchers on the EIES network, suggested the developing information shepherds — a cross between directory assistance operators and reference librarians, who keep the indexes coordinated and direct people to the proper keywords.

☐ People get overloaded with electronic information because access to it is so easy. One response, proposed by Johnson-Lenz, is programming one's terminal to sort through the incoming mail/data anddisplay the most important stuff first. Another response is not using the system so much. People who belong to more than one network often find it hard to keep up.

☐ Uneducated or disadvantaged people may be deprived of opportunities if they cannot get access to terminals or learn how to use them. However, if they do get access, much of the subconscious prejudice against minorities, women, the young and old, disappears.

☐ Words and numbers are easiest to translate into digital signals; but the following can also be transmitted through computer networks with the proper terminals: music and sound, line drawings, half-tones, video, animation, mechanical vibration and fdacsimile reproduction.

☐ There is a great potential in commercial networks for substituting interactive video experience for "real life." Thus far, however, we have not found any examples of anyone who has done this.

Computer paranoia cuts both ways

by Dirk Hanson

A REPORT COMPILED for the business community by Stanford Research Institute's Business Intelligence Program says: "The reason (distributed processing) computer networks will not be available to the general public at an earlier date is primarily one of security. **At present, fraudulent input or access to a data base management system cannot be prevented."**

This is a vital piece of information that the industry does **not** want you to know. There's this security problem. Large, flexible time-shared computer systems are Swiss cheese. Ask a programmer. Computer crime is a growth industry. Computer security is a myth. For every new data encryption system, there's a programmer out there somewhere who can crack it. A program that sneaks you into an operating system is called a Trojan Horse. At most computer centres, the Trojan Horse is already inside the gates.

Some grim worst-case scenarios might just be floating through corporate corridors these days. Striking British civil servants recently turned off key government computer systems, and the result was chaos. Some of the information and assets probably will not be recoverable. The strikers simply pulled the plugs. Crude, but effective.

But what about the likelihood of more sophisticated guerilla tactics, as computer know-how spreads throughout the populace?

Quite a quandary for industry people: they want you as a customer, but can they trust you? They need to sell you computers and teach you the mechanics of programming, but they don't want to let you **too** far into the distributed processing loop. They need your business, but they're scared of you. No kidding. As time goes by, you could become too smart for their own good.

Computer paranoia cuts both ways. The industry may be nervous about widespread consumer participation in future networks, but it seems much less concerned about consumer privacy abuses in current systems.

It's common knowledge — at least it **should** be — that information which goes into such sytems, information about you, your habits and activities, information from which your preferences can be deduced, is accessible to almost anyone. Credit records, criminal records, medical records, driving records, financial data — the whole gamut. Right now, most of it is fair game.

It's a muddy affair. Who decides who gets access to what? There's reason to be wary of controls and limitations on access to digitized information, and equal reason to worry about what will happen if there are no such controls. The deciding **in theory** will be a sociopolitical matter; the accessing **in truth** will be by those who know how. And the **what** being accessed will be almost everything.

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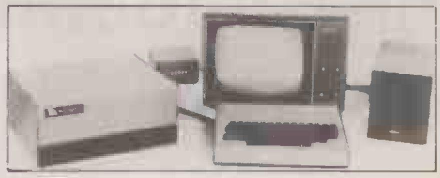

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The Randomiser

by John Abbatt

A decade after Hunter Thompson, a new menace presents itself at the portals of America's capital of gambling, Las Vegas. But this time the fear and loathing is on the side of the organisation. For the Boy who came to the casinos had the key to the machines . . .

THE GAS restrictions dragged the speed of the Greyhound bus down to 40 mph, so that the long haul from San Francisco to Las Vegas became even longer. For the last hundred and fifty miles it beetled its way across the burning dust plain of the Nevada Desert, compressing the passengers in air-cooled boredom.

As Westerners will, they exchanged endless biographical detail with one another; some slept awkwardly; and the three Chicano youths on the back seat took it in turns to slip into the can to smoke a joint.

The Boy sat by a window; to his right, a heavily-built Caucasian in a smart lounge suit had wedged himself. He rapidly tried to strike up a conversation and revealed himself to be a Latterday Saint.

The Saint had realised the possibilities of the bus network as a means of cornering potential converts. He had taken a month's bus pass and spent his days and nights criss-crossing the long-haul routes, handing out tracts and sermons, and collecting names and addresses.

He soon realised that the Boy would be a hard nut to crack. He answered all leading questions monosyllabically and, when handed his first tract, turned it over instead of at least pretending to read it. On the back he copied the number from his baggage check and then covered the page with small, neat calculations.

"Them looks mighty fancy sums, boy," persisted the Saint.

"I'm randomising," said the Boy.

At Las Vegas they all alighted, gasping as the 118°F heat struck at them. The Boy reclaimed his backpack, walked into the terminal building and stood in momentary indecision.

HE was fair-haired and compact. He had steered his adolescence through the twin hazards of acne and obesity, and had emerged into his twenties with a muscular figure and a face more rugged than handsome. His T-shirt, crumpled by the journey, bore the faded legend "I FINALLY GOT IT ALL TOGETHER. NOW I DON'T KNOW WHERE TO PUT IT," and the machine-frayed bottoms of his cut-downs clung limply to his perspiring legs.

He took in the interior of the building. It was very crowded. The gas shortage was wrecking the schedules and the belligerent Pinkerton Securiman, job-selected more for bulk than brain, had difficulty in keeping order among the human flotsam that littered the lounge.

"Excuse me, but I have to make a phone call. Could you change two dollars into quarters for me?"

SHE put down her huge case behind him. The overall beauty almost struck him dumb. She had very little make-up and a simple cotton dress and sandals. The skin had a natural golden glow indicating distant origins south of the Rio Grande.

He found the coins for her and she thanked him.

"Could I ask you another favour? Would you just keep an eye on this case for me for a few minutes? I just got in from Provo."

There was no man alive who could have refused her.

She was back five minutes later. "Thanks. They've cancelled the San Diego bus so I had to let my folks know I'm staying overnight. Have you any idea how to set about getting rooms in this town, I've only got 35 dollars?"

He smiled at her. "I was just figuring out the same problem. Maybe we could share a cab and try to sort something out."

She paused and looked at him a little more closely. Evidently he passed some sort of test for she held out a slim, golden hand.

"Donna Marelli," she said.

He took it. "Jay Waleski."

She gave a little squeeze, which did something electrical to his nervous system, and somehow they had made a contract.

The motel clerk was part Chinese and he had 90% of his attention focussed upon a TV baseball game. He flicked a glance at them.

"One double forty-five dollars."

Jay opened his mouth to speak but then caught Donna's eye. She gave a little shrug of acceptance.

It was a typical Vegas motel room. Smart furniture, a king-sized bed seven foot square, a huge mirror on the opposite wall and a shower large enough for two. The air-conditioner was turned up to the point of discomfort and Jay adjusted it.

DONNA'S face was dimpled in concern. "I don't know what you think about taking a double, Jay. I don't want you to get the wrong ideas about me. It's just that I can't afford a single room."

"Don't worry about a thing. This bed's so big it might as well be two singles," he reassured her.

As they unpacked they talked. Her folks ran a San Diego restaurant and she was on her way back from visiting relatives in Utah. She was in her last year at college and beginning to think about possible careers.

Jay said very little and only half-listened. The voice, the face, the innocent brown eyes and the tinkling laugh simply mesmerised him.

"I've never been here before," she said. "I'd love to have a look at the town but I don't think it's the sort of place a girl should wander around on her own."

Jay paused and thought before answering. "Well I'm going to go round the casinos myself. Would you like to come along and help me?"

"Why that would be great, Jay, but I don't want to put you to any trouble."

"No, another pair of hands would be useful. I must tell you why I've come here: I think I know how to beat the slots."

She laughed again, not unkindly. "Isn't that what they all say, Jay?"

"NO, let me explain. You have to understand how they work. The pictures of fruit, the bells and bars are set on four reels which spin round and then stop to produce a random result in front of a window. There are inertia and timing devices which activate small magnets to apply a break to each reel. The thing is that they are electro-mechanical so they can never be truly random. If you write down all the results, eventually you can pick up a pattern and start predicting them.

"Last year some guys hit upon the idea of using computers to detect these sequences. They would take a hundred turns on the handle and make a note of the results. Then they would take it back to a portable computer at their motel and it would print out the full sequence. That way they could go back to the machine and start predicting the jackpots.

"Pretty soon the casinos guessed what was happening so they got together to find a solution."

She nodded. "You mean they bought them out or threatened them?"

"No — it was too widespread by then. They had to change the machines to make them more random and they hit upon the idea of fitting microprocessors to generate random numbers and


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operate the reel brakes. They are actually cheaper to make and the machines last longer and need less maintenance. I suppose all this sounds a bit technical to you, Donna."

HE had provoked the first flash of anger from those eyes. "I know I'm a girl, Jay, but I did get good grades in maths and sciences. You still haven't told me how you are going to beat the system."

"Sorry. Well, you see the microprocessors all use a randomising algorithm that I originally designed. When I was at Stanford I decided to make random number generation my thesis. No-one else wanted it as it didn't seem to have career potential. They were wrong; it has uses in balancing ship loading, storing data, cryptography and of course gambling.

"I took randomising theory a lot further than anyone had before. When I graduated from college I started freelancing and it wasn't long before I was selling algorithms to some of the microprocessor firms in Silicon Valley.

"To shorten the story, the guys who were using one of my algorithms in the micros for the new slot machines broke contract with me. I should have had a percentage on every micro installed, but they got me on a technicality and I didn't have the money to sue them.

"So now I figure to take back what they owe me direct from the machines, and maybe some more besides. There is no theoretical upper limit to the amount of money I can get in this way."

Donna opened her mouth to speak again but he cut in. "I know I still haven't explained how. Well look at this."

He reached into the side pocket of his backpack and removed a bundle of cloth. Then he unwrapped it carefully to reveal a machine resembling a hand-held calculator.

'So now I figure to take back what they owe me direct from the machines and maybe some more besides. There is no theoretical upper limit to the amount of money I can get in this way.'

"I've got one of the micros in here. They gave me this special version to do the testing: it's programmable. The way it works is that it starts off with a four-digit number, 2468: they all start the same. The first guy who uses this machine pulls the handle and activates four hundred successive randomising calculations while the reels are spinning. At the end they come up with an eight-digit number which determines the points at which the brakes will operate. For the next go, it takes alternate digits from the last number and randomises on those, and so on.

"Now the important thing to know is that on the back of each machine there is a visible sequential counter. It clocks up one for each use of the machine. By taking successive readings of this you can work out how many times the machine has been used. You can work out how often to empty them and service them without opening the case.

"You see what that means? I know the original base number and how many times that the randomising module has been used, and I have a cross-check to the symbols actualy displayed in the window. I key these facts into the micro, run my program, and it produces two numbers. The first is the number of goes to the next win; the second is the yield."

Donna shrugged. "Well all I can say is that it sounds great the way you explain it but I'll wait until I see it work."

"There's just one thing you ought to know. Attempts have been made to get this machine back off me. They offered me $1000 then $2000. Then my apartment was broken into and four nights ago a truck nearly ran me down. That's what made up my mind for me; but it's just possible that they could catch up with me here and I don't want to put you in any danger."

She turned on her smile easily. "Well it sure sounds a lot more exciting than going to San Diego. Come on Jay, they use women as mascots in this town I believe, so let me be your luck."

THEY took turns to shower discreetly and change into clean clothes and he told her about randomising with the warmth and enthusiasm that overtakes a man turned on to his consuming speciality. He told her of all the diseases that afflicted randomising algorithms and made them start repeating themselves. He explained about looping, about function decay and centre-square regression.

He told her that most randomisers made the mistake of operating in decimal, but he had chosen binary because it was simpler and faster. He described the principles of introducing sign bits and parity bits and clock cycle interrupts . . .

She nodded and made encouraging noises and he was still in full flow until they opened the door, walked out to the Strip, and the heat nearly felled them to the sidewalk.

The sign on top of the Sahara lit up and said "15.30" then it went out, lit again and said "1170".

IN spite of the searing heat the town was very much alive. The big casinos stood like sentinels spaced out along the wide road, with no pretence to modesty. Each attempted to outdo the other in signs, in decoration or in sheer vulgarity. Gas-hungry cars sped along the roads vying with taxis and buses. Women plied for trade from the shadows and entrepreneurs thrust vouchers into the hands of passers-by which offered free drinks, free long-distance telephone calls, free food, even free money. Anything as long as you stepped across the threshold into the casino.

In fact the visitor had little choice, for the best food, entertainment, hotels and above all air-conditioning could only be had in these concrete oases.

Jay and Donna needed no inducements, but picked their way from shadow to shadow and entered the Sahara, stopping stunned inside the entrance.

He had read about it, seen pictures of it and knew what to expect, but anticipation did little to blunt the initial impact of that sight. The vast, windowless room twinkled with flashing lights and throbbed with the click of roulette wheels, the calls of the blackjack operators, the satisfying crunch as the handles were pulled on the slots, and the raucous bells which sounded each time that a jackpot came up, which was about every two minutes.

There were thousands of people in there, lost in a gambling-induced, adrenalin-charged mesmerisation. They stood with paper cups full of money, sometimes playing several machines simultaneously. Eating, sleeping, the value of the money they were using, all were lost in the fascination of the spinning reels. In a few decades, the machines had evolved to appeal simultaneously to all of the senses, and more subtly to all of the deadly sins. The percentages were finely balanced to produce an adequate profit but to provide sufficient yield to entice in the next coin.

Donna nudged him back to reality. "Where do we go?"

He wished that he knew the answer. As his eyes adjusted he scanned the area where bookmakers took bets on racing, baseball and any other sport that was being projected live onto huge TV screens, past the roulette tables where elegantly dressed, slim women egged on enthusiastic business men, and swarthy, obese men with bejewelled fingers pushed fifty-dollar bills into table slots and measured out glittering plastic counters. Then he saw them, a bank of about fifty of the new machines, at the far end.

They changed five dollars into quarters and rattled the twenty coins in the bottom of a paper cup, an insignificant drop in the tide of money that was flowing past them.

THEY evolved a routine. He would stand near the back of the machine and key the number from the counter into the micro concealed in his palm. She would call out the symbols on display from left to right and he would mentally convert them into numbers and key them in as a cross-check. Then he would run his program and the LED display would show two numbers. The first machine gave 16 and eight. It would give an eightfold return in sixteen goes, a 100% loss. They worked their way through the next five machines and struck gold on the seventh. It was going to jackpot in five goes with a 200 yield.

He was tempted to take it but took a grip on himself and passed on. The place was well-scrutinized by concealed cameras by the uniformed staff and quite possibly by many well-armed and alert employees posing as customers. They would soon be on to them if they did nothing but win jackpots.

The next machine promised a yield of 25 in five goes, a 400% safe profit. They took it and it worked. Donna stared in disbelief as the coins cascaded into the tray on the fifth pull. "We just made five dollars, I don't believe it."

He squeezed her hand. "'Oh ye of little faith'; let's take them."

THE logistics soon became apparent. It took two minutes to assess a machine, on average every fifth machine was set for a profit, and the average profit was five dollars. However the machines were fixed with arrangements to increase your bet by entering extra coins to gain a corresponding increase in the odds. On this basis they could average forty dollars a win or 240 an hour.

At intervals they took it in turn to visit the change desks to turn the coins into notes which Donna put into her zip bag. They gave it an hour and then moved on to the Silver Bird, followed by the Stardust, the Silver Slipper, the Sands and finally Caesar's Palace. Pretty soon they abandoned the quarter slots and went over to the dollar machines.

He paid off the taxi at midnight and they staggered into the motel room and threw themselves on the bed. Their ankles were swollen, their throats dry and their wrists aching, and they were rich. Pretty soon they started pulling out notes. Donna unzipped her bag and emptied it on the bed, Jay emptied his pockets, and finally they took to burrowing into their underwear, she into her brassiere and he into his shoes, until the cascade of paper finally stopped.

They started counting. "$6249" he announced. "Half of it's yours, Donna."

"No, I won't hear of it, Jay. It's your machine, your idea, all I did was pull the handles for you."

He decided not to press her. "Come on, let's stuff it in a drawer and sort it out in the morning."

Shyly they washed and undressed. He stayed in his underwear and she produced a modest nightdress. They crept into opposite sides of the huge bed.

"Goodnight."

"Goodnight."

It occurred to him that in spite of her attractions and the bond that had been forged between them, not once had it shown itself as any gesture of affection. He switched off the light and two minutes later he was asleep.

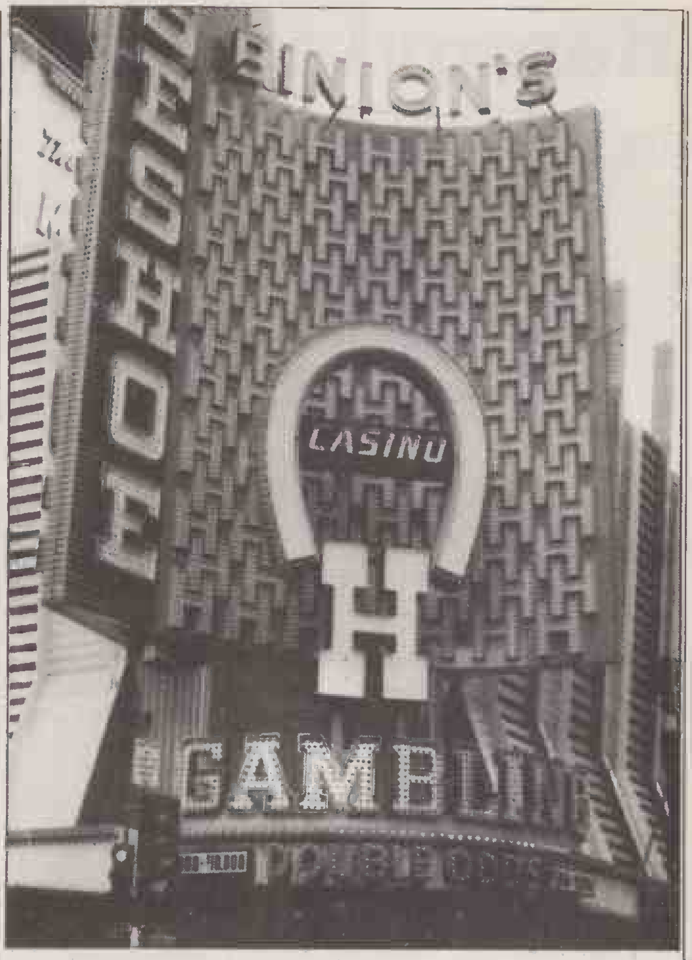
ACROSS the courtyard in the motel office stood a man of monolithic dimensions looking out of the window. The motel clerk was reading a newspaper, tense and sweating, with the equivocal smile of one who knows that the worst may well happen but clings to some inborn optimism that perhaps he might still survive the night in one piece.

The big man pushed him rudely away from the phone and dialled a number. "The light just went out," he said.

A passing police siren woke Jay and he lay staring at the daylight patterns on the ceiling.

During the night something had happened between him and Donna. He had no idea when it had started or how long it had lasted, but she had roused in him elemental passions beyond anything that he imagined that he possessed. She herself had been transformed, the innocence shrugged aside to reveal an undreamt carnality and versatility. He thought that it would never end but eventually he must have slept. He turned his head to look at her. She was gone.

The zip bag was gone and so was the case. Hesitantly he opened the money drawer. Everything seemed to be intact. Then he had a thought and went to the drawer where he had tucked the micro beneath his clothing. There was no sign of it. He pulled the drawer out and emptied it onto the bed. A single sheet of paper floated out with a message scrawled in eyebrow pencil:—



Jay — I hope that for my sake you will destroy this piece of paper but I felt I ought to write a word of explanation to you as I don't want you to look for me. I work for the guys who run the Strip. They can be very generous and they can be very mean. In your case they are generous because they admire a trier. Be sure that you do not see their other side.

We knew you were coming to Vegas and I was waiting for you at the terminal. We have taken the microprocessor. Now you should go someplace else and use your talents in other ways. In return you have over $6000 and of course there was me. I normally rent at $700 a night, so you had the best there is. They are going to wind all of the counters back on the slots so any thought you might have of continuing is hopeless as well as dangerous. Love, Donna.

THE Boy walked into the bathroom and took the top off the water closet. Then he fished out a dripping plastic bag. His back-up device was intact. It was a little cruder than the original because he had had to scavenge a lot of the parts, but it performed the same function. It would need reprogramming. The rows of symbols were visible through the windows of the slots and by keying them in it would be possible to derive the last random number generated and therefore the next sequence.

Donna had been a good actress. But even she had overlooked the fact that poor college girls do not have cases with the remains of Athens and Singapore hotel labels on them. She had not been able to disguise the pale bands on her fingers where rings had been removed. She should have checked that the bus she said that she had arrived on was there. While she had rung her "folks" he had simply ascertained that it was overdue. Finally she should have realised that girls who get off long-distance Greyhounds do not wear uncreased cotton dresses.

There were plenty of other gambling towns in the State. He would start with Reno. As for Donna, she was undervaluing herself at $700 a night. Soon he would find her again and be able to offer much more.

Removing the buttons

by Nick Laurie

TODAY we are suffering a surfeit of combined electronic items typified by the cigarette lighter cum calculator. The future of the microprocessor lies in machines dedicated to one job and operatedby people who are frightened by the word 'computer'.

We already have the combined calculator stop-watch, the tape-recording calculator and the calculating cigarette light. With the continuing reduction in costs, it will become possible to create ever more bizarre hybrids. But is this the real future of the micro-miniaturisation of electronics? And should it be?

The standard question goes something like this: 'But what does it *do?*' To which many personal computer owners will reply 'Anything!'. Yes, it can keep the household accounts straight, it can amuse (or even educate) the kids via the TV screen and, if you want, it can even make the tea for you.

But it can only do all this for *you* and for the few thousand other computer owners who happen to understand something of the complexities of programming: and therein lies an omen for the future . . .

Now, let us digress a little. There are TV games that utilise just a small part of the enormous computing powers of a CPU rather than holding a more limited dedicated games chip. With the addition of a little memory and a cassette unit these can offer a much wider range of games than the dedicated chip version while, at the same time, the manufacturers can offer upgrades by selling software fit only for their own machines.

Of course, it's not called 'software' because the mass market does not want big words with heady implications; in this case, the upgrades are simply described as 'extra games' and they are not sold exclusively through electronics magazines or computer shops but in the Sunday papers and the High Street stores.

Even the fact that these games are operated by a computer is less publicised than formerly — the computer-controlled washing machine is still being sold mainly on its good looks and cleaning abilities rather than because it uses a tiny fraction of a microprocessor's full potential to step its way through a simple program sequence.

Computer buffs

So we have a computer so cheap that we can afford to ignore nine-tenths of its capabilities and concentrate on a few functions only. On the other hand we have a large and erudite group of computer 'buffs', people who are rapidly learning their way around the hardware and software and who are possibly the only large group really able to appreciate the true versatility of the micro.

Now let's have a quick look at some economic facts of life. Semiconductor manufacturers are able to offer us a product that costs very little to make once the very heavy development costs have been written off. These manufacturers tend to be giant concerns (because of those giant R & D costs) and they are not going to make the sort of money they want by selling a few thousand Z-80s at a few pounds apiece; what they would really like are sales running into hundreds of thousands, millions even if that were possible. Alas, there simply aren't ten million potential computer owners available in the market place to mop up their production — but there are many millions of *general* consumers . . .

Pretty vacant

There are two other parties in this developing scenario: the consumer and the software houses. The consumer is now an ordinary person who, in a highly technical society or even a highly technical job, does not usually have the time or the interest or even the need to become a programmer. The software houses would surely be happier if they could treat each piece of work as a one-off job, without the problems of selling and servicing hundreds of separate customers.

So, down to cases.

Peter James is an architect in a small county town practice. He has one partner and a junior fresh out of college. One secretary takes care of all the typing and general duties with the occasional help of a part-timer. Peter spends most of his time designing houses, extensions and does the odd bit of landscape gardening when it fits in.

Talk to him about buying a computer for the office and he thinks of accounting (which his accountant does perfectly well for him at the moment) and cataloguing (slightly more interesting but he is pretty familiar with most of the products he uses anyway) and he ends up with a blank sort of look showing that he has not really mastered the difference between a transistor (a piece of silicon in a tiny tin can) and a transistor (a portable radio). His maths is of the 'A' level variety as he forgot the complicated bits ten years ago and remembers only the material relevant to his immediate work.

Hex is something to do with witches and spells. When faced with one of today's micros he shuddered, looked at the keyboard muttering that he couldn't type and really abandoned all hope and interest when he saw the maze of wires connecting box to box.

So our architect doesn't want a computer. We tried a new approach: 'Here is a machine that consists of a drawing board —'

'— That's more like it' from Peter —

'— and a television screen. Draw on here and it appears up there. You want to change a bit? Press the button marked ERASE and point to the wrong bit with this light pen and away it goes.'

'A sort of electric pen, paper and rubber?'

That's the idea, but there's more to come. Let's imagine you've done a ground plan and a first floor plan and you've picked a site for the client's new house. You're not sure if it's quite what he had in mind. What do you do?

Drawing trees

'I get the junior to draw up a finished version, work out the elevations from a couple of different viewpoints, sketch them out and get him to do a couple of tidy copies, draw in a tree or two and a cat and then offer it to the client.'

And if he doesn't like it?

'Why, do it again!'

And how long does all that take?

'Oh, about a week with luck.'

Okay, back to the machine. Sketch out a ground plan. Never mind the scale drawing; once you've laid out the general lines you can press this button marked DIMENSIONS, point to a line with the light pen, tap in the size on this keyboard here and — see, they all go onto the screen. Do that for all of them then press the button marked SCALE and all the lines wriggle around to produce a perfect scale diagram: any misfits are indicated by a flashing arrow for you to sort out the same way.

'Magic,' says Peter. And this is not the time to contradict him. The consumer at this level doesn't care *how*, only *whether*.

There's more to come still. You wanted an elevation, so press this button marked ELEVATION, up on the screen comes an arrow for you to move around with your light pen, line it up with the viewpoint and you want and press the button again and up comes your elevation. Press the TEXTURE button and you can have the walls filled in and the roof tiled. Button marked CAT will put in your artistic touches to finish off the layout.

Now comes the real time-saver: a button labelled PRINT. Out of the slot comes a perfectly drawn version of the screen picture, cleaner and tidier than anything you could draw yourself. Wrap it up and send it to your client and if he doesn't like it, well, then you'll have to resign yourself to spending another hour at the machine doing another one. How long did you say . . . a week?

'It's not by any chance a *computer*, is it?'

You can actually hear the italics. Hasty reply: No, no, not a computer, it's an *Architect's Drafting Machine;* no programs or flashing lights or paper tapes. It's a straightforward drawing board that couldn't work out your bank balance in a week of trying!

I could hear the sigh of relief. Here was a machine dealing with his own concepts in his own language, and it didn't reflect so much as a sniff of technology more complicated than his own pens, paper and slide rule.

'Still, I suppose it'll cost a bomb.' He sighed again. 'Pity though, a gadget like that could save . . .' A few calculations on his slide rule (yes, they really do still exist) followed by a gasp of astonishment: 'Ten thousand pounds a year — I want one!'

So what would it really cost? Well, this machine does exist today in a slightly different form; it will set you back about £20,000 even before you buy all the extras to make it as versatile as its designers intended.

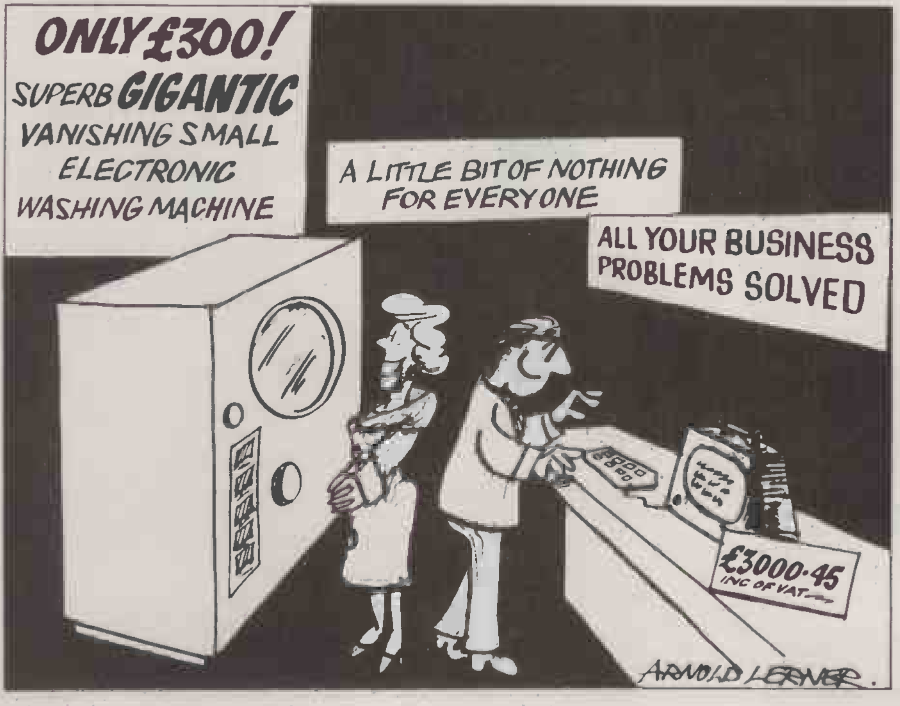
The reason? It's simply too versatile. It can be adapted to be of as much use to a solicitor or a doctor because the designers wanted to cover as many possibilities as they could — after all the CPU can do *anything*.

The real machine of Peter's dreams will be a totally dedicated system useful only to an architect. So let's look at the costings on a dedicated drafting machine. A decent processor (about £60), a bit of memory, let's have 32K to cover most eventualities (around £200) and a floppy disc drive (we're already hearing rumours about the £100 unit), VDU (£50), a digitiser (a bit steep at £500 but well worth the money), a keyboard (£50 should be plenty) and a printer — call the printer £1000 and bear in mind that for some applications it could be a lot more, for others a lot less. The grand total leaves enugh for a pretty plastic case without even reaching the £2000 mark. Then there's the software about which we won't say anything much except that it's on a chip costing all of a fiver, plus the cost of some decent documentation and an installation fee.

It still has to be marketed and lots of people have to make a profit, but even so it still comes out at a good deal less than the junior partner's car, it's all tax-deductible and very appealing at around £3000.

And what have we really done? We've followed the same course as the manufacturer of that TV game we started out with. Instead of going overboard on versatility, we've gone straight off in the opposite direction with a computer designed to perform only a limited number of functions. All we have to do now is count up the number of architects in the world and set out on a giant selling spree before moving on to the next group.

And there is a next group. Hundreds of them, in fact. We could now develop a machine for bicycle designers (same package, same innards, different legends on the buttons!), or a drafting machine for furniture designers, or kitchen designers, or, or, or . . .



Think simple

Then we start off again in a slightly different field from drafting machines. How about a gardening centre? In comes a family to buy a few shrubs: quick as a flash, we sketch out the garden on the screen, whack in a few dimensions, the amount of money they want to spend and their favourite colour (or whatever). A few touches with the light pen in conjunction with a simple keyboard and those bushes are in place. Press a button to see what they will look like in five or ten years' time — all a bit diagrammatic, but quite good enough.

A wipe and a press shuffles them out of the way of the swimming pool the customer hopes to build in a few years' time; another button moves the Scots Pine a little to the left so it does not cut out the sunlight from the living room next summer. Meanwhile, down in the bottom left-hand corner, a running total of the cost changes with each alteration until they have the perfect combination of what they want and the price they want. A last button prints out an order ready to hand over the counter to the sales assistant.

This one can't make tea either, or do the accounts, but it can sell gardening materials! In this case there needs to be a regularly updated link with the catalogue, but it might not be unreasonable to suppose that the major nurseries could be supplying their outlets with a floppy disc update to the catalogue — especially for this sort of use.

Today the jam-spreading alarm clock with built-in electronic cigar-cutter, tomorrow the separate jam-spreader, alarm clock and cigar cutter. The only real hurdle that prevents architects and garden centres from having these miracles is the reluctance of designers to think simple.

As you climb up into your den tonight to add yet another function to your breadboarded micro, just remember this: the machines of the future may well prove to be very much specialist-oriented, designed to do a single job and to be operated by people who know nothing about computers. Think of them as, instead of adding another row of buttons or switches, you remove one!

MICRODIGITAL 1980

Apple II plus

Apple II Plus will change the way you think about computers. That's because it is specifically designed to handle the day to day activities of education, business, financial planning, scientific calculation and entertainment.

· APPLESOFT
A fast, extended 10K BASIC with 9-digit precision and graphics extensions.
· HIGH RESOLUTION GRAPHICS
On a matrix of 280 x 192 individually addressable points.
· AUTO-START ROM
With power on boot of applications programs, reset protection and improved screen editing.
· INTERNAL MEMORY EXPANSION TO 64K BYTES
For big system performance at a low cost.
· EIGHT EXPANSION SLOTS
To let the system grow with your needs

	Nett	V.A.T.	Total
Apple II Plus, 16K RAM	750.00	112.50	862.50

APPLE PASCAL
Apple Pascal is the new extension to microcomputer power.

Pascal Incorporating UCSD PASCAL TM, offers extended features in a complete interactive package employing todays most sophisticated structured programming language. It provides advanced capabilities that boost performance and cut development time for large business, scientific and educational programs.
This software package provides the most powerful set of tools yet available for the microcomputer programmer.

	Nett	V.A.T	Total
APPLE Pascal System	296.00	44.40	340.40

FLOPPY DISCS
Gives your system immediate access to large quantities of data. The subsystem consists of an intelligent interface card, a powerful Disk Operating System and one or two mini-floppy drives.

	Nett	V.A.T.	Total
Floppy disk Subsystem	398.00	59.70	457.70
Second disk drive and connecting cable	355.00	53.25	408.25

Parallel Printer Interface Card
Allows you to connect almost any popular printer to your apple. A BASIC program can produce hard-copy output as easily as it prints to the TV monitor screen. Command interpretation and printer control details are handled by the firmware built into the card, to eliminate user programming requirements.

	Nett	V.A.T.	Total
Parallel Printer Interface Card	110.00	16.50	126.50

Communications Interface Card
Allows your Apple to "talk" (through a modem) with other computers and terminals over ordinary telephone and load programs over the phone, send messages to remote terminals or access your office computer from the comfort of your home.

	Nett	V.A.T.	Total
Communications Interface Card	110.00	16.50	126.50

High Speed Serial Interface Card
Allows Apple to exchange data with printers, plotters and computers in serial format at up to 19.2K Baud.

	Nett	V.A.T.	Total
High Speed Serial Interface Card	110.00	16.50	126.50

apple computer
Sales and Service

Nascom 2

Microprocessor
Z80A 8 bit CPU. This will run at 4 MHz but is selectable between 1/2/4/ MHz.

Hardware
12" x 8" Card
All bus lines are to the Nasbus specifications
All bus lines are full buffered

Memory
On-board, addressable memory:
2K Monitor — Nas-sys 1
1K Video RAM (MK4118)
1K Work space/User RAM (MK4118)
8K Microsoft Basic
(MK3600 ROM)
8K Static RAM/2708 EPROM

Keyboard
New expanded 57 Key Licon solid state keyboard especially built for Nascom. Uses standard Nascom, monitor controlled, decoding.

T.V.
The T.V. Peak to peak video signal can drive a monitor directly and is also fed to the on-board modulator to drive the domestic T.V.

I/O
On-board UART (Int. 6402) which provides serial handling for the on-board cassette interface or the RS 232/20mA teletype interface. The cassette interface is Kansas City standard at either 1200 or 300 baud. This is a link operation on the Nascom-2.

PIO
There is also a totally uncommitted PIO (MK3881) giving 16, programmable, I/O lines.

Character Generator
The 1K video RAM drives a 2K ROM character generator providing the standard ASCII Character set with some additions, 128 characters in all. There is a second 2K ROM socket for an on-board graphics package which is software selectable.

	Nett	V.A.T.	Total
Nascom-2 in kit form	295.00	44.25	339.25
Power Supply ..	24.50	3.68	28.18
Graphics ROM ..	15.00	2.25	17.25

REED RELAY BOARD

Put your Nascom to work with the new Microdigital Relay Board.
· 16 Reed Relays, totally isolated 200 mA, 50 V.D.C. 5W max each. Operate and release time 1 ms (including bounce).
· Single sided, glass fibre board, with gold plated edge connectors and silk screened component layout.
· Plugs directly into Nasbus, does not interfere with normal Nascom operation, all interrupt and D.M.A. Daisy Chain Links carried on. Draws only 250 mA from each of the + and + 12V Rails.
· All components supplied, all IC's socketed, easy to build, and easy to program in Basic or Machine Code.
· Occupies 2 consecutive ports, link selectable — several boards can be used on one Nascom system.
· Output is via front edge connector on 0.1" centres. Uses standard edge connectors for connection to controlled devices.
· Complete manual with sample software.

Applications
· Light displays
· Industrial process control
· Model Railway Control.
· Pre programmed music generation
· Robots, Central Heating Systems
· Stepping Motors
· .....?

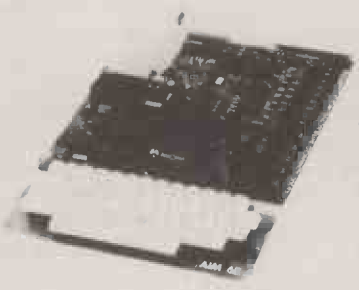
	Nett	V.A.T.	Total
P.C.B. (+ Manual)	15.00	2.25	17.25
Kit	49.95	7.49	57.44
Assembled	60.00	9.00	69.00

Rockwell Aim 65

Thermal Printer
· Wide 20 column printout.
· Versatile 5 x 7 dot matrix format
· Complete 64 — character ASCII alphanumeric format
· Fast 120 lines per minute
· Quiet thermal operation
· Full Size Alphanumeric Keyboard
· Standard 54 key, terminal-style layout
· 26 alphabetic characters
· 10 number characters
· 22 special characters
· 9 control functions
· 3 User-defined functions

True Alphanumeric Display
· 20 characters wide
· 16-segment characters
· High contrast monolithic characters
· Complete 64 — character ASCII alphanumeric format

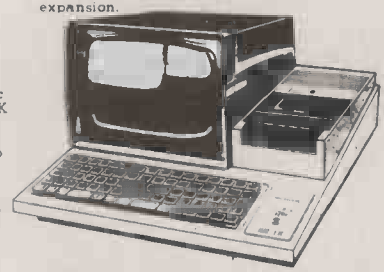
· Read/Write Memory, using R2114 Static RAM devices. Available in 1K byte and 4K byte version.
· 8K Monitor Program Memory, using R2332 Static ROM devices. Has sockets to accept additional 2332 ROM or 2532 PROM devices, to expand on-board Program memory up to 20K bytes.
· R6532 RAM Input/Output-Timer (RIOT) combination device. Multipurpose circuit for AIM 65 Monitor functions.
· Two R6522 Versatile interface Adaptor (VIA) devices, which support AIM65 and user functions



	Nett	V.A.T.	Total
AIM-65 with 1K	249.50	37.43	286.93
AIM-65 with 4K	315.00	47.25	362.25
8K BASIC ROM	70.00	10.50	80.50
4K ASSEMBLER ROM	59.50	8.93	68.43
CASE (includes PSU.)	78.00	11.70	89.70
P.S.U.	41.83	6.27	48.10
MOTHERBOARD	136.50	20.48	156.98

Sharp

SHARP MZ-80K
· Z-80 based CPU.
· 4K Byte monitor in ROM.
· Internal memory capacity from 4 to 48K RAM.
· 14K Extended BASIC.
· 10 in video display, 40 chars. of 24 lines.
· 80 x 50 bit mapped graphics.
· Extensive character set with upper, lower case, graphics etc.
· Full 79 Key Keyboard.
· Built in music synthesizer with 3 octaves.
· Fast reliable cassette unit with tape counter 1200 b.p.s.
· Wide variety of system software on cassette.
· 50 pin bus connector for system expansion.



A complete personal computer system for the microcomputer user, at an economic price. The Sharp comes complete with all necessary peripherals, sample software and excellent documentation — giving the user a personal system of unmatched flexibility and ease of use. At the heart of the machine is the Z-80 CPU — widely accepted as the most powerful 8-bit CPU on the market. A 4K byte system monitor controls system operation. From 4 to 48K of RAM can be resident on board; enough room for the most demanding applications.

An extensive graphics character set, plus 3 octave sound generator and fast cassette unit hi-resolution video monitor complement these basic facilities. It has the ease of use and compactness of "black box" computer combined with extensive peripherals and facilities for expansion.

Sharp Basic occupies 14K of RAM and offers extended features above those of normal microcomputer implementations;

Model	Nett	V.A.T.	Total
6K	520.00	78.00	598.00
10K	540.00	81.00	621.00
18K	620.00	93.00	713.00
22K	640.00	96.00	736.00
34K	740.00	111.00	851.00

Acorn

This compact stand-alone micro-computer is based on Eurocard modules, and employs the highly popular 6502 MPU Take a look at the full specifications, and see how Acorn meets your requirements.

The Acorn consists of two single Eurocards:
1. MPU card; 6502 microprocessor, 512 x 8 ACORN Monitor; 1K x 8 RAM; 15-way I/O with 128 bytes of RAM; 1 MHz crystal; 5V reg 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.

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

	Nett	V.A.T	Total
Kit	65.00	9.75	74.75
Ready Built	75.00	11.25	86.25

Acorn Memory
A high quality fibre glass, through hole plated, PCB with solder resist and component identification, this eurocard has provision for 8K of RAM (2114) and 8K of EPROM (2732).

	Nett	V.A.T.	Total
8K RAM (Kit)	95.00	14.25	109.25

ACORN V.D.U.
The Acorn V.D.U. Board connects to the Acorn Computer Bus and contains memory mapped character storage RAM which is transparently written to or read from, by the C.P.U.

An MC 6845 programmable controller I.C. Provides all the synchronisation signals to drive a 625 line 50 fields per second V.D.U. together with read addresses for the character R.A.M. Characters are then fed to an SAA 5050 character generator IC which produces the necessary dot patterns to create the characters to refresh the V.D.U.

The SAA 5050 produces Teletext standard characters and has Red, Green and Blue drive outputs giving coloured characters or graphics.

	Nett	V.A.T.	Total
V.D.U. Card (Kit)	88.00	13.20	101 20

In Space, no-one can hear you think

Blake7: A space battle game against a simulated enemy. By D. N. Sands

UNLIKE Startrek and similar games for smaller systems, this program has no graphics. The relative positions and speeds of your craft and the enemy craft are presented entirely numerically and in three dimensions, requiring some intelligence and imagination to visualise the actual situation in the void.

The program uses Newtonian physics and this, too, is difficult for some people to grasp. For example, turning your ship about has no effect at all until you fire your rockets.

Some people turn on the rockets and leave them on, resulting in colossal speeds, forgetting that in space there is no friction and you do not need power just to maintain a speed.

Figures are given for three axes.
X-axis: left is minus X, right is plus X.
Y-axis: up is plus Y, down is minus Y.
Z-axis: front is plus Z, back is minus Z.

If the relative position of the enemy (displacement) on the Z-axis is positive, but his relative velocity is negative, then he is in front of you and closing. Additionally, he has components of displacement and velocity in the other two axes.

For clarity the computer also tells you the distance measured directly between the two craft and the true relative speed, ie rate of change of this distance.

If the two craft were side-by-side going in the same direction and one were going faster than the other, the true relative speed would be zero at that time because the two craft are neither closing nor parting.

Also the approach angle measured from the Z-axis, amount of fuel etc — see listing 2.

This is the captain of your ship

The operator is the ship's captain and issues commands to control speed and direction, laser guns, protective shield and fuel regeneration. After each command, the situation is presented as it would be after ten seconds. All data is metric and is realistic.

The program is designed so that the enemy tries to close in smoothly, decelerating at the right time in order to be at low speed when very close in order to board your spacecraft.

Actually it doesn't work too well because my integration algorithm only uses ten-second increments and other shortcomings, but in practice you wouldn't just sit there and the whole dynamic situation is altered by your own movements, and also laser damage which affects rocket efficiency. Damage to both craft is gradually repaired.

When the program starts, it asks for a random number seed 0-9 then for a value (QO) for enemy strength. Enter one for this latter value the first few times you play. If the enemy is losing a laser battle he tried to get away (see line 5405). At this point his rockets are damaged and you can finish him off easily with QO = 1.

With QO = 10 he gets away too easily and it is very difficult to keep up with him as he is constantly changing direction. Then there are two half-pages of instructions and a request for amount of fuel 0-1000 litres. This is another value then can be reduced to make the game harder. Fuel is a limiting factor in a chase. See listing 1.

Entering the program (see listing)

This program is written in North Star Basic but can be easily converted to Microsoft or other Basic. The following should be noted:—

1. If you don't have ELSE then leave off that part and insert one line after an unconditional goto, or for a variable alteration put an unconditional statement one line before.
2. Exclamation mark is North Star shout for PRINT. Microsoft, use question mark.
3. When entering the program take great care. Unlike other Basic listings, this one is next to pure gibberish. If it doesn't work, check every line again, or get someone else to check it. It has been thoroughly tested by many players and works well. I have also written it in Microsoft Basic and proved it works in that as well.
4. The OUT instruction is an optional screen clear for the author's system.
5. If you have North Star and are stuck, then send me a well packed disk with a file ready, 20 blocks long, called BLAKE7, plus stamps for return postage.

D. N. Sands,
Sands Whiteley Research and Development,
Cambridge Road,
Orwell, Royston,
Herts.

```
5 REM 'BLAKE7' SIMULATION GAME
6 REM D.N.SANDS 1979
10 P=3.14159
20 INPUT"ENTER RND SEED 0-9: ",F
30 F=RND(F/10)
40 OUT134,12\REM CLEAR SCREEN
50 INPUT"ENTER ENEMY STRENGTH, 0-5 : ",Q0
100 !"BLAKE'S 7"
110 !"YOU ARE IN A SPACECRAFT AND AN ENEMY CRAFT IS DETECTED."
120 !"IF THE ENEMY GETS TO CLOSE HE WILL DETECT YOU AND TRY TO ATTA
CK."
130 !"YOU THEN HAVE THE CHOICE OF TRYING TO ESCAPE OR TO RETALIATE.
"
140 !"YOUR COMPUTER CAN GIVE YOU THE STATUS OF BOTH CRAFT"
150 !"AND YOU ALSO CONTROL YOUR CRAFT AND WEAPONS THROUGH"
160 !"THE KEYBOARD WITH A REPERTOIRE OF COMMANDS."
170 !"THE COMPUTER WILL INFORM YOU OF MAJOR CHANGES IN STATUS"\!\!
190 INPUT"ARE YOU READY TO PROCEED? ",C$
200 OUT 134,12
210 !"YOU MAY DEMAND INFORMATION AS FOLLOWS:-"
220 !"'DATA' GIVES SPEEDS OF BOTH CRAFT,PLUS VECTORS X,Y,Z ETC."
260 !"'POWER' THEN A VALUE 0 TO 1000 SETS YOUR ACCELERATION"
270 !"'TURN' CHANGES YOUR ORIENTATION: FOLLOW WITH +OR- X,Y OR Z"
280 !"REMEMBER THIS DOES NOT CHANGE YOUR DIRECTION WITHOUT POWER ON
"
285 !"'ATTACK' ATTACKS THE ENEMY WITH LASER WEAPON."
286 !"'SHIELD' TOGGLES LASER SHIELD BUT USES FUEL TO MAINTAIN"
290 !"'REGEN' REGENERATES FUEL SUPPLY"
292 !"HIT RETURN TO REPEAT LAST COMMAND."
295 !"AT EACH COMMAND TIME IS ADVACED BY 10 SECONDS"
300 INPUT"ARE YOU READY TO PROCEED? ",C$
310 IF C$="NO"THEN100
320 X=INT(RND(0)*20000)-10000
330 Y=INT(RND(0)*20000)-10000
340 Z=INT(RND(0)*190000)-95000
345 U2=0\V2=0\W2=INT(RND(0)*100)
350 D=99000\U1=0\V1=0\W1=100\H1=0\P2=.001\P1=0\D$="+Z"\H2=0
355 INPUT"ENTER AMOUNT OF FUEL REQUIRED 0-1000 ",F
356 IF F>1000 THEN 355
360 OUT 134,12
370 !"YOU ARE PROCEEDING AT 100 M/SEC IN DIRECTION Z"
375 !"YOU HAVE",F," LITRES OF FUEL AND YOUR MOTORS ARE OFF"
380 FOR Q=0 TO 2000\NEXT\OUT 134,12
390 PRINT"ENEMY CRAFT DETECTED!"
395 S0=-1
400 GOSUB 5000
420 INPUT"COMMAND? ",C$
430 IF LEN(C$)=0 THEN C$=C1$\REM SO THAT RETURN ONLY
431 REM REPEATS LAST COMMAND
435 C1$=C$
440 IF C$="ATTACK"THEN5500
450 IF C$="REGEN"THEN 600
460 IF C$="POWER"THEN1200
480 IF C$(1,4)="TURN"THEN1300\REM OR 'LEFT$(C$,4)'
490 IF C$="DATA"THEN 400
495 IF C$="SHIELD"THEN 510
500 PRINT\GOTO 400
510 S0=S0*-1\C1$="DATA"
520 GOTO400
600 F=F+25\GOTO400
```

```
1100 PRINT "YOUR FUEL",F," LITRES, POWER=",P1," ",D$,
1110 IF S0>0 THEN PRINT"SHIELD ON",
1120 PRINT
1130 RETURN
1200 INPUT"HOW MUCH POWER 0-1000? ",P1
1205 IF(P1>1000)OR(P1<0)THEN1200
1210 C1$="DATA"
1220 GOTO 400
1300 D$=C$(5,6)
1320 GOTO400
5000 REM RECALC ALL PARAMS FOR NEXT 10SEC
5002 IF D<500THEN5800
5003 N=10
5005 IF D<10000THEN5400
5010 IF D<90000THEN 5040
5020 IF D<100000THEN5070
5030 PRINT "ENEMY CRAFT NOW OUT OF RANGE"\END
5040 PRINT "YOU ARE IN ENEMY RADAR"
5060 P2=500
5070 IF D$="+X"THEN U1=U1+P1/5*(1-H1/10)
5080 IF D$="-X"THEN U1=U1-P1/5*(1-H1/10)
5090 IF D$="+Y"THEN V1=V1+P1/5*(1-H1/10)
5100 IF D$="-Y"THEN V1=V1-P1/5*(1-H1/10)
5110 IF D$="+Z"THEN W1=W1+P1/5*(1-H1/10)
5120 IF D$="-Z"THEN W1=W1-P1/5*(1-H1/10)
5130 F=F-P1/100
5135 IF S0>0THEN F=F-50
5140 IF F>0 THEN 5170
5150 P1=0\F=0\S0=-1
5160 PRINT "OUT OF FUEL!"
5165 GOSUB1100
5170 PRINT"           YOUR SPEEDS:- X:",INT(U1)," Y:",INT(V1)," Z:",I
NT(W1)
5180 H1=INT(H1*9.9)/10
5200 REM POLAR POSITIONING(RELATIVE)
5210 G=ABS(U0-X)+ABS(V0-Y)+ABS(W0-Z)
5220 A0=G((X↑2+Y↑2)↑.5/Z)
5230 H2=INT(H2*9.9)/10
5240 A=(U0-X)/G*P2/50*(1-H2/10)
5242 IF ABS(X)<ABS(U0↑2/A)THEN A=A*2*SGN(U0)*SGN(X)
5245 U2=U2+10*A\U0=U2-U1\X=X+U0*10
5250 B=(V0-Y)/G*P2/50*(1-H2/10)
5252 IF ABS(Y)<ABS(V0↑2/B)THEN B=2*B*SGN(V0)*SGN(Y)
5255 V2=V2+10*B\V0=V2-V1\Y=Y+V0*10
5260 C=(W0-Z)/G*P2/50*(1-H2/10)
5262 IF ABS(Z)<ABS(W0↑2/C)THEN C=2*C*SGN(W0)*SGN(Z)
5265 W2=W2+10*C\W0=W2-W1\Z=Z+W0*10
5270 REM RELATIVE SPEED&DIST
5275 A0=ABS(A0)
5280 S=U0*SIN(A0)*SGN(X)+V0*SIN(A0)*SGN(Y)+W0*COS(A0)*SGN(Z)
5290 D=SQRT(SQRT(X↑2+Y↑2)↑2+Z↑2)
5300 PRINT"  ENEMY CRAFT SPEEDS:- X:",INT(U2)," Y:",INT(V2)," Z:",I
NT(W2)
5310 PRINT"ENEMY CRAFT REL. POSN. X:",INT(X)," Y:",INT(Y)," Z:",INT
(Z)
5320 PRINT"REL. SPEED=",INT(S)," DISTANCE",INT(D),
5325 PRINT" APPROACH ANGLE",INT(A0*180/P)," DEGS"
5330 GOSUB 1100
5335 IF N<6THENP1=0
5340 RETURN
5400 P2=(INT(D/100))+10*5
5405 IF (H2>H1)AND(H2>5)THEN P2=P2*-Q0
```

```
5410 PRINT"YOU ARE UNDER LASER ATTACK: ";
5415 IF S0=1THEN5460
5420 H=1000/(RND(0)*D)
5430 IF H<.5 THEN5460
5440 PRINT" YOU HAVE BEEN HIT";
5450 H1=H1+1
5455 IF H1>10 THEN 6000
5460 PRINT" DAMAGE FACTOR ";H1;\!\GOTO5070
5500 H=1000/(RND(0)*D)
5502 IF D<500 THEN 5560
5503 IF H1>=9.5THEN5570
5505 IF F<10 THEN 5700 ELSE F=F-10
5510 IF H<.5 THEN 5550
5520 H2=H2+1
5530 IF H2>10THEN5600
5540 PRINT"A HIT, DAMAGE FACTOR ";H2\GOTO400
5550 PRINT"MISSED: DAMAGE FACTOR ";H2\GOTO 400
5560 PRINT"TOO CLOSE: COMMAND IGNORED"\GOTO 400
5570 PRINT"LASERS INOPERATIVE"\GOTO 400
5600 PRINT"YOU HAVE KNOCKED OUT THE ENEMY"\END
5700 PRINT"SORRY, NO FUEL."
5710 GOTO400
5800 N=N-1\!"ENEMY TRYING TO BOARD"
5810 IFN>8THEN5070
5820 PRINT"ENEMY BOARDING"
5830 IF N>7 THEN5070
5840 PRINT"UNAUTHORISED PERSONELL IN ENGINE ROOM"
5850 IF N>6THEN5070
5855 PRINT"ENGINES UNDER ENEMY CONTROL-RESET POWER"
5860 IF N>1THEN5070
5870 PRINT"YOUR CRAFT UNDER ENEMY CONTROL"
5880 END
6000 PRINT"-YOU ARE IMMOBILISED"\H1=10\GOTO5070
READY
```

Nuts and bolts fix for the learning process

J. A. M. Howe investigates the practical and philosophical problems of teaching children by model building.

TWENTY YEARS ago, educationists had such an impoverished understanding of human learning processes that they expected to replace teachers with machines within a decade. Today, we are more aware of the deep pedagogical problems that would have to be solved before this task could be accomplished.

For example, when a pupil flounders around unable to start on a new problem, what should the machine do? It wouldn't want to give the game away, so it would wish to hint rather than direct. But how are these hints generated and evaluated? Again, if a pupil gets stuck in the middle of a problem, the system would need to interpret what he had done and provide assistance in tune with the pupil's thinking.

If his difficulty is due to an early error, ought the system to have allowed him to carry on regardless, or ought it to have interrupted his work when the error was made? Indeed, if the error was hidden because the relevant working was not shown to the system, how would the system figure out sensible questions which might reveal basic misconceptions? Given these kinds of pedagogical problems, *and* financial considerations *and* the teacher's traditional dislike of machines in the classroom, we can confidently anticipate that expert systems in the shape of computerised tutors will play a minor role in education for many years to come.

So instead of talking about expert systems, we want to talk about systems which experts, ie teachers, can use as a resource to help them achieve their objectives, eg teach maths, physics, literary style, and so on. The notion, which will become clearer in due course, is to use the computer to simulate a modelling system which a learner can use to carry out model-building experiments.

Building physical models

When the average person hears the word "model", he probably thinks of the kits of parts from which children assemble miniature plastic replicas of aeroplanes, space ships, buildings and a host of other familiar objects. For the moment, we will take advantage of this association to begin our discussion of model building.

Since a toy model captures the essential form of an object, it is a pleasing representation of its *structure*. But a child can also buy the finished product, so why does he bother with a kit of parts? Almost certainly the answer is that he enjoys the activity of assembling the model.

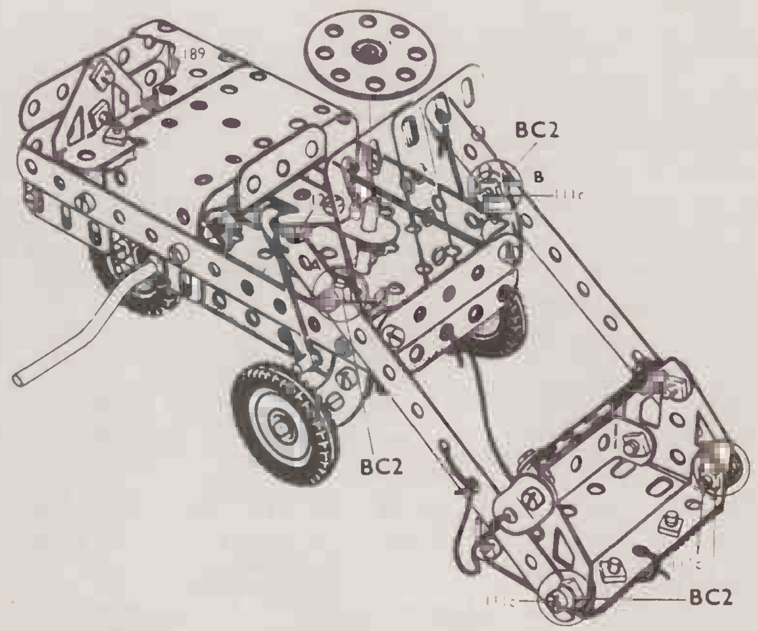
Indeed, a child is often more interested in grappling with the problems of assembling the object from its parts than he is in playing with the final product. What he is engaged in is learning the process of model assembly, which involves such skills as identifying parts and their relationships, and ordering the assembly sequence.

But besides learning to assemble models which represents familiar structures, the child can also learn to assemble models which represent mechanisms. Here we refer to models which simulate mechanisms such as the steering systems in a car or the actuating system for flaps and rudder in an aeroplane.

The advantages of working with these representations of real world mechanisms are two-fold. First of all, working models are more compelling as simulations of reality and secondly the child might come to understand the general principles underlying the mechanisms. Of course, the latter cannot be assumed since a child might simply follow assembly instructions in an unthinking way.

To promote real understanding of mechanisms, there is a need for a modelling system which allows a child to be creative. It should provide him with an opportunity to alter pre-determined models, and even to create his very own models. What we are talking about now is a very different kind of kit of parts: instead of a set of particular components needed to assemble a particular object, we need a set of general purpose components in terms of which a child can conceive a design and execute it.

An example of such a kit of parts would be a collection of electronic components.



The learner has to be led skilfully through 'models' of increasing complexity. Here, for example, are excellent examples taken from the now unhappily defunct Mecanno range. Both figures show bump trucks. Above is a novice's, on the right is the expert's version of the same idea.

These could be assembled into working circuits to a child's own design, given enough knowledge of electronic circuit principles and access to facilities to test the characteristics of the circuits at various intermediate points, since all but their final behaviour is hidden from view.

Another example which may be more comfortable for many of you is a mechanical construction set, called Meccano. It comprises a collection of perforated metal strips, plates, brackets, wheels, axles and gearwheels, and so on, which can be bolted together to form models. To the uninitiated, a box of Meccano parts is a bewildering collection of pieces of metal. Give such a box to a novice without instructions and he can make little sense of the parts: the models which he builds are unstable and the working mechanisms usually stop working as soon as they are run.

The point is that learning to use Meccano creatively and successfully involves a long period of apprenticeship. The size of the task becomes clearer when we identify what a child has to know.

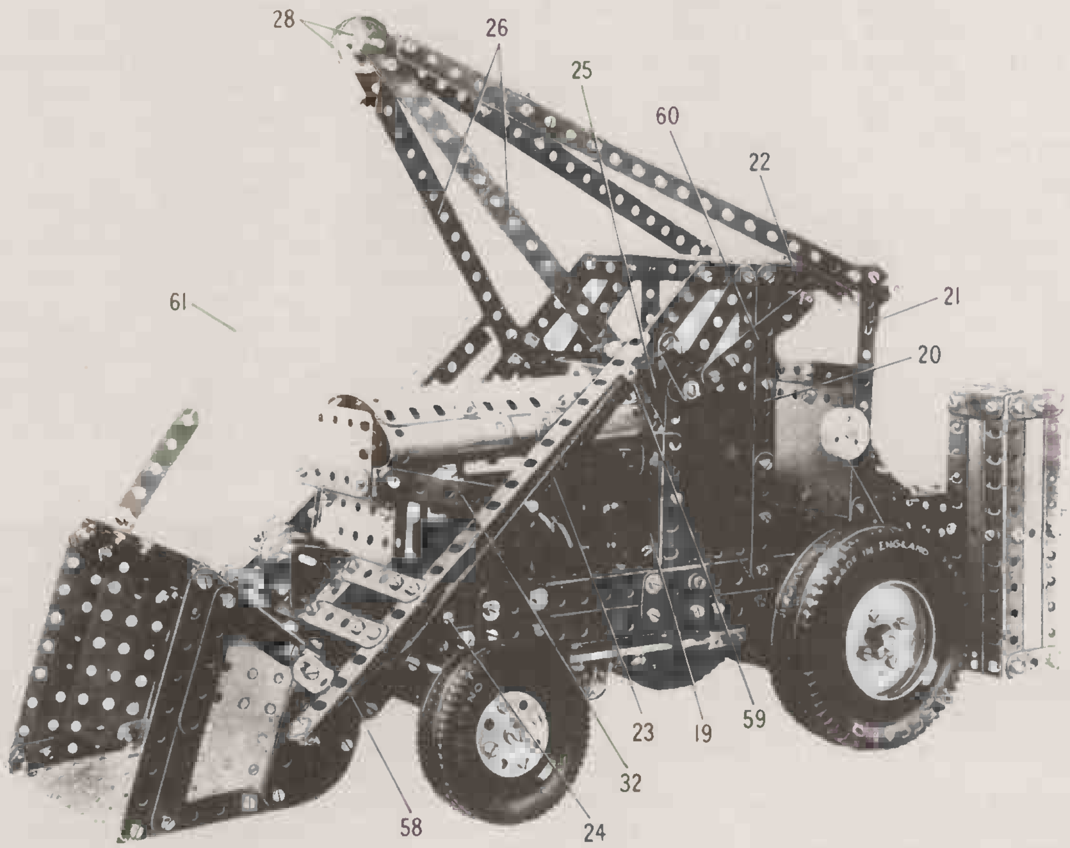
1. He has to become completely familiar with the full range of components, eg strips, plates, tubes, axles, gearwheels, brackets.
2. He has to learn the basic operations for assembling components to form models, eg making measurements, establishing correct relationships between the parts, and so on.
3. He has to understand the structure and the mechanism used in the machine he wants to model so that he can represent their essential features, eg the structure of a mechanical grab and its winding gear.
4. To represent these structures and mechanisms successfully in Meccano, he has to learn to apply important general knowledge about mechanical construction, eg the importance of triangular bracing, the use of plates to provide stiffening, the need for standardisation of parts for interchangeability, the need for alignment parts (tolerance), the need to minimise friction, and so on.
5. He also has to learn how to plan an assembly sequence, involving breaking down the object into a set of sub-parts, eg chassis, suspension, steering gear, final transmission, gearbox, engine, body, etc which can be separately assembled but which are subject to mutual constraints when brought together.
6. Finally, he has to learn to cope with any mismatches which occur between the plan and its execution in terms of the available components, making modifications to overcome problems not anticipated in the design.

So learning to use Meccano creatively is a formidable undertaking, requiring a great deal of time and a great deal of help and guidance. But the manufacturers realised this situation; they organised the teaching most carefully. First of all, they designed a series of Meccano models of objects such as cars, cranes, bridges, and so on, which ranged from very simple models made from a few components wich were but sketchy representations of the real objects, to highly elaborate models, made out of many hundreds of components, which could simulate a working system.

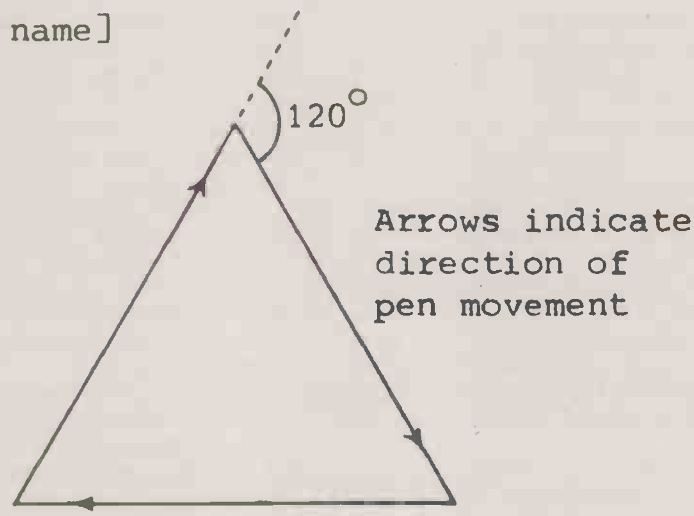
Graded difficulty

Next, they graded these projects into 10 levels of difficulty and made up 10 standard sets of components which could be used to assemble all the objects encompassed by a particular level of difficulty provided the detailed assembly instructions were followed. The manufacturer also provided conversion kits, containing the components necessary to increment from one level to the next one up.

We can see that their teaching strategy was to match the projects to a child's level of expertise in assembly, beginning with a small set of components and a few simple tasks and gradually widening the scope. Such an approach provides the kind of



```
DEFINE "TRIANGLE   [its name]
          FORWARD 500
          RIGHT 120
          FORWARD 500
          RIGHT 120
          FORWARD 500
          RIGHT 120
          END
```



Given a simple graphics program, the computer becomes a mechanism for drawing geometrical shapes — in this case a triangle.

close guidance which a novice needs on being introduced to new skills, new concepts and new ideas. Yet it does allow him to experiment and to be creative.

We can contrast the simplicity of the novice's model with the complexity of the expert's model by comparing the two figures on the previous page both of which depict a Lifting Shovel.

The program as a modelling toy

Can we create modelling systems for other non-engineering domains which will provide similar opportunities to experiment and to be creative? Perhaps the most versatile modelling system is the digital computer. Using the computer as a modelling tool is similar to using a kit of components as a modelling tool because the computing activity centres on using a programming language to describe how some structure or mechanism is made.

The designers of the Meccano system had to decide what components should be provided, and how they would be combined to form meaningful structures and mechanisms. The designer of a computer-based modelling system has to face up to exactly the same problem. He has to decide which instructions should be included in the modelling language, and how they would be combined to form models.

What we are referring to here is designing an appropriate representational system for a particular class of task, eg composing tunes, generating poetry, making drawings. In practice, this is a very difficult problem, and one which is shared by research workers in Artificial Intelligence who are trying to create and experiment with computer-based models of complex cognitive processes like seeing the objects in this room, making sense of the words I am using and understanding the issues I am raising.

Once such a system has been designed, it can be implemented on a general purpose computing machine, converting that machine into a domain specific representational system. This involves writing the domain-specific modelling language which is used to describe the structures and mechanisms, ie processes, in that domain.

Notice that instead of starting from scratch, the modelling language can be written in one of the existing high-level structured programming languages, such as Pop-2 (Burstall *et al,* 1971); Logo (Feurzeig *et al,* 1977) or Smalltalk (Ingalls, 1978). This saves time and eases the process of altering or extending the modelling language in response to modelling needs, but suffers from the disadvantage that the modelling language inherits the host language's weaknesses and limitations.

Since this explanation is quite difficult to grasp, let me illustrate it with a simple example of a representational system for drawing pictures. Suppose the modelling language provides commands which can control the movement of a mechanised pen around a drawing surface, for example FORWARD a distance BACK a rotation , RIGHT a rotation . These commands can be used to make a program which describes the process of drawing some object, for example an equilateral triangle.

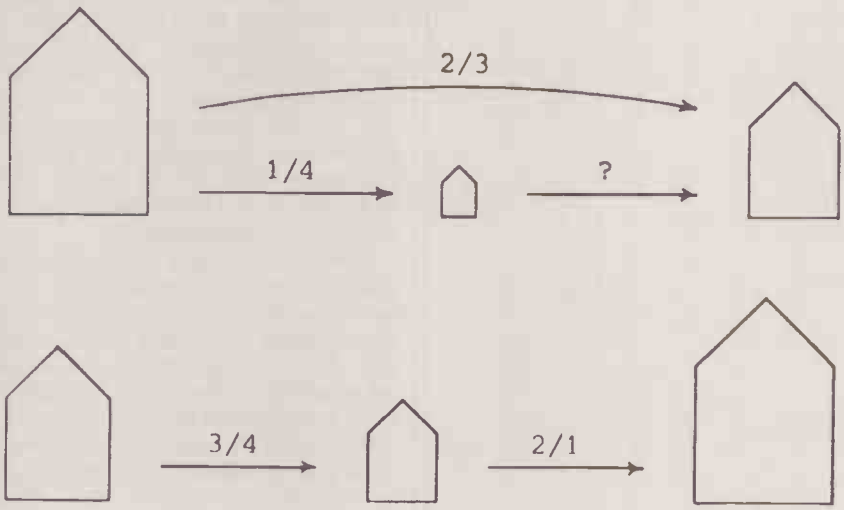
When the description of the process of drawing a triangle is typed in, the computer becomes a mechanism for drawing a triangle. Operating the mechanism, ie running the program, produces the drawing of the triangle. Notice that the program can be stored in the computer's memory, and can be re-used by calling it by name.

Suppose the child wants to draw a house: all he needs to do is break down the house into two components, namely square and triangle. Having worked out how to draw a square in terms of basic pen movements, and having defined and stored the corresponding program, he can define a new object called house which is described in terms of a call to the object named square and a call to the object named triangle.

Defining descriptions

Notice that by defining and storing descriptions, the representational power of the drawing system is being made more readily available. This is like building up standard sub-units from Meccano parts, eg a gearbox, which is used subsequently in a variety of different vehicle types. In fact, instead of expecting children to assemble everything from the basic components, modern Meccano systems contain sub-units like cabs for lorries.

In similar fashion, a drawing system might contain instructions which would invoke pre-defined programs for drawing and the next illustrates $^2/_3$ divided by $^1/_4$,



A triangle and square together make a house: different sized houses illustrate mathematical fraction operators.

unit forms such as the house described above, and that drawing system might become a sub-part of another representational system. For example, du Boulay (1978) uses the change in size of a simple house outline as an iconic representation of fraction operations in mathematics. The picture above illustrates fractional operators.

Acting out the role of the pen

The drawing system described earlier was devised by Papert (1972) to enable children to learn about geometry. Since it is a relative geometry, couched in terms of changes in the heading of the pen, it is easy to use it to describe regular figures. Movements of the pen correspond roughly to a child's own movements through space, so he can try to "act out" the role of the pen to help him work out how to construct a particular shape, or how to correct a drawing that has gone wrong.

Just as using Meccano creatively involves a long period of apprenticeship, the same applies to learning to use the drawing system creatively to find out about geometry. For example,

1. He has to become completely familiar with the basic maths concepts, eg straight line, arc of circle, angle as rotation.
2. He has to learn how to assemble components to form descriptions, eg build procedures; use inputs, counters, conditionals.
3. He has to learn how to plan drawings, eg breaking down a complex drawing into a set of more familiar sub-parts which can be separately constructed but which are subject to mutual constraints when brought together.
4. He has to learn to cope with mismatches between the planned behaviour and the actual behaviour of the program, making modifications to solve problems. This is known as "debugging activity".

To these activities which are primarily concerned with learning the characteristics of the drawing system, and learning to use it to build descriptions of geometrical forms, can be added a third activity, namely using the programs as structured apparatus which can be explored by a pupil in a consistent way to yield new insights concerning the domain being represented.

For example, in the geometry application a child will write a series of programs to describe a range of different shapes. After a while, he is likely to notice that some of the descriptions are quite similar. This finding is likely to prompt him to construct a generalized program which can produce a class of shapes, and to understand the relationships between families of apparently different shapes by experimenting with the generalised program.

Having learned how to write a program to draw an equilateral triangle, he is introduced to the notion of a subprogram and the use of the REPEAT instruction. This makes him aware of the repetition of side and angle, ie FORWARD and LEFT, in his original program, and he defines a new program called TRIBIT which when executed draws one side and changes the heading. Now an equilateral triangle is drawn by a new program which runs TRIBIT three times. It is easy to generalize, and construct programs to draw squares and hexagons.

Drawing regular figures

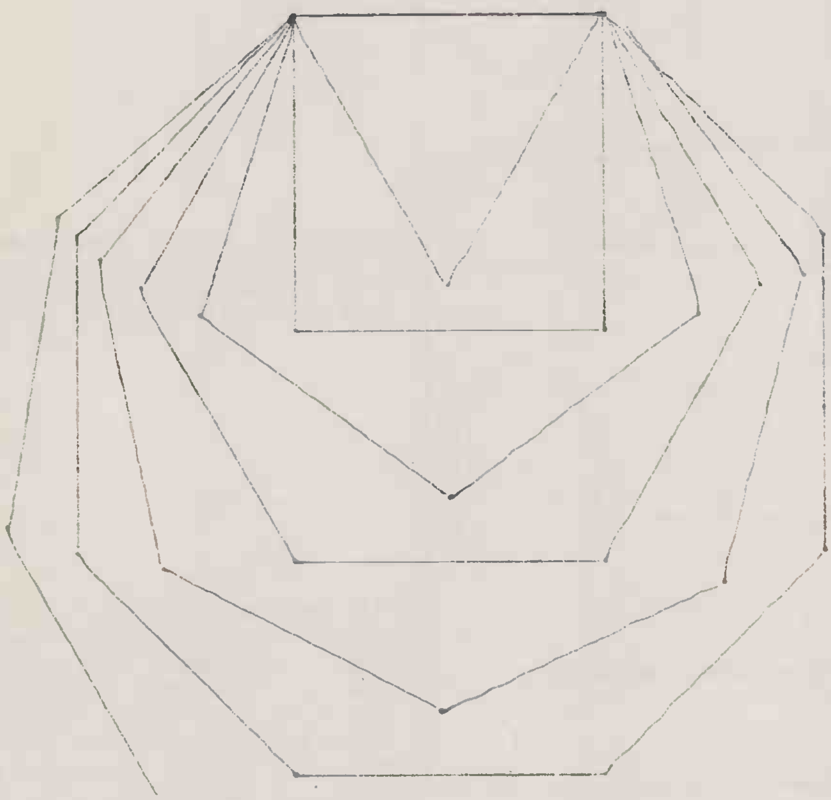
In due course, when introduced to the notion of an input, greater generality can be achieved since the child can define now a program for drawing a range of regular figures. Called POLYGON, it uses a general sub-program called POLYBIT, which is run the number of times specified by the value assigned to POLYGON's input. The value of POLYBIT's input is determined by dividing 360° by the number of sides bounding the shape, eg POLYGON 3 specifies a triangle, POLYGON 4 a square, and so on.

Of course, it would be difficult to use a relative geometry to construct irregular plane shapes. For this, quite a different kind of representational system would be required, namely a system based on the use of co-ordinates and vectors. Working with these would impose quite different demands on a child's understanding of mathematical concepts, and would extend it in very different ways. Besides geometry, representational systems have been developed for a variety of school maths topics (du Boulay, 1978; Howe *et al*, 1979); composing tunes (Bamberger, 1972); orbital mechanics (diSessa, 1975); simple electrical circuits (Boming, 1979).

Relevance to education

In the introduction, we suggested that the child enjoyed the activity of model building more than playing with the final product. This accords with Papert's view

This article is taken from **Expert Systems in the Microelectronic Age,** *edited by D. Michie and published by the Edinburgh University Press in December 1979, price £8.*



Triangle and square are just the two lowest order polygons: the computer building kit will happily draw the rest — until it hits the edge of the paper.

(Papert, 1972) that the programming approach should emphasize problem-solving skills in the expectation that when a child has worked in several different domains, he will recognize the similarities between the methods used to make plans and to debug them.

In this way, he will build up genuinely domain-independent study skills. While not wishing to deny the importance of such skills, others would take the view that these skills can only be appreciated when a person has extensive domain-specific knowledge, suggesting that in the early stages of learning emphasis should be placed on content learning.

Specimen procedure

The point is that the preferred emphasis affects the choice of objective with consequent effects on the way teaching is organized. For example, a highly structured approach has to be adopted if the objective is to teach domain-specific knowledge. In common with Goldberg and Kay (1977), the structure which we favour involves getting a child to learn by providing him with a model in program form which he types in and runs. This is followed by exercises which involve modifying the specimen procedure in minor ways, and finally adapting it to some other problem area.

This approach is followed whether the objective is to teach computational ideas as an aid to building programs (du Boulay and O'Shea, 1976) or to teach mathematics (Howe *et al*, 1979). In contrast to this emphasis on content, other investigators such as Papert (1972) and Dwyer and Critchfield (1978) focus on teaching problem-solving skills. New ideas are learned as and when necessary in the course of solving a selection of problems drawn from different domains.

Given these differences in emphasis, what evidence is there that children learn by bulding models in program form? It must be admitted that at present the evidence of benefit is scanty, irrespective of whether we are talking about content or problem-solving skills.

Dealing with the first of these, in one of the earliest studies Feurzeig *et al* (1969) taught arithmetic and algebra to 13-year-old children, using the Logo programming language. But the participants' scores on a standardised ability test were no better than those of a control group.

In contrast, Milner (1973) reported that Logo programming increased children's scores on an unstandardised test of variables, and Bjork *et al* (1975) describe how programming in Basic improve numerical ability, especially among the less able children. Howe and O'Shea (1978) report marked gains in the mathematical self-confidence of 11-year-old boys participating in a mathematics course based on Logo programming, and more recently Howe *et al* (1979) report that both these boys' understanding of mathematics as measured by a standardised test and their ability to do school mathematics, as measured by a series of unstandardised school maths tests, improved relative to the performances of a more able control group.

Finally, in a case study of trainee teachers who investigated topics in primary school mathematics through Logo programming, du Boulay (1978) suggests that not only did they begin to understand the meaning of many basic mathematical rules, but they also found that they could make enjoyable personal mathematical discoveries by exploring the mathematical representations which du Boulay provided.

Problem solving skills

Turning now to problem-solving skills, there is less evidence of benefit. Statz (1973) records little improvement in children's ability to cope with problem-solving tasks after a year's programming activity. This problem of estimating improvement in problem-solving skill through programming is reminiscent of the problem faced by psychologists like E. L. Thorndike who tried unsuccessfully to collect evidence to support the strongly held belief that learning Latin helps a child to learn to reason. Like learning Latin, the belief that learning to program involves problem-solving must remain an act of faith until evidence appears.

But in the meantime, it would be wrong to conclude that the shortage of evidence supporting the programming approach indicates that it lacks educational value. After all, most educational schemes rest on the teachers' faith in their usefulness, and not on the results of a formal educational evaluation. Indeed, one might be tempted to question the need to produce such evidence to support the programming approach when everyday teaching procedures lack such substantiation.

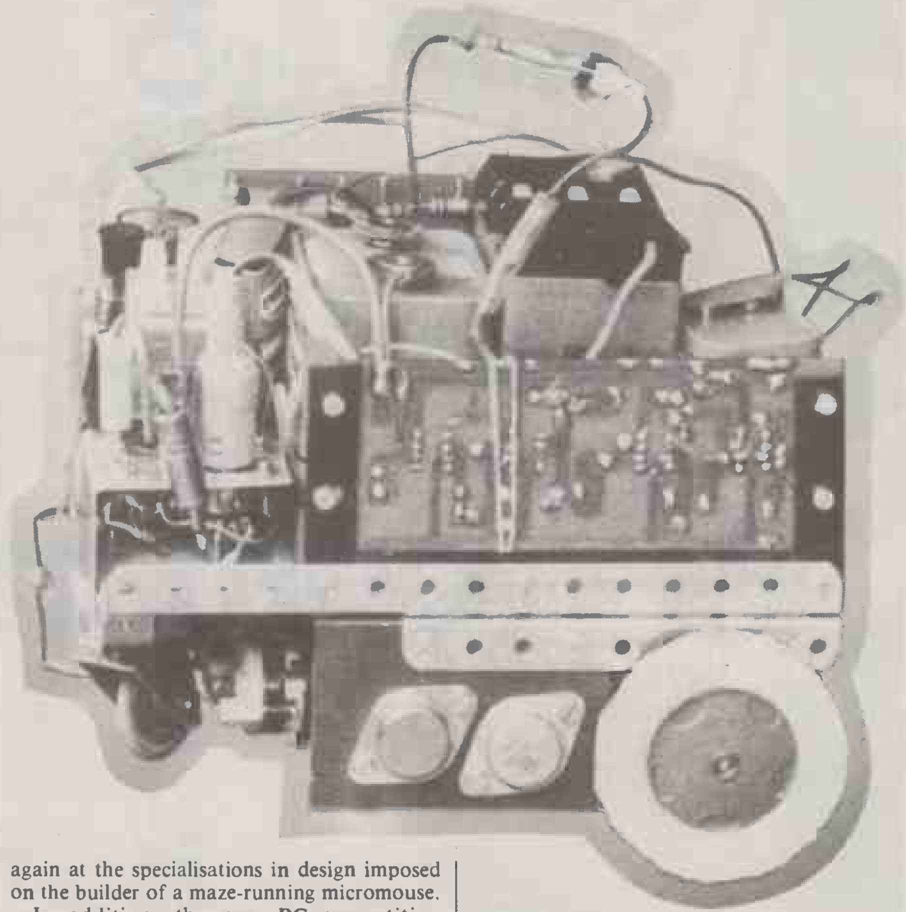
Classroom context

Perhaps the most telling criticism is that most of the evidence available has been gathered in studies by committed investigators. The need now is to try out the modelling approach in educational institutions under the control of the institution's teachers, in conjunction with a continuing teaching programme. Survival under these circumstances is probably the best testimonial of educational worth. Given increased access to computers, we can expect relevant evidence to emerge from studies of the modelling approach in a classroom context during the next decade.

• Circle No. 195

What rough beast, its hour come round at last . . .

. . . slouches towards the centre to be born? With an electronic memory, who needs a ball of twine and a female accomplice? Don't be amazed, there's no bull in our introduction to robotics.



by Mark Witkowski

Practical Computing **and Euromocro invite you to step into the 1980s and design your own robot — sixty years after Karel Capek coined the word. It's a challenge the talented do-it-yourselfer can't refuse. This background article is the first in a series on the science of robotics.**

TWO 'MICROMOUSE' — type contests that were so successful in the States are included in the four sections of the Euromicro — *PC* contest to be held in the autumn of this year.

These will be run under the rules and regulations laid down by the American Institute of Electrical and Electronic Engineers (IEEE) magazine *Spectrum*. A robot 'micromouse' has to be designed and built to run a maze constructed to strict specifications. These rules and specifications are available from *PC*.

In addition to a section in which the micromouse must run the maze in the shortest time, a second section is open to mice that can explore and learn the maze and then use this information to find the optimal path through the maze from the start in one corner to the finish in the maze centre.

This has much to commend it as competitions go; the rules are well defined and the construction of a mouse is well within the resources of most individuals and small groups. Bear in mind that *Spectrum* has been running this type of competition for some years now, so there are already many tried and tested mouse designs.

Allen (78) gives details of just three of the entrants in the 1977-79 trials. These three, the 'Moonlight Special', 'Microbot' and 'Charlotte' recorded times through the maze as low as 51.4 seconds, though several minutes was a more typical time. Each had a microprocessor on board, two had Z80's and one an Intel 8748. Later in the series, we will look again at the specialisations in design imposed on the builder of a maze-running micromouse.

In addition, the new *PC* competition includes a section for 'free-style' robots, and this is a golden opportunty for the robot enthusiast to show some real ingenuity in the choice of robot, its design and design implementation. This first article discusses the various types of robot that have already been built and are in use. From these you should be able to choose some aspect of robotics that takes your fancy.

As you will see, there is plenty going on in one way or another. The rules of the competition are sufficiently flexible to accept equally innovation in the form of a totally new idea or improvements to existing ones. Future articles will be dedicated to a summary of the multiple skills that are needed, with practical hints on how to go about building robots, although we do not intend to provide a 'constructional' design.

To complete a robot project using a microprocessor will involve some mechanical construction, some electronics to interface processor to wheels and monitor any sensors; programming to write the control software; a certain quantity of luck; and not a little perseverance. In terms of the flexibility offered to small 'hobby' robots, microprocessors hold out a considerable improvement over machines that are wholly hardwired.

The most famous of these hardwired automatons must be Grey Walter's *Machina speculatrix* (Walter 53), which showed some interesting, if limited, light-seeking behaviour. Since then, most hobby electronics magazines have produced their own design or designs (eg Brown 69, Brown 71 and Galitz 72, who produced machines called EMMA, ZEE! and Cyclops). The behaviour of such a machine (shown in photograph one) was based on that of the planarian, and its control strategy closely modelled on biological principles.

The dictionary definition of robot is that of a mechanical man, or an automaton with some human-like quality. The word is usually thought to have entered the English language after a play by Karel Capek called *R.U.R. (Rossums Universal Robots)* which was trans-

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lated from Czech in the early Twenties. In Czech the word 'robota' means statute labour or servitude, and is therefore well applied to machines manufactured in human form to do manual labour. As with most fiction concerning robots it is something of a cautionary tale. Interestingly most of the friction between people and robots in fiction results from robots being sufficiently intelligent to be a nuisance. In fact, any current conflict appears to stem from exactly the opposite cause — very stupid robots doing exactly as they are told.

By far the most successful application of robots to date has been their use in industry. For the numbers used, hours of work completed and usefulness, they are far ahead of any other form of robot usage. They are not, of course, suitable for every aspect of manufacturing, but they are currently used in many industrial processes for moving partly-completed objects between stages, die-casting, materials handling and palletisation, machine-tool loading, welding and paint-spraying. Photographs two to seven show a small selection of the many makes and types on the market.

Pick-and-place

Photograph two shows a Unimate 4000-Series pick-and-place industrial arm. It has a maximum reach of nearly three metres, with about 1.3 metres variable, a horizontal sweep of 200 degrees and a vertical sweep of 50 degrees, with a lifting capability of up to 175kg. Typical robot payloads vary from 10 to 100 kilogrammes (from data sheets given in Rooks 72 and also Abraham, Stewart and Shum 1977). The hand of the Unimate is interchangeable for a wide variety of tasks — the photograph shows a sheet-metal lifter.

Photograph three shows a Hall Automation robot with a torch attachment. Photograph four shows a general view of the DeVilbiss-Trallfa paint-spraying robot. The control unit for this robot, photograph five, shows the tape units used to store the sequence of spraying actions ready for playback.

A key (leftmost unit on the control panel, second row down) can either be set to 'Teach' or 'Repeat'. In 'teach' mode, a handle is attached to the end of the arm and the machine is led through the desired sequence of movements by a skilled operator. When the workpiece is satisfactorily sprayed, the handle is removed, the switch turned to 'repeat' and the machine will reproduce the sequence, either as a 'one-shot' continuously or under the command of a switch or photocell that indicates when a new work piece is aligned, ready in front of the robot.

Photograph six shows a pneumatic arm, interesting mainly for its fluid logic controller (photograph seven) — quite a way removed from microprocessor control!

An electric beam arm manufactured by the British United Shoe Manufacturing Co can be raised, lowered and rotated on its vertical pillar as well as moved in and out. The wrist at the end of the arm can be rotated, and the gripper rotated in two dimensions.

Point to Point (PTP) operation differs from that used in spraying or welding robots. These use continuous path — all intermediate points are recorded. A typical control unit would offer in the region of 1024 points or 500 inches of continuous-path operation.

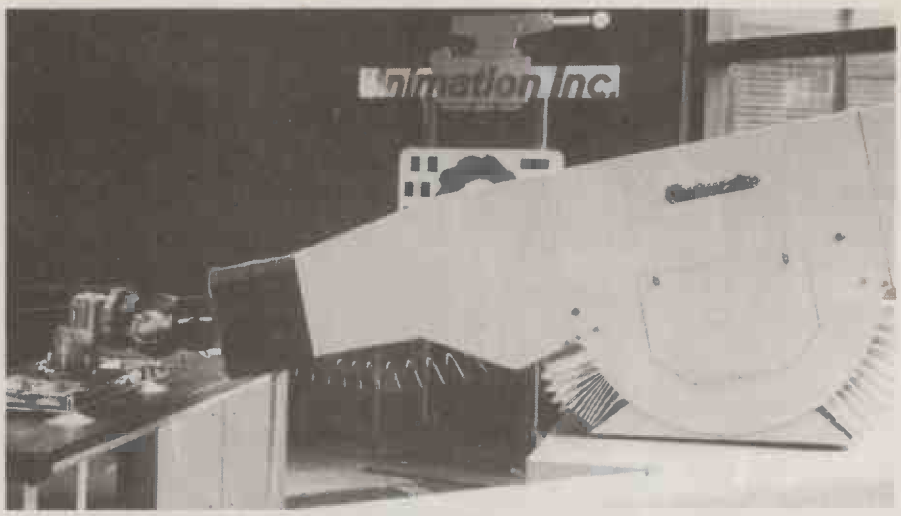

Figure 2: Unimate 4000-Series pick-and-place arm.

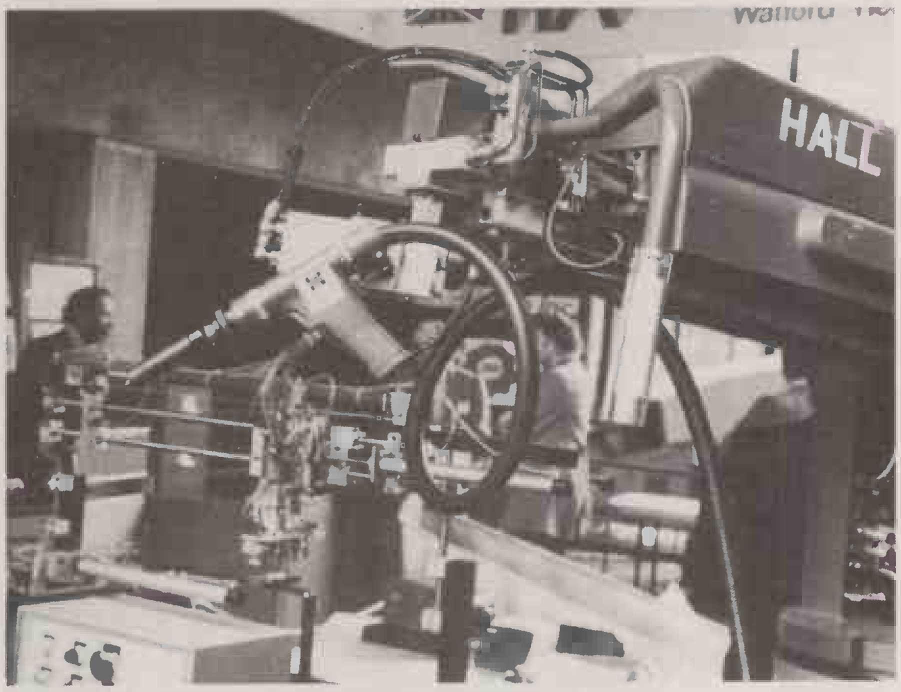

Figure 3: Hall Automation robot with torch attachment.

There are many reasons why robots may be desirable in industry. They find obvious applicability in those industries that are dangerous, or unpleasant for people to work in. Undersea, nuclear power-plants and mining all fall into this category. A robot also remains oblivious to tasks where heavy or hot loads are to be transported, to high levels of noise, or where noxious fumes are present. Robots are ideal where the work to be done is of a highly repetitive nature, requiring no skill from a person, and as a result are undesirable jobs.

Industrial robots are sold as a cost-effective method of introducing a higher degree of automation into processes where the production run is not high enough to warrant the full expense of total 'hard' automation. Robot manufactures will stress the cost savings over either people or specialist machines (Engleburger 79).

Grounds for the introduction of an industrial robot on the factory floor might include lower initial cost than 'hard' automation and lower running costs — than either people or other types of machines. Reliability is good and work-rate predictable. Unimation quote an up-time of "better than 98%". It is versatile too, and can be reprogrammed for other tasks where hard automation would have to be scrapped when the run is finished.

Zermio, Molesley and Braun (79) give a more comprehensive list of robot applications, and review various surveys that have been completed as to why manufacturers actually introduced robots in the specific application of spraying and coating. They also estimate that there are about 8000 robots in industry worldwide, 3000 of them in Japan, 2500 in the USA and 2000 in Europe. Of the European robot-using countries, Sweden and West Germany have about 600 each, although estimates very considerably, and Italy about 400.

The United Kingdom would only seem to have about 70 such machines and is the only country to show a reduction in the number since 1975. Interest in robotics, however, remains high in the UK and in the year September 1979 to November 1980, seven out of 19 international conferences and exhibitions listed in the *Industrial Robot* journal are in England.

As yet, sensing and feedback play only a

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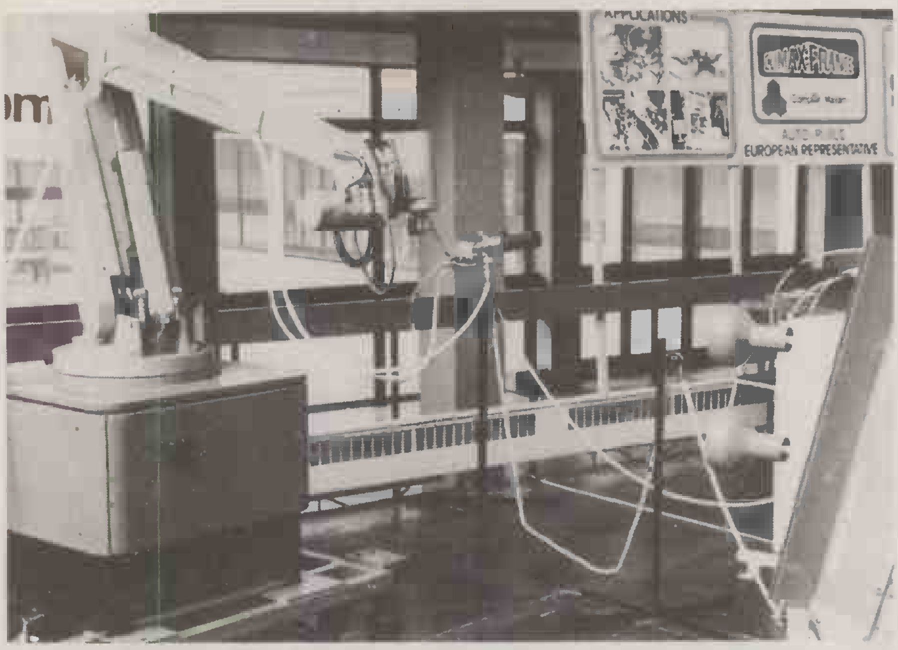

Figure 4: DeVilbiss-Trallfa paint-spraying robot.

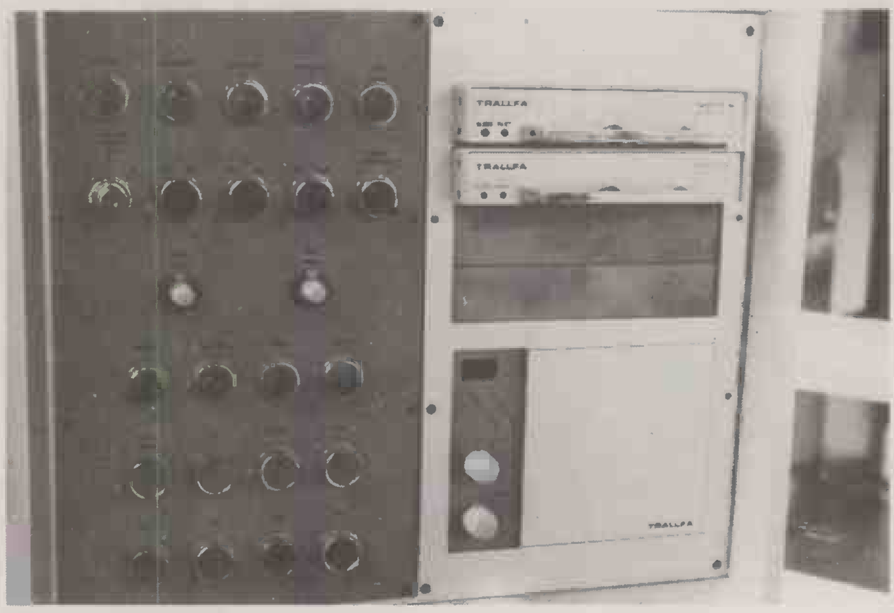

Figure 5: Control unit for paint-sprayer.

minor part in industrial robotics; they may be used either to guide the robot more effectively in situations where the work-piece is presented unpredictably, and increase the safety margins, both for people who work in close proximity to robots and other machines. These sensors tend to be rather fragile and in harsh industrial setting would soon be damaged.

It is also remarkably difficult to design sensors that really do detect all the things they should. Furthermore, the amount of computer power required to interpret this information rises sharply, and programmers with these specialist skills are rare. Wang and Will (78), of IBM describe some work on sensor development that might be generally applicable. Perkins (78), at General Motors, has been looking at the more specific problem of recognising parts used in the manufacture of cars with digitised TV pictures.

Robot 'brains' are now very much the province of the computer scientists, more specifically that of artificial intelligence research. Those of you who are following the current series on artificial intelligence in *Practical Computing* will notice that there is little danger of the 'super-intelligent' machine appearing any too soon to give us all a hard time. This is quite distinct from super-powerful machines being controlled by intelligent men.

There is a growing number of artificial intelligence researchers who feel one of the main limitations to progress in their field is that the only contact the program has with the outside world that it must be intelligent about, and the people it must communicate with, is through a teletype device.

While it is no doubt theoretically possible to input every scrap of knowledge the program must have, in this way it does show a number of major limitations. Apart from being incredibly hard work, it also deprives the machine of many potent sources of information, firstly the ability to process raw data, like that which pours in through our eyes, ears, nose, mouth and skin, and secondly the program's inability to make important correlations between different information received through different senses about the same event.

It is the lack of muscles and limbs that really restricts. These can be used to check the validity of the program's observations, deductions and assumptions. However complete a logical proof appears, the result is still rubbish if any of the axioms upon which it is based is false, or even inapplicable within the context of that proof.

Robots provide the eyes, ears, skin (and any one of a hundred different other senses modern instrumentation techniques can provide), as well as the muscles to move and behave that a *complete* artificial intelligence program will need. We would have no hesitation in saying that an example of natural intelligence would be at a severe disadvantage without these abilities.

There are still relatively few robots involved in artificial intelligence research. Some researchers will not use them on principle, others feel they do not need them; linguists, for instance, have enough problems without becoming involved with all the electronics and mechanics required.

Pre-processed data

Some programs require their data in a highly preprocessed form and in any case would not work fast enough to handle the data rates the real world produces. Even simple sensory systems such as tough and range-finders must be scanned so often if transitory effects are not to be missed that the complete power of a mini-computer can easily be used up just processing this.

When it comes to vision input from TV camera, the problem becomes horrendous.

Consider that a 100 × 100 retina matrix, scanned 10 times a second, which is less than 3% of the resolution of an ordinary television, would only allow two or three machine instructions per picture point on an ordinary mini-computer. It may actually take several hundred instructions per point to analyse the picture properly.

Two projects that used both robots and television input to computers were the Stanford Shakey project, which has been described as the first complete robot system (there is a brief description of the project in Jackson 74). Freddy at Edinburgh University is the second (Barrow & Crawford 72, Ambler et al 75 and Michie 79).

Shakey was a free-ranging robot with a camera that existed in a suite of rooms. Its control was provided by a suite of programs, a specialised vision program, a theorem prover that planned its actions according to pre-set goals, and a low-level controller to convert the plans produced into real actions.

Freddy was a hand-eye system, a manipulator and TV camera that could be used to construct toy models from their parts. Freddy had an interesting construction.

Shakey and Freddy

The gripper was suspended from the roof and could grip, turn and move up and down. A particular object would be selected by moving the floor in an X or Y direction. Both of these projects suffered due to a reversal in government funding policy towards artificial intelligence and robotics in the early Seventies.

One mobile robot we have examined has seen a good deal of service in artificial intelligence research over the past few years. It is hardly as grand as Shakey or Freddy, mainly because it has never been funded properly — even though it has been used by a number of funded projects.

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In one sense this has been an advantage because it was protected from the more abrupt changes of heart by funding agencies. Unfortunately the quality of engineering required for this type of work was not up to scratch for lack of cash.

Over the years, facilities have been added as and when possible, and all the initial problems are pretty well solved. The vehicle has no 'intelligence' of its own. It is just a motorised base with integral power supply (batteries) and a multi-way analogue-to-digital converter. Into these A/D channels are plugged a range of standard sensors, with plenty of spare capacity to add new ones required by any particular project.

Every single action it makes is under the control of one or more computers. Communication is via the thin wire visible in the photograph. In the five years since the project was started it has been interfaced to a wide range of micro, mini and main-frame computers. Programming languages ranging from 6800 assembler to POP-2, through Fortran, C, RTL/2 and Algol-68 have all been used — depending on the preferences and experience of each of the users. This set-up is sufficiently versatile to allow a wide range of robotic experiments to be carried out. These have included such topics as (at undergraduate, post-graduate and research levels) map-building and best-path generation, navigation using only on-board sensors and external coordinate generating devices in separate experiments. Tracking and limited pattern recognition using the 32 by 32 binary camera have been investigated.

Mainstream research

Long-term research has been based on biological modelling, learning by production rule and more generalised learning and problem solving techniques, this latter project forming a complete robotic system. Apart from this, considerable effort has gone into the construction of the human interface end of the business. This includes the design of programming languages, computer systems and inter-computer communication.

Most recently, the mainstream of our research has taken a path more closely aligned with the requirements of man-robot co-operation, with man, robot and computer working as a team to solve problems: robots with their superior strength, accuracy and special adaptions to the task, the computer to analyse data from specialised transducers and for fine control, also to prepare sensory data for presentation to the human in its most helpful form. The man is there to supervise, guide and be prepared for the unexpected.

The current machine is not designed for this and we are busy designing and constructing a vehicle which is a motorised base, with two multi-axis arms and a TV system capable of digitising a 256 by 198 point picture in one-fifth of a second. Computer power is provided by three 64K LSI 11s.

From the amateur point of view, there are many robot designs that could from the basis of a home-brew machine. For the maze contest, the restrictions to the design are quite severe; it must perform a fixed task in a well-defined arena. For a more free-style robot, the first decision to be taken is about the form of the robot.

Close attention must be paid to the mechanical design of an industrial-arm type of robot, but these have been attempted in the home. Most have five or six degrees of freedom and there are two popular configurations. Some follow the DeVillbis-Trallfa paint sprayer, and model the human arm, with shoulder, elbow and wrist, but if you do not have access to a full machine-shop in which to build it, a type which features some combination of cartesian joints that slide the polar ones that swivel (eg the British United Shoe Manufacturing Co) may be more appropriate.

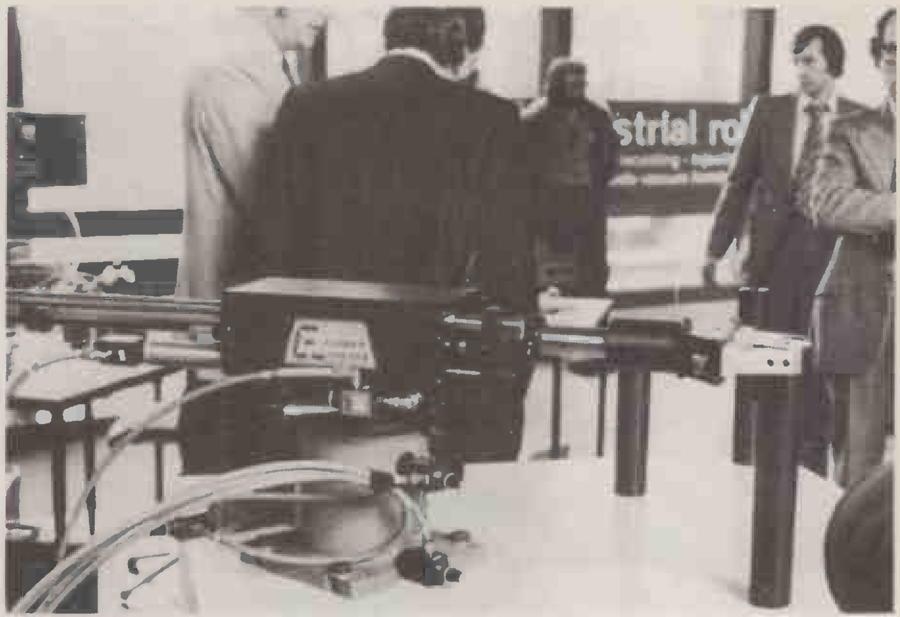

Figure 6: Pneumatic arm . . .

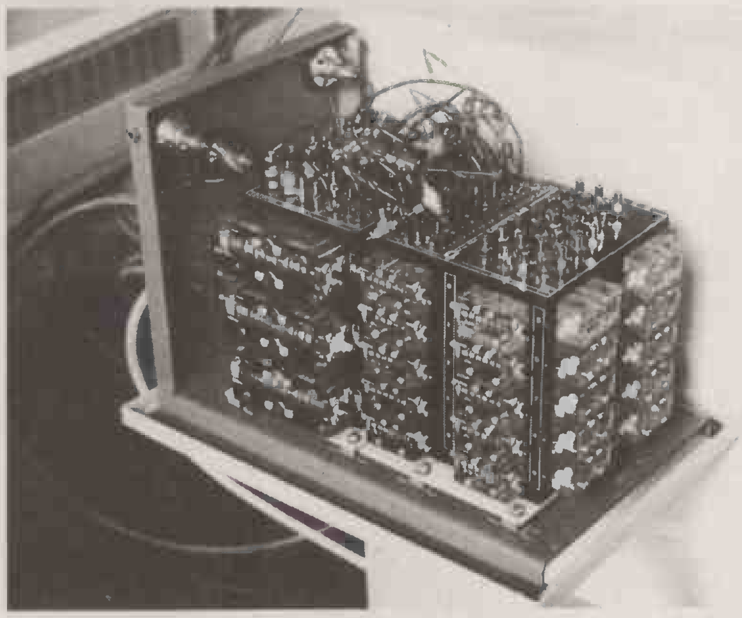

Figure 7: . . . and its fluid logic controller

Electric motors are a useful compromise between power output, availability, controllability and ease of interfacing to a processor. Stepping motors provide adequate accuracy for open-loop control, though if they are used at shoulder and elbow joints, the weight of the remainder of the arm and hand may require rather larger and hence more expensive motors.

Be careful that the design eventually chosen can both reach all the places you want and that the larger joints have a comfortable margin of strength and power. The arm must not only be able to lift its own weight, but also that of some payload.

For good power-to-weight ratios and high speeds of operation, hydraulics and pneumatics are an excellent choice, and they are much in evidence in industrial units. They do tend to be expensive — particularly proportional valves and pumps. They can also be very powerful, so a solid design is called for if the slightest software fault is not to pull the whole thing apart.

In an 'industrial'-style competition entry, solid, well-engineered designs start with an advantage. Nothing is more disconcerting than a shower of 6 b.a. nuts and bolts each time the thing moves. Real credit, however, will surely go to the design that incorporates ingenious and appropriate sensing, but is also easy to use on the shop floor; when it comes down to brass tacks, good engineering only takes money — good ideas are precious.

You would be up with the leaders if the arm could pick an item in a random orientation off a conveyor belt and leave it in a specified place and orientation. If the arm picked the object out of a hopper full of them, it would be ahead; if it can do it at about the same speed as a person, patent it — quickly. Judges will

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Figure 8: British United Shoe electric beam arm

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probably look for a design which is versatile, quick to adapt to a new task, and requires minimal modifications to the gripper between jobs.

Many people and organisations have proposed robots to help in the home. Every so often the news is full of a robot to be "programmable for a range of household tasks", available "soon" (always "soon"), for "a few thousand pounds". Such announcements are invariably met with a quite uncharitable degree of cynicism from those researching into robotics; still, one day, 'soon'!

The task is not impossible, just damn difficult; one could try to design a vacuuming machine. It might just go down better with the loved one than a robot that spills hot hydraulic fluid over the carpet. Criteria for a good hoovering robot would include its hoovering everywhere, right to the edges, moving the furniture, sometimes, not knocking the Ming vase off its stand or running over the cat sleeping in the most inconvenient place possible.

Androids and golems

Robots have been used in education too. A good example is the Logo project from the Massachusetts Institute of Technology (MIT) (Papert 71). These small computer-controlled Turtles have been used to teach a range of concepts to young children in computing, mathematics and music. The children can use the Logo programming language to control and then program the robot to give them insights into processes of computing and computers.

These techniques are used successfully to hold the interest of the children in traditionally unpopular or difficult subjects. Competition entrants who are teachers or interested in education could well try something along these lines. Quite a lot of work has already been done, so better read around a bit.

Assorted automatons, androids, golems, robots and bionic entities are frequently featured in stories, films, plays and pictures and there is no reason why these should not form a valid part of any robot scheme. Jasia Reichardt's recent book *Robots: Fact, Fiction & Prediction* (Reichardt 78) treats robotics mianly from the artist's point of view.

An example of robots making art, as opposed to being in art, is provided by Harold Cohen's work. He uses a turtle, with pen attached to its underside to draw child-like pictures under the control of a PDP 11/40. These pictures may cover over one hundred square feet. The program consists of about 300 interconnected rules about the artwork it is to produce (Lansdown 78).

Robots and medical prosthetics, artificial limbs, are closely linked (Todd 78), and the full mechanisation of wheelchairs would almost certainly depend on robotic principles. Many of the artificial intelligence applications of robots in the past involved very large investments in computer power. Shakey, for instance, used a PDP 15 for local control, connected to a specially paged PDP10. Freddie used a local Honeywell H316 and an ICL 4130, ours uses a local PDP11/10 connected to an ICL 1904S.

The much considered and computed deliberations and then actions of any of these machines could not be described as rapid or real-time. This is partly because of the languages used to implement the high-level ('intelligent') end of the system. They tend to be relatively slow interpreted languages, used not for their efficiency, but for the power they provide the programmer. It is possible that by careful recoding of these ideas, probably with some reduction in complexity, considerable improvements in performance could be obtained.

The amateur is well situated to take the best ideas of artificial intelligence and modify them into a useable form. A program that could translate instructions in English to the correct robot actions, or one that could plan a course of robot actions using knowledge about the environment, giving reasons for each choice, or a robot that modified its behaviour according to sensory information in a sensible fashion, should all be welcome entries. More than this, they would all be worthwhile work in their own right.

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Head up your own letters

Rex L. Tingey finds out what Commodore's Printer can do

AT LAST Securicor delivered the Commodore Printer. Now I could discover all that it would do — and all that it could not. The model had become the 3022 Tractor printer instead of the cheaper 2023 (now 3023) Matrix printer since the 3022 was the only model immediately available after a wait of six months. At least the "Letter Writer" programme, compiled in readiness for the arrival, worked, and it was soon coupled with a letter-heading programme once the graphical possibilities of the printer had been explored.

Line writing

The programme is virtually in two parts. The first part is a line-writing programme, up to Line 9, with a self-contained destruct device which cancels the part completely when it is no longer required. The lines written at this time are numbered to follow the next part of the programme, so that the text of the letter follows the heading.

The second part of the programme constructs and prints a personalised letter-head, to be printed on all copies of the letter, and filed on tape each time with a letter.

The line writer first requests input of the date, so that it may be printed on the letter, and then presents seven numbered and stated print lines, with correct tabulation. After the letter lines have been written on the 60 or so spaces of each of the seven, a further Return puts up seven more lines numbered to follow.

At the end of the letter, the cursor can be shifted down to the lowest screen printing and a Return given. This puts onto the screen a line of numbers at the left edge, with the cursor over the top one; by Returning down these numbers, the line-writing programme is cancelled. A RUN prints the letter, together with its heading, on the printer.

The heading

The line-writing part is adaptable to various Basics, but the heading will require some variations for machines other than Commodore printers. This is because this printer has its own unique commands, instructions and addresses, together with the enhanced character capability plus the forming of a new character constructed from the matrix dots. It is possible to construct a new character for every printed line.

```
                PET C TITLER
      100 COMPUTER LANE, PROGRAMMING STREET        TEL:0101

                                     12TH JANUARY 1980

Dear Sir,
With reference to your computer programme 'Letter Writer',
note that the lines can be readily justified, and that the
date is inserted as input, but in a permanent way, so that
it is recorded, should the letter be filed on tape.

The line-producing part of the programme is cancelled
after the letter is complete, so that only the heading and
text are left for storing.The heading remains part of each
letter.

Spaces between the lines and paragraphs can be varied by
the PRINT#4 and PRINT#6 variations.

Errors are very easily corrected.
                                          Yours sincerely
```

The example letter and letter-head

The programme opens up files, accesses the printer, and directs information to the correct secondary addresses. It prints the letterhead, and, after printing the letter, closes the files to avoid errors in further work on the computer.

The heading employs the enhanced character capability of the printer, which spreads the characters to two, three or four times their normal width. It employs the high resolution reversed field, which needs a new ribbon for a first-class black. Graphic lines are included above and below the reversed line to improve readability.

The programme

The programme is written entirely in Pet Basic but some of the control characters are different when using the printer. Some of the CHR$ numbers normally giving a blank are used, and others normally giving a symbol do not respond in the way expected. A major difference is that all letters are typed upper case on the screen and controlled by Cursor Up and Cursor Down keys: the Cursor Down following a Quote produces lower case on the printer.

The first line of the programme starts a device for taking string data, normally held only in the memory, and transferring it over to the second part as a programme line, preventing it being cleared by RUN. This is achieved by an Input to Z$ — the date — which then reappears above the first batch of letter lines, contained in a "Print" line — 155 — with the cursor flashing on the line for fixing with a Return. The inverted commas — only one set is necessary — are achieved by inserting the Quote character code before Z$.

The line numbers are consecutive, but this can be readily altered by changing the "A" figures to A + 10, for example, and to A — 20 etcetera, with a starting value on line 1 of A = 180. The programme puts up seven lines at a time, which should be sufficient for a good paragraph.

The screen will take nine lines, and this can be obtained by altering line 5 to IF B = 11 GOTO . . . Line 6 is nearly full length, so that a blank line follows each numbered line, eliminating the need to Insert. Tabulating guides could be inserted on the blank part as an aid.

At the bottom of the screen, the cursor first alights on A = A — 2: GOTO 4, printed from line 7; when this is REturned on, the next set of lines appear. Below this is GOTO 2, and if the previous line is skipped with a Cursor Down, and this is Returned on, then lines 2 and 3 come up with a homed cursor, brought down onto

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the first number by Break and Ready signs.

The instruction "Cancel by Return" heads the screen, and a quick nine presses of Return cancels the line-making programme. Run and Return and the letter will print out on the printer.

Line 8, by the way, puts up a reverse field instruction above the date-line, but only on the first set of produced lines. The GOTO 10000 instruction on Lines 7 and 8 avoids the "Break in 9" as well as avoiding the "File not open" errors. The sending to a high address REM just produces a screen "Ready" and avoids the loss of screen space with "Break".

The letter-head programme half has the various secondary addresses and logical file numbers to enable the printer to perform. Open 5,4,5, for example, readies the printer memory for the binary-constructed special characters, formed using the data on line 101 as two characters A$ and B$, used to make the two-line T in the main heading. The CHR$ (254) prints out the character after the $ has been printed to the # 5 file.

CHR$ (1) is the enhancing instruction which doubles the character width, and increases within the line as many times as is required, but which is cancelled upon a carriage return: this makes some of the instructions limiting by taking up too much of the 80-character line-length.

Open 6,4,6;PRINT#6,CHR$(no) establishes a line-feed length which remains until altered by a further instruction. The PRINT#4 instructions print one line of the specified feed-length. The comma tabulates in tens from left to right; there are now eight positions instead of the screen's four.

The files are closed within the programme, at the end, and the computer will work as normal without the need to switch off the printer. If a programme is listed to the printer, it may be found that the Return key does not behave correctly, and that the cursor does strange things, even after a Close File has been completed.

Writing a letter

All upper-case letters are typed in for a line of a letter, and lower case is seen by the symbol Reversed Q, which is shift down, a shift back up is Reversed Ball. When justifying the lines, these symbols must be counted as extras in line length. In fact, the easiest way to justify is to write the letter with some line room left, and then to print out on the printer. On listing on the screen, the letter can be justified using the print-out as a guide.

The printer will print but stop before a line with an error, and display the usual "Syntax Error" and line number on the screen so that it can be corrected in the normal way after listing. The main error occurs whilst correcting lines where upper/lower case change requires "quote" on, and a correction requires "quote" off, leaving an odd "quote" in the middle of a line.

For invoices, receipts and accounts — AT LAST A POUND SIGN. Data to produce the sign is given here. The example is printed enhanced X2, but the short programme does not include this.

Now the bad news

One major reason for buying a printer, in my case, was for listing the programmes I produce for Petsoft, to give easy reference when checking or constructing the educational word programmes in upper and lower case. However, lower-case from within a programme lists as the equivalent graphic symbol, which means learning a new language to interpret the symbols. To list a readable word-programme means that all the lower case has to be altered to upper, which is no check on the original programme, and very time-consuming.

Another defect is that, though it gives plenty of formatting options for data, the formatting for programme listing is minimal. By sending Alpha field information to the printer via a secondary address and logical file, it is possible to tabulate a listing to the right, but any line longer than the Alpha field is blanked at the end, and not printed; strings tabulated over have their surplus printed on the following line. What I required was a listing capability of 40 character-length lines, exactly as on the screen.

Apart from these criticisms, the printer performs well, producing good, clean copies. In its letter-writing function it gives a first-class heading, which could be used alone, the letter being typed on an ordinary typewriter. A small version of the letter-head could be used to produce personal and business cards, and other stationery — using your own name and address, of course, not the example given here!

```
POUND SIGN                              £ 3200
                                        £ 240
                                        £ 1805

 10 OPEN5,4,5
 20 DATA9,63,73,73,65,33
 30 FORA=1TO6:READZ:Z$=Z$+CHR$(Z):NEXT
 40 PRINT#5,Z$:OPEN4,4
 50 PRINT#4,CHR$(254)" 3200
 60 PRINT#4,CHR$(254)" 240
 70 PRINT#4,CHR$(254)" 1805
 80 CLOSE5:CLOSE4
READY.
```

Programme for printing pound sign

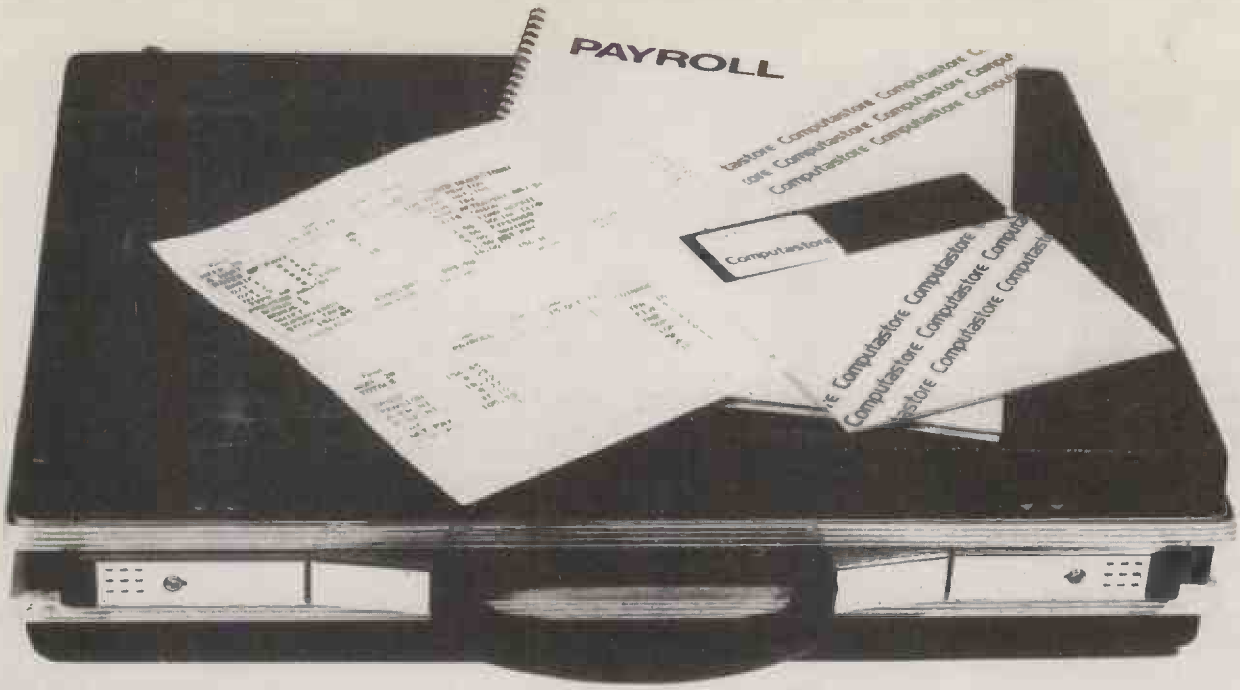
```
100 OPEN5,4,5:PRINT"
101 DATA126,0,96,1,127,127,127,127,96,1,126,0
110 FORI=1TO6:READA,B:A$=A$+CHR$(A):B$=B$+CHR$(B):NEXT:PRINT#5,A$:OPEN4,4
120 PRINT#4:PRINT#4,CHR$(1),CHR$(1)"        "CHR$(254)
130 OPEN6,4,6:PRINT#6,CHR$(18):PRINT#5,B$
140 PRINT#4,CHR$(1),CHR$(1)" ET C "CHR$(254)"ITLER"
148 PRINT#4,,"
150 PRINT#4,,"            100 COMPUTER LANE, PROGRAMMING STREET      TEL:0101
151 PRINT#4,,"
152 PRINT#6,CHR$(80)
155 PRINT#4,,,,,,"12TH JANUARY 1980
160 PRINT#6,CHR$(30):FORI=1TO4:PRINT#4:NEXT
201 PRINT#4,,"DEAR SIR,
202 PRINT#4,,"WITH REFERENCE TO YOUR COMPUTER PROGRAMME 'LETTER WRITER',
203 PRINT#4,,"NOTE THAT THE LINES CAN BE READILY JUSTIFIED, AND THAT THE
204 PRINT#4,,"DATE IS INSERTED AS INPUT, BUT IN A PERMANENT WAY, SO THAT
205 PRINT#4,,"IT IS RECORDED, SHOULD THE LETTER BE FILED ON TAPE.
206 PRINT#4
207 PRINT#4,,"THE  LINE-PRODUCING  PART  OF THE  PROGRAMME IS  CANCELLED
208 PRINT#4,,"AFTER THE LETTER IS COMPLETE, SO THAT ONLY THE HEADING AND
209 PRINT#4,,"TEXT ARE LEFT FOR STORING.THE HEADING REMAINS PART OF EACH
210 PRINT#4,,"LETTER.":PRINT#4
211 PRINT#4,,"SPACES BETWEEN THE LINES AND  PARAGRAPHS CAN BE VARIED  BY
212 PRINT#4,,"THE PRINT#4 AND PRINT#6 VARIATIONS.
213 PRINT#4
214 PRINT#4,,"ERRORS ARE VERY EASILY CORRECTED.
215 PRINT#4:PRINT#4:PRINT#4:PRINT#4
216 PRINT#4,,,,,,"YOURS SINCERELY
9999 CLOSE6:CLOSE5:CLOSE4
10000 REM-AVOIDS'FILE NOT OPEN'ERROR
```

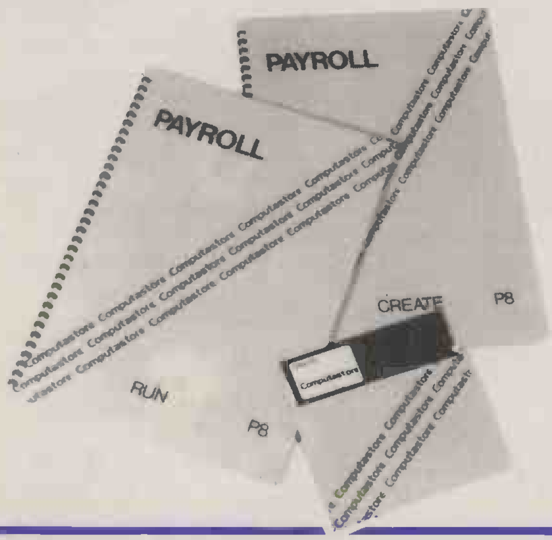
Program of the example letter, line-making cancelled

Travellin' to California

THE NCC SHOW, in Anaheim, USA, 19th-22nd May, 1980, is the computer show of the year. All the latest products and ideas will be on display.

To help readers planning a visit, *Practical Computing* will be offering a package to include the flight, hotel accommodation and tickets for the show. For further details of the cut-price deal, please contact us as soon as possible. There may have to be a limit on the numbers.





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Each issue is packed with essential reading on microcomputers, including all our regular monthly features: Book and cassette reviews; Glossary of computer terminology; Computabits; Pet Corner (February onwards); Apple Pie (May onwards); Tandy Forum (March onwards); serialised *Illustrating Basic* (October 1978 onwards).

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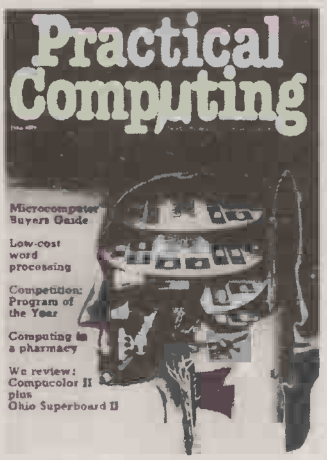

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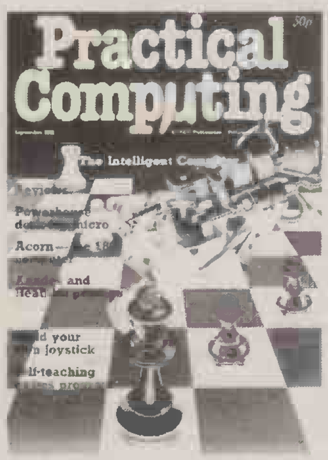

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Gallery moves out of the flat earth era

THE REGENT GALLERY, in Cheltenham, is a typical small business. Founded sixteen years ago by one man, David Bannister, it has grown slowly but profitably and with the recent international boom in 16th and 17th century maps has carved itself a valuable niche in a skilled and competitive market.

But in the past couple of years David, and his recently acquired fellow director, Peter Baxter, have had to look for new ways to cope with the problems of growth.

"The main difficulty in map dealing," explained David Bannister, "is that whenever you sell a map you have to replace it. As you might imagine, there is only a limited supply of 16th and 17th century maps. Most people only buy maps as a form of investment or saving and will only resell when they are hard-pushed for cash.

by Duncan Scot

"The result is that we have had to spend more and more of our time travelling around Europe and the States, seeking out dealers and private collections and trying to persuade them to sell, sometimes at the expense of keeping track of the enquiries at the Gallery. The business has grown so fast it has become extremely difficult to remember every item we have in stock."

David, who built the business on picture framing and decorative prints, suddenly found that his stock of maps was producing enquiries from all over the world.

"When someone writes in and asks for a list of every world map we have in stock, it could take the better part of a working day to check through every item and write a good reply, simply in the hope that he would like to buy one of the maps on the list. But the time came when we couldn't afford to reply to every enquiry. We were obviously losing a lot of potential business."

They both spent months talking about the problem when the suddenly both hit upon the idea of computerizing the list of maps. Neither of them knew anything about small computers, but Peter had once helped install an IBM system at an insurance company and had picked up enough knowledge to write a detailed specification.

A friend introduced them to Commodore Business Systems and they were persuaded to buy a PET. The software was supplied by Petsoft. "As far as we are concerned," said Peter Baxter," the PET was not a serious computer. And the software was not up to what we wanted to do." The PET is now lying idle in a back room.

Armed with his specification, Peter wrote to a number of dealers inviting tenders, for what was, essentially, a stock-control and information-retrieval system for about 700 maps. The response was disappointing. Both David and Peter were horrified by the number of official dealers who appeared to know next to nothing about the systems they were trying to sell. David said "You just have to be firm. Any small business must be prepared to shop around and find the right system or go elsewhere."

David Bannister and Peter Baxter in their studio, with a 17th Century world map and their North Star Horizon-based information retrieval system in the background.

Special program

They found their solution at the Byte Shop in Nottingham. "The manager recommended a system based on the North Star Horizon and put us in touch with a software specialist called John Potter, of Loveden Computer Services. He agreed to write a special program for a very reasonable sum."

The least impressive offer came from Keen Computers. "They offered to butcher one of their standard stock control packages for nearly five times as much as Potter wanted."

Maps can be classified in a number of different ways — for example by the cartographer or by region. "Most of the maps we deal with were drawn by one or other of sixteen cartographers," says Peter. "But then most of our buyers ask for listings by region."

Classification system

The menu program is simple. Maps can be listed by any one of 21 regional groupings, by cartographer or by regional grouping and cartographer. There are also, of course, options for amending or deleting entries.

Each of the sixteen major cartographers has his own entry; the rest fall into one part or another of an eight-part alphabetical listing.

Each one of the 700 maps in stock is classified by the region the map covers, the name of the cartographer, its status — whether it has been sold, in which case it will be removed from the system by the end of the day, and the map's value. Each entry also includes a title, a descriptin and a four- or five-line narrative for the information of potential buyers.

There is no doubt that the system is useful. One letter which arrived when I was there asked for a listing of all the maps in stock of Scandinavia, the Polar

Regions and Sussex. Such a list could be printed within minutes, leaving plenty of time to deal with other aspects of the business.

In writing the program John Potter, of Loveden, managed to alter the standard interpreter on the North Start Horizon and cut out all the functions which were unnecessary for this application, such as the trigonometry functions. This gave almost 2KBytes of extra main memory to play with.

He also fitted the 700 map entries onto a single 5in diskette by means of data compression techniques. John explained: "This particular application divides everything into very neat categories, with the same names appearing several times. In some cases we have been able to reduce the conventional storage sizes by factors of up to 20."

He has now adapted and developed the system, dubbed Mapox by Peter Baxter, but renamed LOCATE, into a range of packages for antique dealers and booksellers who have to deal with similar problems.

Surprisingly — and this is rare — the Gallery did not experience any of the difficulties normally associated with bringing computers into small business operations, except for the first abortive attempt with the PET. The package was running within days of delivery and the files were complete within weeks. David is now planning to extend his use of computers into other areas of his business, starting with his mailing list.

Right: Peter Baxter with a map of Cheshire by John Speed, issued in 1627. John Speed is the best known English cartographer and his atlas *The Theatre of the Empire of Great Britain* was the first collection of separate maps of the English and Welsh counties.

Below: A typical printout from 'Mapox'.

```
                    REGENT    GALLERY
              14 Regent Street, Cheltenham
              Gloucestershire, England
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              Telex  27950 (Ref. 2088)


LIST OF SELECTED MAPS CURRENTLY HELD IN STOCK AT THE REGENT GALLERY,
PREPARED FOR MR. DUNCAN SCOTT, PRACTICAL COMPUTER.


 REF.    REGION        CARTOG.    DESCRIPTION                        COST(£)


LT 12   Middle East   Ptolemy    ARABIA ULM 1482 ORIG COLOUR        3750   CG

        Arabian peninsula from Ulm edition of Ptolemy's Geography.
        Magnificent original colouring.  The Ulm Ptolemy was the
        first atlas printed in Germany and the first woodcut atlas
        in the World.
        A very rare map in excellent condition.

Deletion list of

 REF.    REGION        CARTOG.    DESCRIPTION                        COST(£)

LT 12   Middle East   Ptolemy    ARABIA ULM 1482 ORIG COLOUR        3750   SD
Aborted
```

The design of small, fast good programs is not an art of esoteric complexity. Keep it simple and code it late, urges C. A. Malcolm.

Smaller, faster, quicker, slicker...and more elegant too

MICROPROCESSORS and personal computers are new phenomena, but programming computers is a well-established craft. I have been inspired to write this article by the number of extraordinarily ponderous, lengthy and obscure programs I see published in the micro journals! It is not hard to write much better programs. It is not a black art of esoteric complexity, nor does it require great experience — on the contrary, it depends only on the careful pursuit of simplicity, a pursuit steered by a few general principles which practice has shown to be useful.

Many things distinguish the programs produced by a good professional programmer from those written by newcomers to programming. One of these is that his programs are smaller and run faster. In this article I shall show you the general principles for designing small fast programs. Not surprisingly, this strategy also tends to produce more elegant programs.

There does always come a point where elegance can be sacrificed for gains in smallness and speed. It is important to postpone this point as far as possible, so that you do have some elegance to sacrifice! In most cases, however, the pursuit of elegance and neatness of design produces sufficient gain in size and speed that it is not necessary to go to the final stage of optimising bodges.

It is often difficult to follow an abstract theoretical discourse, however correct and excellent, so I shall illustrate the general rules of programming for designing small fast programs by developing a particular example. I shall take an example which everyone will be familiar with, and which many of you will already have played with: finding the prime factors of a number. This strategy will enable you to write a factoring program for your machine, whether PET, NASCOM, programmable calculator or whatever, which will run between 2 to 'n' times faster than anything you have seen published in a magazine, where 'n' can be quite large! This is also the crucial kernel of a prime number program.

Refine the design

Note that I mention "design", rather than "writing", in the title.

The first important rule is to refine the original design, *not* the written code.

We shall begin with finding the prime factors of a number, simply and crudely without any thought at all, just to give the design wheels something to grip. This starting point is illustrated in **figure 1**.

This is a very simple algorithm, and it works. There are obvious ways of making it go faster, and we shall proceed by examining these.

To begin with, it is not necessary to try divisions by divisors greater than the square root of the number being divided. For example, if trying to decide whether 101 is a prime, since $\sqrt{101} < 11$, dividing by 11, if it worked, would produce another factor less than 11 — and we would have found the other factor already, if it existed, in a previous division.

It is tempting, having recognised this, to stick in a simple test before each division, "is the divisor less than the square root?", and many programs do just this. But this involves calculating the square root afresh each time round the loop. If it takes 25 divisions to establish that a number is a prime, the square roots will be calculated 25 times, when obviously it only needs to be calculated once! In general, the square root only needs to be calculated each time the number being divided *changes,* which is only each time a factor is found.

This illustrates an important principle of loop design: only put into the loop what has to be repeated; keep all the processing which can be done outside the loop, outside it.

Having thus improved the end condition of our first simple sketch design, what other obvious flaws has it? It tries every possible whole number as a divisor, when it is pointless, after the first divisions by two, to bother dividing by even numbers.

In fact, to generalise, we are wasting time by dividing by *any* number which is not a prime number. Ideally, it would be nice to hold a table of all the prime numbers, and extract the divisors from it. This is impractical for two reasons.

Split loops

The first is the memory it will take up. The second is, where do we get the list from? If it is a small list, we can set it up by hand as presets; if large, a program can set it up. But however large it is, it will never be large enough, if we wish to avoid restrictions on the maximum size of number we can examine. Therefore, without deciding at this stage how big this list of primes should be, it is reasonable to decide to split our single factor loop into two loops: one which extracts prime divisors from a list; and a second loop, which carries on from there, inventing divisors. It is an obvious saving only to invent odd divisors. This algorithm is illustrated in **figure 2**.

Our design is now getting fairly sensible and efficient, and is at the level of most published routines. But we should not rest

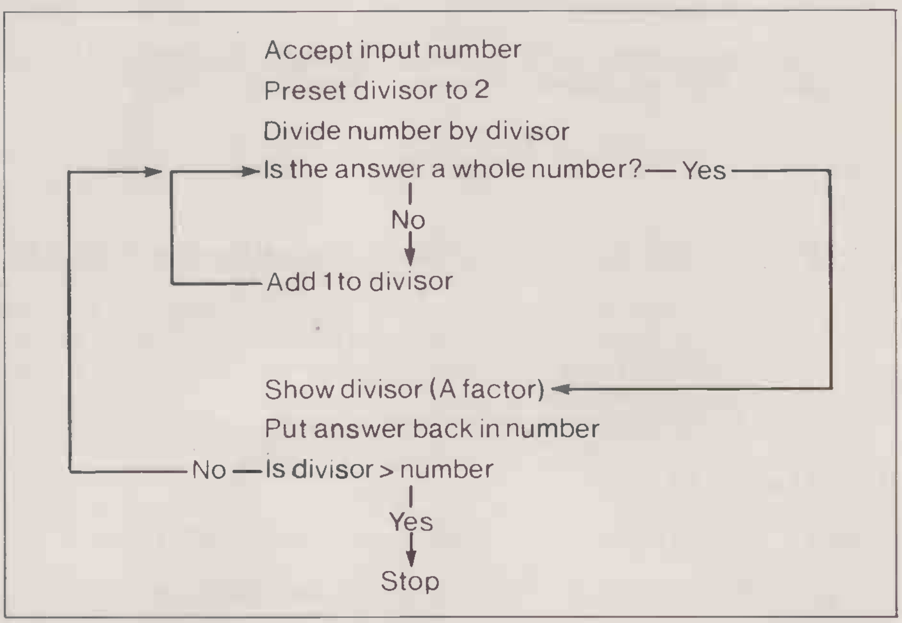


Figure 1: The simplest possible program

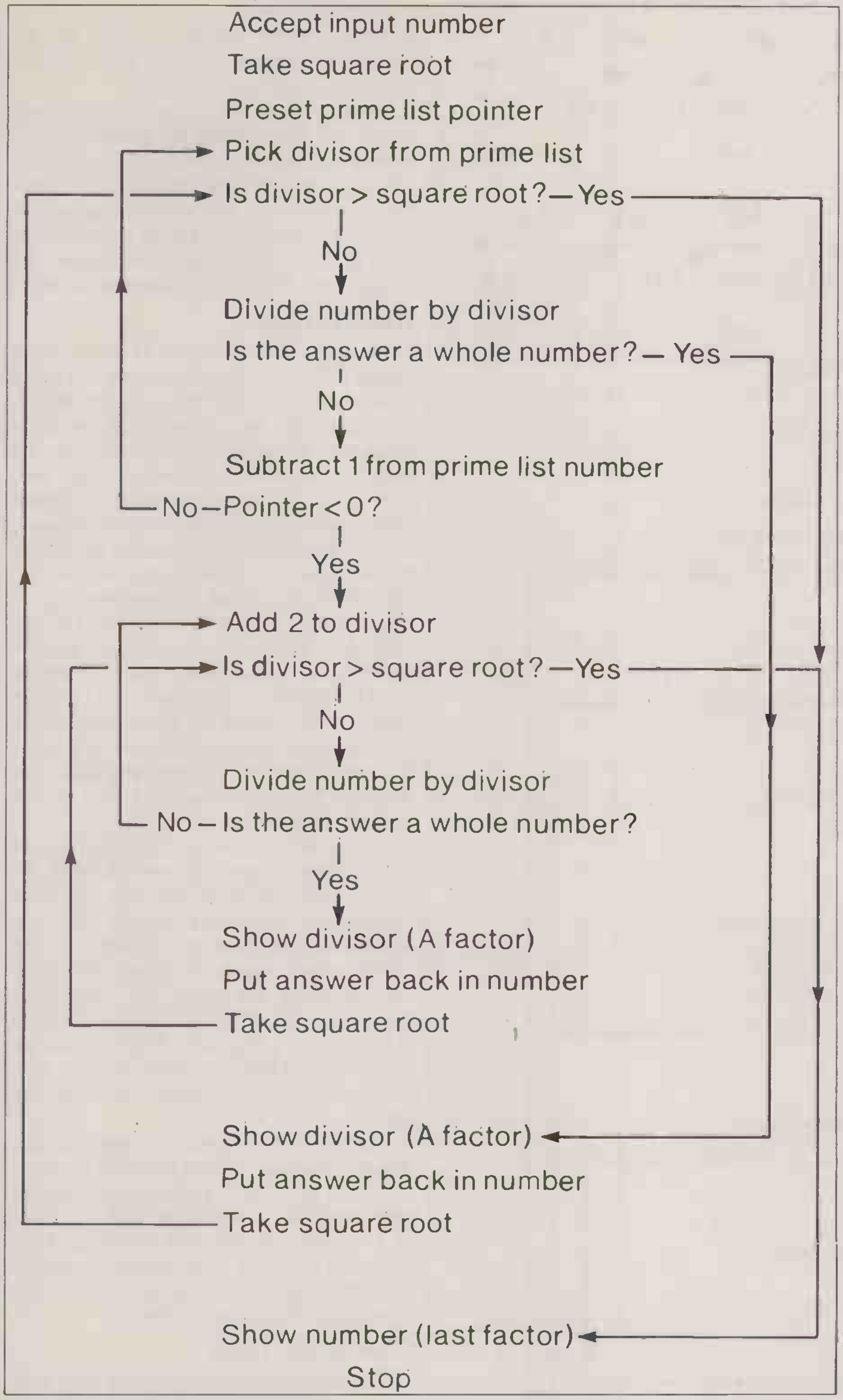


Figure 2: A reasonable first design

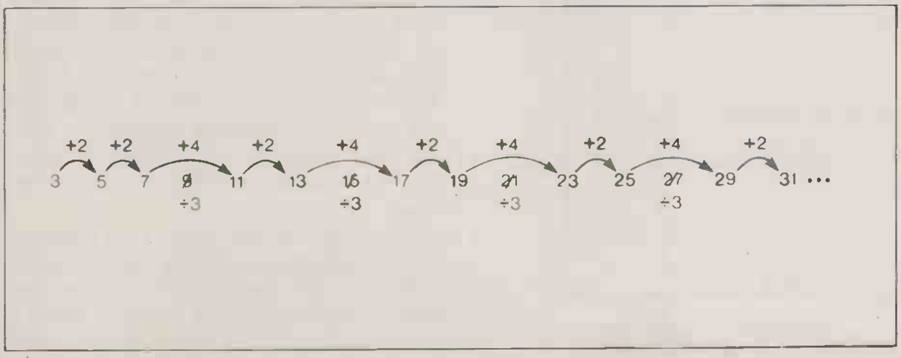


Figure 3: Omitting odd numbers divisible by 3

until we are clear that it cannot become substantially better. In fact, it will become a lot faster, and smaller!

Once outside the prime list, and inventing divisors, we are obviously wasting time still, by dividing by non-primes. We have improved the original design by omitting even numbers, ie, omitting divisors divisible by two. Is there a simple method of omitting divisors divisible by three?

Figure 3 gives a list of odd numbers, marking those divisible by three. It is plain that every third odd number is divisible by three, so that we can save 33% of our processing time by omitting them. It is also plain that if we invent divisors by alternately adding two and four to the last divisor, we omit divisors divisible by three. Since the omission saves 33%, the crucial question is: does the decision to add two or four add 33% to the loop? In most machines the overhead is a maximum of about 10%, so that this is a most worthwhile saving.

Scribbling code

At this point, most programmers have become so excited at having had a clever idea that they are already scribbling code. We are not so easily panicked however. We are not finished. We have glimpsed a generalisable principle. We have omitted divisors divisible by two and three: What about omitting divisors divisible by five? How difficult is this?

Figure 4 shows a list of numbers not divisible by two and three, with those divisible by five marked. It is not so obvious this time, but there is still a sequence. This time the sequence is eight steps long, and saves about 13% of the remaining divisors.

This sequence of eight steps does not look simple to generate. The obvious solution is to hold the sequence of divisor increments as a list. Handling this list introduces very little, if any, overhead over the previous two/four increment decision, and saves us dividing by another 13% of the remaining divisors.

We could consider omitting divisors divisible by seven ... and 11 ... — but this would be handled by extending our existing difference list procedure, and at this stage of general design I shall leave that as a detail, like the decision about the optimum size of the prime list.

Late decisions

There is a good reason for not bothering our heads with those kind of details at this stage, changes in the more general area of procedure, which we are considering at the moment, may well remove the need; or change the context, in which these details operate. This is another important principle: leave decisions as late as possible in the process of design refinement.

Figure 5 illustrates this now quite sophisticated prime factor program. It is not so

continued over page

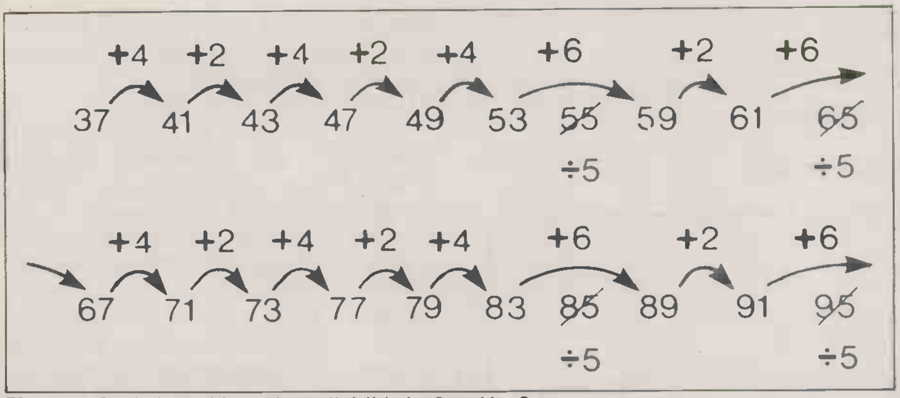


Figure 4: Omitting odd numbers divisible by 3 and by 5

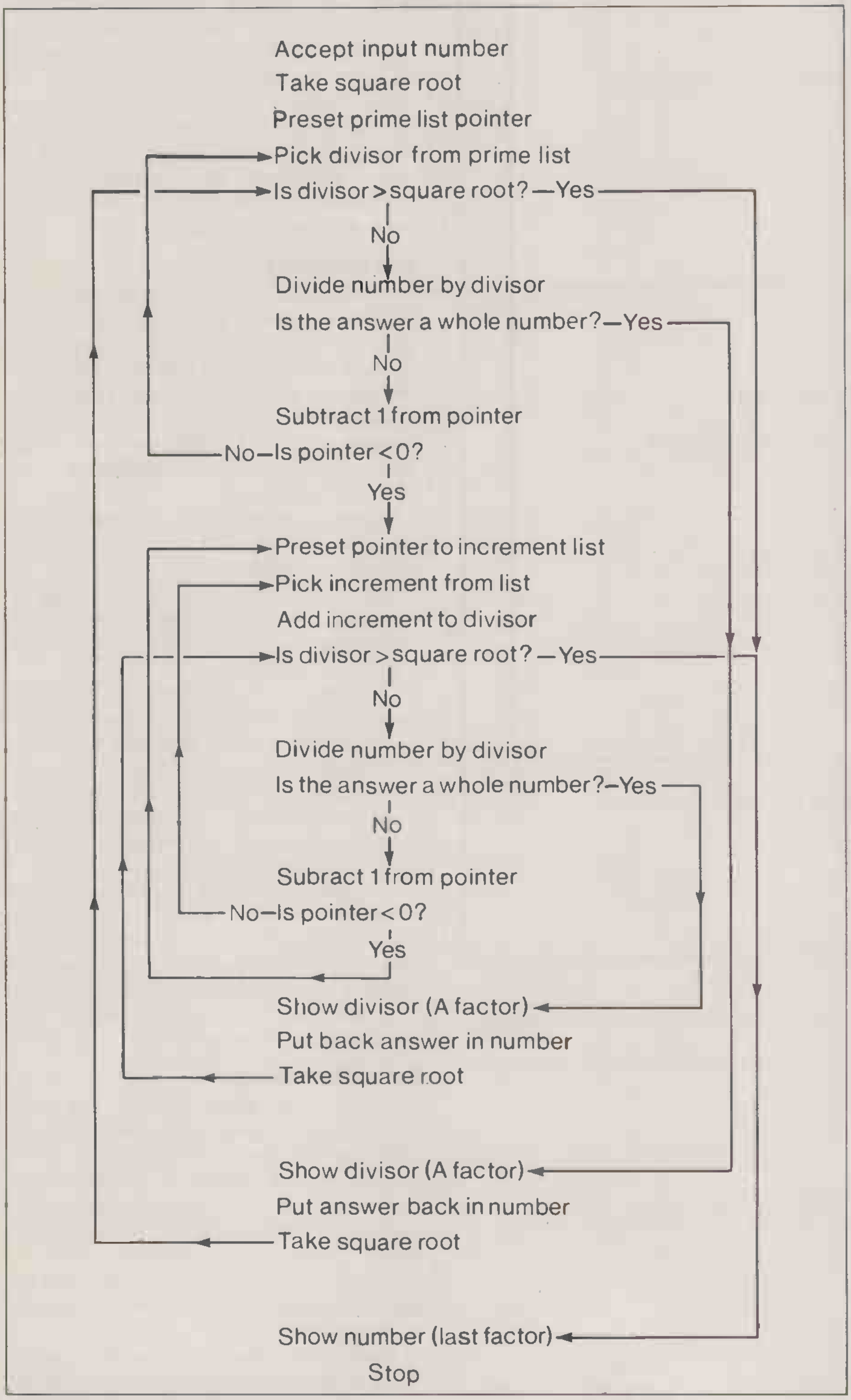


Figure 5: A fast prime factor program

from previous page

difficult, is it? Mostly a question of keeping the animal instincts at bay, while logical progressions are made.

So our algorithm now contains two loops, the first picking up prime divisors from a list, and the second generating sort of prime divisors by picking up differences from a list. The astute programmer should be wondering about the possibilities of combining these two loops, by holding the first list as differences as well.

Real primes

In fact, as the list of differences in **figure 6** shows, it is quite simple. To begin with, the list of differences will be initialised from the top, to pick up the early sequence of real primes; and then the list will be initialised thereafter part way down, to pick up the repeating element that generates the further almost-primes.

This new algorithm contains all of the speed enhancing refinements we have so far discovered, and has returned to a single small loop. It is now time to consider the size of the combined prime/difference list. We have already established that a sequence of 11 differences, with a repeating element of eight, will generate all primes successfully up to 47, and thereafter will omit as divisors all divisible by two, three, and five. Try it and see if you are not sure.

If you can be bothered to try and extend this process to omit divisors divisible by seven, you will find that the repeating sequence is very long indeed. In fact, considering the amount of store so far taken up with list and program, the extension to seven will buy a few percent of speed at a cost of more than doubling the size of the program. This extension obviously is taking the design into the area of marginal improvements for large size costs.

Therefore I propose to stop at this point, omitting divisors divisible by three and five, as being a good compromise of speed and size — a minimum in the curve of size versus speed. Before coding this, however, it should be scrutinised carefully for optimisation possibilities, in the light of what we want to use it for.

Check the loop

The most important point to scrutinise is the main dividing loop. Is it possible to take anything further out of this loop? Note that we have an outer loop, of re-initialising the list pointer, which runs only an eighth as often as the inner loop. What would be the effect of taking the test for divisor exceeding the root out into the outer loop? — it is possibly the only non-essential component of the inner loop.

Two effects: the finding of factors within the inner loop speeds up, because it is shorter; and the discovery of the last factor (or primeness in a prime) is delayed by at most eight iterations of the inner loop. In other words, the moment of

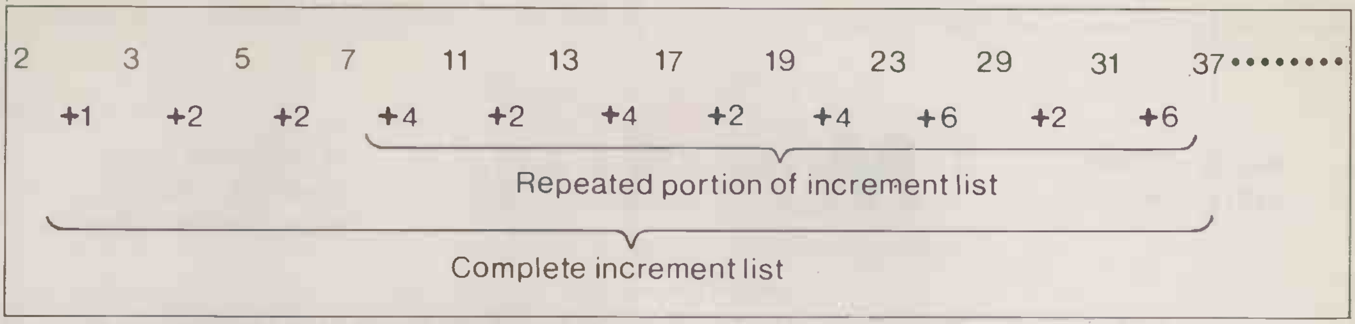
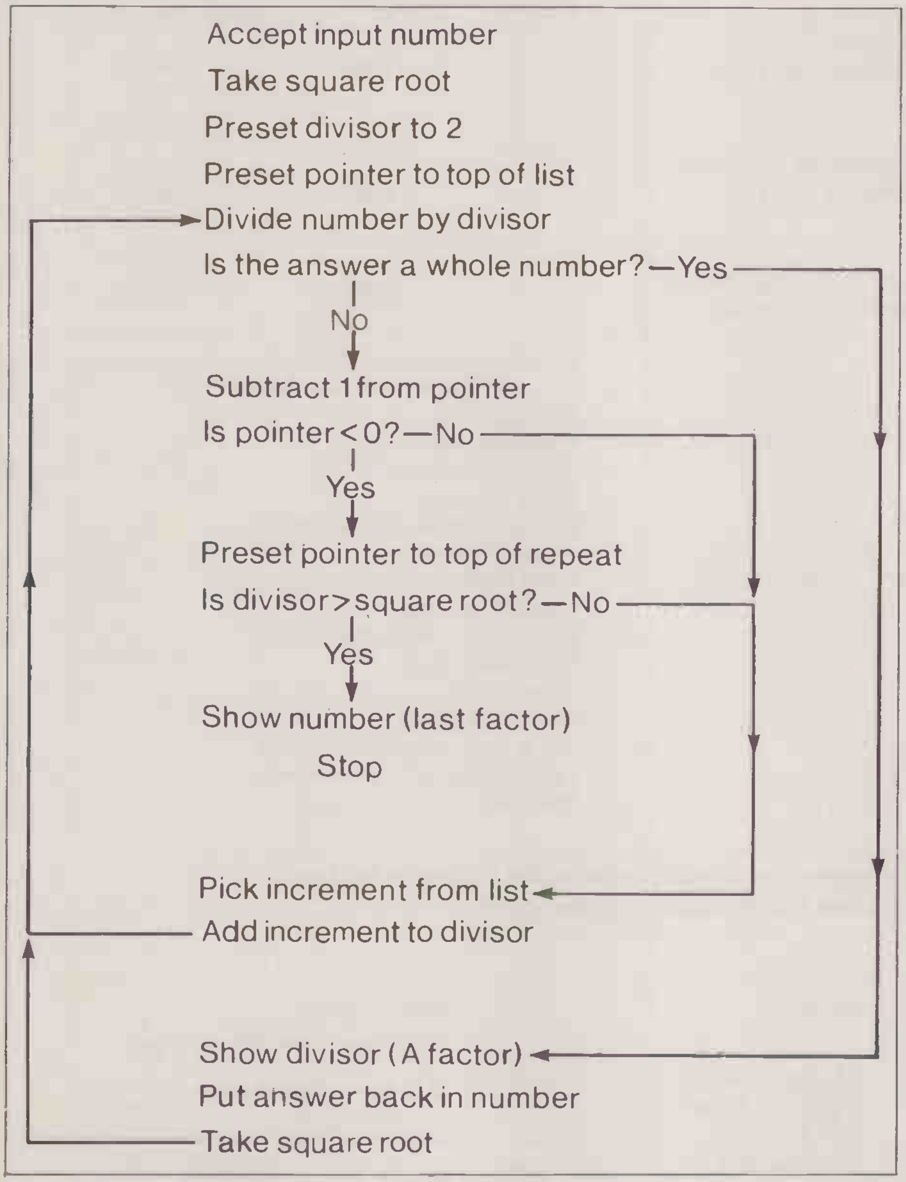


Figure 6: Generation of primes and increments from a single list



finding a factor is very slightly delayed, while the long tedious runs of the inner loop, when finding large factors or primes, is speeded up by a few percent. A few percent of hundreds or thousands of iterations of the inner loop is well worth buying at the cost of a fixed small overhead of a few iterations in showing the result — unless you are only interested in factoring small numbers, of course.

I leave it to you to adapt this algorithm for your own machine, and to compare its speed with any others you may have. As an example, I show it done in 41 steps on a Hewlett-Packard HP-29C programmable calculator, also easily adaptable to Texas machines.

I have only really begun the topic of good program design, but I hope this will get you started!

Remember the principles:
Refine the design, not the code.
Take everything possible out of the most iterated lops.
Don't code your first idea — generalised, extend, and compare.
Calculate benefits — don't optimise where it doesn't count.
Leave decisions as late as possible when refining design.
Don't code it yet!

Figure 7 (left): Even smaller, and faster too

Figure 8 (below): A program of 41 steps on an HP-29C calculator.

```
LBL 0;
STO .5; 1; 1; STO 0; 2; STO .4; (set up initial divisor and list pointer
LBL 1;
RCL .5; RCL .4; —; FRAC; x=0; GTO 2;      divide and test for integral answer
RCL (i); STO+ .4; DSZ; GTO 1;             increment divisor and loop on pointer
8; STO 0; RCL .5; RCL .4; x²;x≤y; GTO 1;  reset list pointer and test for big divisor
RCL .5; STO .4; GTO 1;                    set number as divisor to force out of loop
LBL 2;
Last x; STO .5; RCL .4; R/S;   reset number to answer and show factor
x²; x≤y; GTO 1;                test for big divisor
RCL .5; R/S;                   show number at last factor
1; R/S; GTO 0;                 show 1 at end

Memory registers .1(11) → 1 contain 1,2,2,4,2,4,2,4,6,2,6
```

• Circle No. 202

Start practising for the Amazing Micromouse Maze Contest

THE AMAZING Micromouse Maze contest has come to Europe, and the finals will be held in September 1980 during the Euromicro Conference. A few changes have been made to the rules devised by IEEE Spectrum, who first ran the contest in the USA, and two new classes have been added to the contest. These are a 'free world' course in an open arena with obstacles and targets, and a 'virtuoso display', writes **John Billingsley**.

The maze is based on a matrix of seven-inch squares, with alley widths of six and a half inches. Maze walls are two inches high, and the mouse is allowed to bulge over the top within a ten-inch limit on length and breadth. There is no height limit, but remember that if it topples there must be no outside help. Of course, walls must not be crossed illegally.

When the contest was held in the USA, a high-speed wall-follower managed to put up an excellent time with no intelligence whatsoever. The new maze contest has its target at the centre, and the maze will be arranged to send the wall followers on a swift turn around the edges and back out of the entrance. Unlike the children's picture-book mazes, there will be many highly connected paths to the goal, some much shorter than others.

With this connectivity comes the possibility of running round and round a loop. That is where intelligence will start to score, from a simple 'haven't I been here before', to 'I must have circles the centre clockwise, so I should look for a turn to the right'. Remember that unless the mouse is equipped with a television camera or such, its only knowledge of the maze comes from remembering the walls it has touched.

To give a feel for the problem, and to give practice at developing strategies, a program has been written for the Commodore Pet. On the screen you are shown the mouse (an asterisk) and the cheese. No maze walls are shown until you explore them, by driving the mouse using the keys 4, 6, 8 and 2 as a 'joystick'. Your moves are counted, and when you have painfully stumbled to the centre you can press D to display the whole maze,

A space will let you start again 'blind', whilst typing C allows you to construct or change the maze; in this case, key 5 rebuilds the walls around the current position of the mouse. At any time a maze can be written to tape using key 'W', or a new maze can be read by typing 'R'. In detail, the program runs as follows:—

1. Load and run the program. A summary of the directions is shown on the screen:
   8, 4, 2, 6 as joystick, 5 to rebuild wall
   Space to tray
   *D*isclose *C*onstruct
   *R*ead *W*rite
2. The program asks for maze dimensions. Start small with ten by ten — type 10, 10 (return).
   The screen clears, the machine ponders a while, and then draws an array of squares, with an asterisk 'mouse' top left and the cheese in the middle. Now cut yourself a maze using the joystick keys. If you change your mind about a wall, you can rebuild the walls around the mouse by typing 5.
3. When you are satisfied, type 'space' to try out the maze. As you move the mouse to a new square, any right-hand or bottom walls are shown. Left-hand or upper walls appear if you try that direction, but they do not cost a move.
4. If you want to disclose the maze, type D.
5. If you want to modify the maze (ie construct it), type C.
6. If you want to try again, 'blind', type space'.
7. If you want to keep the maze for later use, type W. The Pet asks 'W. File name?'. Give it a name such as M01, so that you can later read mazes from a tape in turn with file name M.
8. If you want to read a maze from tape, type R. The Pet asks 'R. File name'. Type the file name (return), the maze will load, and you are ready to try it blind as soon as the mouse and cheese appear.
9. To start off with a recorded maze, just run the program, type in a very small maze dimension, say 2, 2, and then press R as soon as the mouse appears.

```
10 GOSUB2000
30 PRINT"]██8,4,2,6 AS JOYSTICK, 5 TO REBUILD WALLS"
40 PRINT"██SPACE TO TRY":PRINT"███D█ISCLOSE, ██C█ONSTRUCT"
50 PRINT"███R█EAD,      ██W█RITE.██"
100 INPUT"MAZE DIMENSIONS";IM,JM
105 IFPT=0AND(IM+1)*(JM+1)>256THENPRINT"ARRAY > 256; TRY SMALLER MAZE":GOTO100
110 DIMW%(IM,JM):PRINT"]"
120 A=3:FORI=1TOIM:FORJ=1TOJM:W%(I,J)=A:NEXT:NEXT
130 FORI=1TOIM:W%(I,0)=2:NEXT
140 FORJ=1TOJM:W%(0,J)=1:NEXT
150 GOTO800
190 IJ=D+I+L*J:A=V(W%(I,J))
200 WAITP,Q,Q:POKEIJ,U:GETA$:WAITP,Q,Q:POKEIJ,A:IFA$=""THEN200
205 IN=I:JN=J
210 IFA$="6"THENIN=I+1:IT=I:JT=J:GOTO270
220 IFA$="4"THENIN=I-1:IT=I-1:JT=J:GOTO270
230 IFA$="2"THENJN=J+1:IT=I:JT=J:GOTO280
240 IFA$="8"THENJN=J-1:IT=I:JT=J-1:GOTO280
250 FORN=1TO6:IFA$=MID$("5 RWDC",N,1)THENC1=N:N=6:NEXT:GOTO1000
260 NEXT:GOTO200
270 T=W%(IT,JT)AND1:T1=1:GOTO290
280 T=W%(IT,JT)AND2:T1=2
290 ONCGOTO300,400,500
300 IFIN=0ORJN=0ORIN>IMORJN>JMTHEN190
310 W%(IT,JT)=W%(IT,JT)AND(3-T):POKED+IT+L*JT,V(W%(IT,JT))
320 I=IN:J=JN
330 GOTO190
400 IFTTHEN420
410 I=IN:J=JN:K=K+1:PRINT"█";K;" MOVES      ";INT((TI-T0)/60);" SECONDS":GOTO190
420 M=D+IT+JT*L:N=V(W%(IT,JT)):IFPEEK(M)=NTHEN190
430 IFPEEK(M)=V(T)THEN190
440 IFPEEK(M)=32THENPOKEM,V(T):GOTO190
450 POKEM,N:GOTO190
500 CLR:INPUT"]R.FILENAME";A$
510 OPEN1,1,0,A$
520 INPUT#1,IM,JM:DIMW%(IM,JM)
530 FORI=0TOIM:FORJ=0TOJM:INPUT#1,W%(I,J):NEXT:NEXT
540 CLOSE1:GOSUB2000:GOTO1030
600 PRINT"]":INPUT"W.FILENAME";A$
605 IFPT=0THENPOKE243,122:POKE244,2:Z=59411:Z1=53
610 OPEN1,1,1,A$
620 PRINT#1,IM:PRINT#1,JM
625 IFPT=0THEN650
630 FORI=0TOIM:FORJ=0TOJM:PRINT#1,W%(I,J):NEXT:NEXT
640 CLOSE1:GOTO700
650 FORI=0TOIM:FORJ=0TOJM:PRINT#1,W%(I,J):POKEZ,Z1:NEXT:NEXT:GOTO640
700 C=2:PRINT"█                                                    "
710 FORI=0TOIM:FORJ=0TOJM:POKED+I+L*J,V(W%(I,J)):NEXT:NEXT:T0=TI:GOTO1035
800 C=1:GOTO710
1000 ONC1GOTO1005,1030,500,600,700,800
1005 IFC<>1THEN200
1010 W%(I,J)=3:A=V(3):W%(I-1,J)=W%(I-1,J)OR1:POKEIJ-1,V(W%(I-1,J))
1020 W%(I,J-1)=W%(I,J-1)OR2:POKEIJ-L,V(W%(I,J-1)):GOTO190
1030 T0=TI:PRINT"]":C=2
1035 I=1:J=1:IN=1:JN=1:POKED+INT((IM+1)/2)+L*INT((JM+1)/2),V(4):K=0
1040 GOTO190
2000 D=32810:L=40:P=59456:Q=32
2010 DIMV(4):PRINT"] └┘█*":FORI=0TO4:V(I)=PEEK(32768+I):NEXT:U=PEEK(32768+5)
2020 PT=0:IFPEEK(61667)=165THENPT=1
2030 RETURN
3000 OPEN1,8,15:INPUT#1,A$,A$:PRINTA$:CLOSE1
READY.
```

MANY intending contestants may be finding difficulty with the underpinnings of their mice — the motors, and their control electronics, wheels, steering. We would draw their attention to the *Hebot* robot has been featured in the last three issues of the magazine *Hobby Electronics* (November 1979 to January 1980).

As it stands, or rather rolls, this is too wide for the Micro-mouse maze, but it could easily be reformed into a suitable shape.

Copies of the magazine are 63p each, inc. pp, from *Hobby Electronics*, 145 Charing Cross Rd, London W.C.2. A source for the hardware is mentioned.

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

Look, no hands!

C. G. CHRISTIE was interested to read of the problems of I. R. Sinclair and the remote plug on his cassette:

A month ago I took a delivery of a TRS-80 Level 1 which came with a CTR-80 cassette recorder. The CTR-80 has been designed for micro-computers and costs £41.95 from Tandy. The following points should be noted:

- The remote plug may be left in during rewind/fast forward. (No constant plugging/un-plugging. Neat, eh!)
- The dummy mic, plug should not be used during CSAVE. This results in blank tapes. This discovery took a lot of trial and error as the manual refers only to the old CTR-41.
- You should remove AUX plug when loading and the MIC plug when saving, as this will help reduce noise.

Debounce problem

Steve Baker has also been looking at the debounce problem (Tandy Forum, November 1979).

I had independently arrived at a very similar solution as Ed Phipps, based on the listing of A. J. Harding in your April edition — my program also crashes right at the end with a ?SN ERROR although it does seem to debounce the keyboard OK.

So armed with a homemade Hex Monitor program and a list of the Z80 op-codes, I decided to try to discover the cause of the error ... it turns out to be *your fault* for failing to spot a typo in A.J. Harding's code.

It seems that the first few instructions of the assembler patch routine load the address of the remainder of the program into the Keyboard device control block, call a routine in the Level II ROM to initialise the keyboard and then return to location 1A10 Hex which exists from the Basic program and causes Level II to print READY. This last part is given in your listing as

```
FFD7  CF191A  JP  1A19
```

which actually does a RST 8 instruction (which is where BASIC goes to report a ?SN ERROR I presume) so this line should read ...

```
FFD7 C3191A  JP  1A19 ; Return to LEVEL II
```

Mea culpa! These things do happen—Ed.

Proper syntax

IN THE TANDY FORUM column in November, we published a keyboard debounce routine which apparently contained a syntax error in line 6. Laurie Heath, from New Malden in Surrey, has found the solution and has enclosed an amend DATA statement for line 3.

TRS-80 keyboard debounce correction

```
3 DATA 175,17,10,0,205,11,0,25,34,22,64,205,97,27,205,
25,26,33,54,64,1,1,56,22,0,10,95,174,115,163,32,8,20,
44,203,1,242,226,79,201,95,197,1,220,5,205,96,0,193,10,163
200,195,251,3
```

Dutch tip

ONE OF OUR DUTCH readers, R. A. Keijzer from Hilversum, has written in about the hint from Stephen Toop in the October Tandy Forum:

Stephen Toop's way of disabling the keyboard, by means of POKEing a Ø in location 16405 is great. However, this doesn't work under Disk Basic. When using Disk Basic it's necessary to POKE a value of 16 in location 16405 to get the same effect.

It's also possible to disable the display in a similar way. This is done with the following statement:

```
POKE 16413,Ø under Level II Basic
or POKE 16413,16 under Disk Basic
```

This can be useful, if you want to input, for example, a secret keyword. These lines are necessary then:

```
1ØØ POKE 16413,Y
11Ø INPUT A$
12Ø POKE 16413,7
```

When using Level II Basic, Y = Ø; under DISK BASIC, Y = 16.

Using the lines 1ØØ-12Ø lets you input A$ in the normal way; however, it won't be displayed. The POKE 16413,7 is used to put the display function back to normal again.

Automatic recording

W. T. COWHIG has discovered that waiting to record three or four copies of a program can be tedious. The following should make it automatic.

```
For N = 0 to 999: Next N: CSAVE "J":
for N = 0 to 444: Next N: CSAVE "J":
for N = 0 to 4444: Next N: CSAVE "J":
for N = 0 to 4444: Next N: CSAVE "J":
```

Press "enter" and return five or so minutes later and — hey presto! — four recordings will be ready. The initial delay allows the cassette recorder to settle down.

Machine artistry

I HAVE seen several programs which permit pictures to be drawn on a TRS-80 screen, and some that allow pictures to be recorded on tape, writes Mike Gardner — but they seem complicated and slow.

With this in mind he has developed the following program:

I have often seen the keys 'U', 'D', 'L', and 'R' used to cause movement up, down, left, and right respectively; my program makes use of the directional arrows to effect the appropriate movement. Further, if the shift key is held down with the appropriate direction key, a repeating movement in that direction will be obtained.

The program allows for text to be mixed with the graphics, though when in the text mode the repeating function is not used. By the inclusion of two machine-code routines, which are loaded automatically when the program is run, recording and loading the contents of the screen to and from tape is also possible, and takes approximately 21 secs regardless of the screen content.

As no instructions are included with the program, a description of its operation follows. The program is intended to run on a 16K Level II machine and will require a fair amount of modification for other sizes of memory. Before running the program, memory space should be reserved in response to the Memory Size request, the response being 32670. After entering run, there will be a short pause to load the machine-code routines, and then the screen will clear and the graphics point at (0,0) will be set; the program will now be in the Graphics Cursor Mode.

Graphics cursor mode: To return to the graphics cursor mode when in the graphics mode, press the 'C' key and the last graphics point set on the screen will become the graphics cursor.

In this mode, pressing the direction keys

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```
10 DEFINT A,C,S,X,Y
20 POKE 16553,255
30 FOR A=32672 TO 32758:READ X:POKE A,X:NEXT A
40 DATA 243,62,0,205,18,2,205,135,2,33,0,60,1,0,4,126,229,197
50 DATA 205,100,2,193,11,62,0,184,202,195,127,225,35,126,195
60 DATA 176,127,185,194,183,127,205,248,1,251,201,243,62,0
70 DATA 205,18,2,205,150,2,33,0,60,1,0,4,229,197,205,53,2,193
80 DATA 225,119,35,11,62,0,184,202,238,127,195,219,127,185
90 DATA 194,219,127,205,248,1,251,201
100 CLS
110 S=1:C=1:X=0:Y=0:SET(X,Y)
120 IF PEEK(14464)=1 GOSUB 490
130 A$=INKEY$:IF A$="" THEN 130
140 A=ASC(A$)
150 IF A=91 GOSUB 410  :GOTO 120
160 IF A=10 GOSUB 430  :GOTO 120
170 IF A=8 GOSUB 450  :GOTO 120
180 IF A=9 GOSUB 470  :GOTO 120
190 IF A=31 THEN CLS:GOTO 110
200 IF A$="S" THEN S=1:C=0:SET(X,Y):GOTO 120
210 IF A$="R" THEN S=0:C=0:RESET(X,Y):GOTO 120
220 IF A$="C" THEN S=1:C=1:GOTO 120
230 IF A$="T" GOSUB 550  :GOTO 110
240 IF A$="P" THEN 270
250 IF A$="I" THEN 300
260 GOTO 120
270 POKE 16526,160:POKE 16527,127
280 A=USR(0)
290 GOTO 110
300 POKE 16526,204:POKE 16527,127
```

will move the cursor one graphics position in the direction chosen. By depressing both the shift key and a direction key, and keeping them depresssed, repeated rapid movements of the cursor in the chosen direction will be achieved.

Complete wrap-round of graphics is always maintained.

Graphics set mode: When in the graphics mode, to enter or return to the graphics set mode, press the 'S' key.

In this mode, use of the direction keys and repeating function is as for the cursor mode, but this time all movements of the cursor will leave all previously set points in the set state. This allows lines to be drawn on the screen. Diagonal traverses are not supported and will have to be built up by careful use of the cursor mode and set mode.

Graphics reset mode: When in the graphics mode, to enter or return to the reset mode, press the 'R' key.

This mode is similar to the set mode, except previously set points will be reset.

Graphics clear: When in the graphics mode, pressing the 'CLEAR' key will clear the screen and cause it to return to the graphics cursor mode with the cursor at position (0,0).

Graphics print: When in the graphics mode, pressing the 'P' key will cause the contents of the screen to be recorded on tape; the user should make sure the recorder is ready before pressing this key.

Graphics input: When in the graphics mode, pressing the 'I' key will cause previously-recorded data to be read in from the tape and displayed on the screen, overwriting what was there before. This routine requires all 1024 bytes to be read; if a byte is missing, the program will hang up. Rewinding the tape and playing it again should overcome this, although the display will be corrupt, and you will be returned to the graphics cursor mode.

Graphics to text: When in the graphics mode, pressing the 'T' key will cause entry to the text mode.

Text mode: When in this mode, pressing the 'CLEAR' key will return to the graphics cursor mode with the cursor at position (0,0).

In this mode, the direction keys should be used with the shift key depressed and will move the text cursor one text position in the direction chosen, at each pressing. Any graphics in the path of the cursor will be restored after the cursor has passed by. Pressing all other keys in this mode will print their appropriate characters; the 'CLEAR' key is used to return to graphics cursor mode.

Once having mastered the use of the various modes of the program, the user should find it very easy to produce pictures on the screen.

```
310 A=USR(0)
320 GOTO 110
330 IF S=1 THEN 350
340 GOSUB 360  :RESET(X,Y):RETURN
350 GOSUB 360  :SET(X,Y):RETURN
360 IF X>127 THEN X=0
370 IF X<0 THEN X=127
380 IF Y>47 THEN Y=0
390 IF Y<0 THEN Y=47
400 RETURN
410 IF C=1 THEN RESET(X,Y)
420 Y=Y-1:GOSUB 330  :RETURN
430 IF C=1 THEN RESET(X,Y)
440 Y=Y+1:GOSUB 330  :RETURN
450 IF C=1 THEN RESET(X,Y)
460 X=X-1:GOSUB 330  :RETURN
470 IF C=1 THEN RESET(X,Y)
480 X=X+1:GOSUB 330  :RETURN
490 IF PEEK(14464)=0 THEN RETURN
500 IF PEEK(14400)=8 GOSUB 410  :GOTO 490
510 IF PEEK(14400)=16 GOSUB 430  :GOTO 490
520 IF PEEK(14400)=32 GOSUB 450  :GOTO 490
530 IF PEEK(14400)=64 GOSUB 470  :GOTO 490
540 GOTO 490
550 POKE 16416,0:POKE 16417,0:PRINT CHR$(14):
560 A$=INKEY$:IF A$="" THEN 560
570 IF ASC(A$)=31 THEN PRINT CHR$(15)::RETURN
580 PRINT A$;
590 GOTO 560
600 END
```

Critics convince Commodore

COMMODORE have finally given in over the much-criticized calculator style keyboards, writes Julian Allason of Petsoft. Future shipments of 8K PETs will feature typewriter style keyboards — and the revised ROM set. Also new will be moulded plastic cases instead of the original steel cse. There are rumours, too, of a third ROM upgrade which will include a revised DOS. This is said to simplify the rather complicated existing system.

Arguments about the pros and cons of Commodore and Petsoft disk systems abound. At present the latter, manufactured in California by Compu-Think, outsells the CBM unit which has been in short supply. However, teething problems due to overheating appear to have been overcome on the Commodore system. Dealers report that the 400K and 800K Petsoft drives are going more to businessmen who need the extra speed and additional storage.

The trend appears to be for the 360K Commodore system to be sold somewhat more into schools and scientific establishments. Both systems are well supported by applications software.

There is in fact a third system on sale, the Petdisk by Analog Electronics. This is the original side-saddle unit which mounts on top of the PET with one drive on either side. First seen on the Commodore stand at Compec last year, there is still comparatively little software available for the system.

Anyone interested in discovering the authorship of the new ROM system software can have their curiosity satisfied by executing WAIT 6502,Ø.

Despite reports of a freeze in the appointment of new dealers, the number of retailers selling the PET has risen to some 220. Not all of them obtain their PETs from Commodore, an increasing number being shipped from the States, and the power supplies converted in this country. Discounts of up to 20% are being offered by some of these "unofficial" dealers.

What, no programs?

I HAVE FREQUENTLY searched through *Practical Computing* for compilers on cassette for languages other than BASIC for the PET. I have found such programs for the TRS-80 but none for the PET. Are there such programs as CP/M, Fortran, and Pilot available for the PET?, asks K. Keyle from Wigan.

If the availability of such packages is indeed as limited as the lack of advertisements suggests, it seems a pity, since the PET is clearly a very popular microcomputer.

Please read quickly

IN DECEMBER we published the listing of a splendid game called Star Trader. In ignorance, we failed to acknowledge its original appearance in the book *What to do after you Hit return*, published by People's Computer Co. Sorry about this.

Revenge yourself on PET

MAURICE FOZZARD of Southend writes: This particular game was devised to show the inability of Pet to learn from previous mistakes, to demonstrate the advantage of unorthodox play, and to show that a "points greedy" computer can be outfoxed quite easily.

Pet owners who wrestle with Peter Jenning's Microchess 2 may like to revenge past defeats with this quick game at level 8. Has anyone managed to beat level 8 using fewer moves?

WHITE		PET RESPONSE (BLACK)
D2-D4	Queen's pawn gambit	G8-F6
D4-D5	Push Pawn forward	D7-D6
C2-C4	Protect forward Pawn's position	C8-F5
B1-C3	Bring out Queen's Knight	B8-D7
G1-F3	Bring out King's Knight	B7-B6
F3-D4	Attack black Bishop	F5-G4
D1-A4	Queen's Knight pinned	A7-A5
A4-C6	Reinforce pin	A8-A6
C3-B5	Bring up cavalry!	E7-E6
B5-C7	Check!	E8-E7
C7-A6	Capture Queen's Rook	D7-E5
C6-B7	Check!	D8-D7
D4-C6	Check!	E5-C6
D5-C6	Pawn captures Knight, attacks Queen	D7-B7
C6-B7	Pawn captures Queen	F6-D7
C4-C5	Sacrifice Pawn	D6-C5
C1-F4	Bring out Bishop	E6-E5
F4-E5	Sacrifice Bishop	D7-E5
B7-B8	Pawn promoted to Queen	E5-C4
A1-D1	Move up Rook	C4-B2
B8-D6	Queen checks	E7-E8
D6-D8	You win!	

Pet tape cure

AS ANY PET user knows, the most annoying part of loading from cassette is waiting for the FOUND '————' message, writes R. Cason.

This is mainly due to the lack of a tape counter, but even with a counter you would not know if the PET had passed the Program Header. You can sometimes miss the header — wait several minutes — only to find you are on blank tape.

My method is as follows:

Connect a Soundbox to the user Port Pin 6 (Cassette No. 1 Read) The Soundbox connection is Pin M (CB2 Line).

On both SAVE and LOAD you can then hear the following:

a) The Header Tone
b) The Header Token
c) The Header 'Title'
d) The Program DATA
e) The 'Half Way Point'
f) Second copy of DATA
g) The end of file Token

By using the F.FWD, PLAY and REW keys you can then locate the header on a multi-program tape — Press Play — and wait. If you do not get the message FOUND '————' at the Header Title stage, rewind slightly and try again. Using this method you can CUE the tape to the right position.

Other advantages are that you can also hear:

a) DROPOUTS
b) CROSSTALK
c) NOISE
d) VARIATION in PITCH due to tight Cassettes.
e) The difference between DATA and PROGRAM tapes.

This is an invaluable aid, and is best implemented by fitting a small toggle switch to the cover of the user port connector.

i.e. Position SOUND (Pin M)
Position 2 OFF (No Connection)
Position 3 CASSETTE (Pin 6)
With Pin N being the 'earth'.

For those who like to keep a 'Working Copy' of their programs in addition to the 'MASTER' a separate cassette is an advantage.

I use an Hitachi TRQ 299 which has an automatic level control (ALC) and a Cue and Review facility. In my case the ALC gives perfect results on the PET recordings every time. The Cue and Review facility allows you to fast wind using Cue to find the 'nth' program on the tape.

Position the header using Review and transfer the tape to your PET Cassette.

Perhaps somebody will devise a method to convert the PET Cassette to 'Cue and Review'.

Incidentally can anybody suggest a method of recovering data from a Program tape, on which the header and part of the first copy of DATA has been erased? (Caused by pushing RECORD instead of PLAY).

Fingertip fade

CLIVE HAND, who bought his PET in October 1978, notes that: as any 4K or 8K Pet owner knows, keytops don't die, they just fade away.

I noticed my keytops slipping away after two or three months' use. The answer is at your fingertips. First you must remove the plastic film which covers each key, when first bought. Then paint a layer of nail varnish over each keytop. Obviously you must use a clear varnish.

Two thin layers should work. Experiment before actually painting, because the varnish will dry very fast. Beware of dust and take care when painting the 'SPACE' and 'RETURN' key.

I can't say I admire the idea of using a new set of keytops, or even sticky tape. I painted my keys nine months ago, and I haven't had any fading whatsoever since, and don't expect any. Possibly the suppliers of Pets could perform this simple task before selling a Pet.

The Exidy Professionals

The Exidy Sorcerer is now one of the leaders in the world of micro-computers, being equally at home as an 8K cassette based system, or expanded to 48K with dual 315K disc drives and running CP/M, Microsoft BASIC, C-BASIC, FORTRAN, COBOL, ALGOL, etc.
The Word Processor must be the best available in the price range and compares very favourably with purpose built word processors costing twice as much — do not confuse with other widely advertised but inferior packages on other machines! The video/disc combines dual disc drives together with a high quality display screen, all in one neat, compact unit.

SYSTEM 1 — Word Processing & Business
- 32K Sorcerer
- Video/disc unit
- Daisy wheel printer
- Word Processor PAC
- CP/M

£4150

SYSTEM 2 — Low Cost Disc System
- 32K Sorcerer
- VDU monitor (green)
- 315K single disc
- Daisy wheel printer
- Word Processor PAC & CP/M

to be announced— approx. £3200

SYSTEM 3 — General Business Applications
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SYSTEM 4 — Cassette based Word Processor
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- IBM Golfball printer
- TV monitor screen
- Cassette recorder
- W/P & BASIC ROM-PACS

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SYSTEM 5 — Minimum System
- 8K Sorcerer
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- Cassette recorder
- BASIC ROM-PAC

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Most items in stock.

SPECIAL — Daisy Wheel Printer

For the first time you can buy a quality daisy wheel printer for a reasonable price. These printers are made by RICOH and are sold elsewhere for over £2000. They are built into many brands of expensive word processors.
We are supplying these printers together with a Centronics TM interface for direct connection to Sorcerer, Tandy, Apple etc.
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Sales Ledger	£125 + VAT

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DRAW on screen	£4.60 inc. VAT
STATS statistics package	£17.25 inc. VAT
CBOOK chequebook	£13.80 inc. VAT
PLOT 3 graph plotting (hi-res)	£6.90 inc. VAT

+ many others (send S.A.E.)

All the above are available from these two Exidy Professionals:

Basic Computing
Oakworth Rd, Keighley,
W. Yorkshire BD22 7LA
Tel: (0535) 65094 — Mike Collier

Micropute
Communique Place, 9 Prestbury Place,
Macclesfield, Cheshire
Tel: (0625) 612818 Telex 666971
— Don Cooper

• Circle No. 205

High-speed stepper motors and the PET

THE COMBINATION of a computer and a stepper motor gives us one of the most precise methods of producing and controlling rotary and linear motion. Stepper motors come in all sizes, from the small motors used in calculator printers to multi-horsepower motors for use in computer-numerically-controlled (CNC) machine tools.

The ease with which a stepper motor can be controlled by a microprocessor based computer like the PET makes it an ideal subject for experimentation, especially for those interested in robotics.

A stepper motor is totally different in design from an ordinary electric motor, which is characterised by its continuous motion when energised. The shaft of a stepper motor, on the other hand, moves in small incremental angular steps on command and will maintain this position between commands.

To achieve this, the rotor consists of a permanent magnet with alternate poles magnetised around its periphery. The stator consists of a set of coils which can be magnetised under control of external electronics. Motion is produced by the alternate attraction and repulsion of the permanent magnet and the coils the rotor moving to the position of greatest magnetic attraction — a position which it will hold until the coil magnetisation is changed.

In a previous article in *Practical Computing* (April and May 1979), we looked at some methods of controlling stepper motors. However, the results were severely limited in both power and speed, being confined to just a few tens of steps per second.

The reason for this is that the designs were based on simple drive electronics which utilised only a small part of the start/stop operating curves for a given motor. These curves give the motor torque for a given speed at which the motor may be stopped or started instantaneously without loss of command position.

Cash limits

Beyond this curve is another, termed the slew curve, which, depending on motor and drive, may extend to thousands of steps per second. This is possible by accelerating the motor field up to and down from the high speed. The limit on these step rates is eventually the motor, but the drive cost also becomes an important consideration for the home user. So here we will consider high speeds as being in the motor's slew region, up to a maximum of 5000 steps/sec, and a drive price of approximately £25.

There are many different types of motor, with varying numbers of steps/revolution. The motors driven and described here are four-phase hybrid stepping motors with 200 steps/rev. The motor phases (coils) may also be sequenced differently to produce the normal 200 steps or half-stepped to give 400 steps. The drive card used does this and all references to the step pulses assume 400 steps/rev.

Torque versus speed

The torque available will, as already stated, depend on the motor and drive combination. In **figure 1** we see speed-torque curves for a 22 frame size motor driven from APKS 1186 drive card. The lowest curve is the start/stop curve, the upper curves represent the torque available when the field is accelerated.

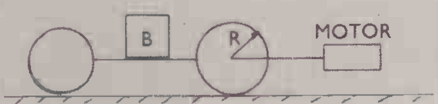
If the motor is driven from its nominal voltage with no external resistors and a coil energised, the current will rise exponentially. The rate of rise is a function of the winding resistance and inductance. To reach 95% of full current will take 3LR.

If, however, we double the voltage and fit a series resistor equal to R, the time to reach the same current will only be 1.5LR, due to the time constant for the exponential being halved.

As the total resistance is doubled, the motor current remains the same but switching times are improved, allowing current to be maintained in the coils at higher step frequencies.

With the PKS 1186 drive card at nominally 24 volts, and a 6 volt 22 frame size motor, we have the L/2R torque curve. This may be extended to the L/4R curve by increasing the drive voltage to 48 volts if required.

Higher voltages and larger resistors are possible but losses are also high. More sophisticated drives, such as the PKS 1054, overcome this by current regulation. With this technique step frequencies of 20,000 steps/sec. (3000 RPM) may be achieved.



System torque calculations

Often the rotary motion of the motor shaft has to be translated into a linear movement. The most common forms are a wheel moving along a surface, or a screw thread driving a nut. The torque required to drive such systems may be calculated and a motor chosen from its torque curve.

1. Wheel drive

B = weight of system kp.
R = radius of wheel cm.
M = mass of wheel kg.
Inertia of wheel JW = M*R*R/2 kp/cm²
Effective inertia of weight JE = B*R*R kp/cm²
If velocity = V cm/sec,
then angular VEL W = V/2*PI*R rev/sec.
If the motor is driven at 400 steps/rev, then clock frequency = (400*V)/(2*PI*R) Hz
If JM = motor inertia
TS = time to accelerate the system, then total inertia JT = JM + JW + JE
Torque T = JT*400V/2R*TS*0.9/180*1.021/1000 kp/cm

Here friction has been assumed to be negligible. If this is not so, add the frictional load to T for the total value.

B = weight kp
P = pitch of screw mm/rev
E = efficiency of screw in %

Note:— The efficiency of a normal acme screw is only 35-45%. For best results a ball screw or acme screw with low friction nut (PTFE) should be used. The efficiency will then be greater than 80%.

Linear speed mm/sec = (steps/sec)/(steps/rev)*60*P*1E—3
Axial force kp = 62.8*T/P*E
I = torque kp/cm
Rotational equivalent of weight
JE = B*P*P*2.53*1E—4kp/cm²
The inertia of the screw
JS = D4*L*7.721E—4 kp/cm²
D = diameter of screw cm
L = length of screw cm

Note: The factor 7.72 assumes a steel screw.

As before, the total inertia JT = JM + JE + JSç
Where JM = motor rotor inertia
therefore if V = velocity in mm/min
step frequency SF = (V*400)/(60*P*P*1E—3) at 400 steps/rev
torque T = JT*SF/TS*9.9PI/180*1.021/1000 kp/cm²
where IS = time to accelerate the system, torque to overcome friction F
TF = F*P/62.8*E kp/cm²

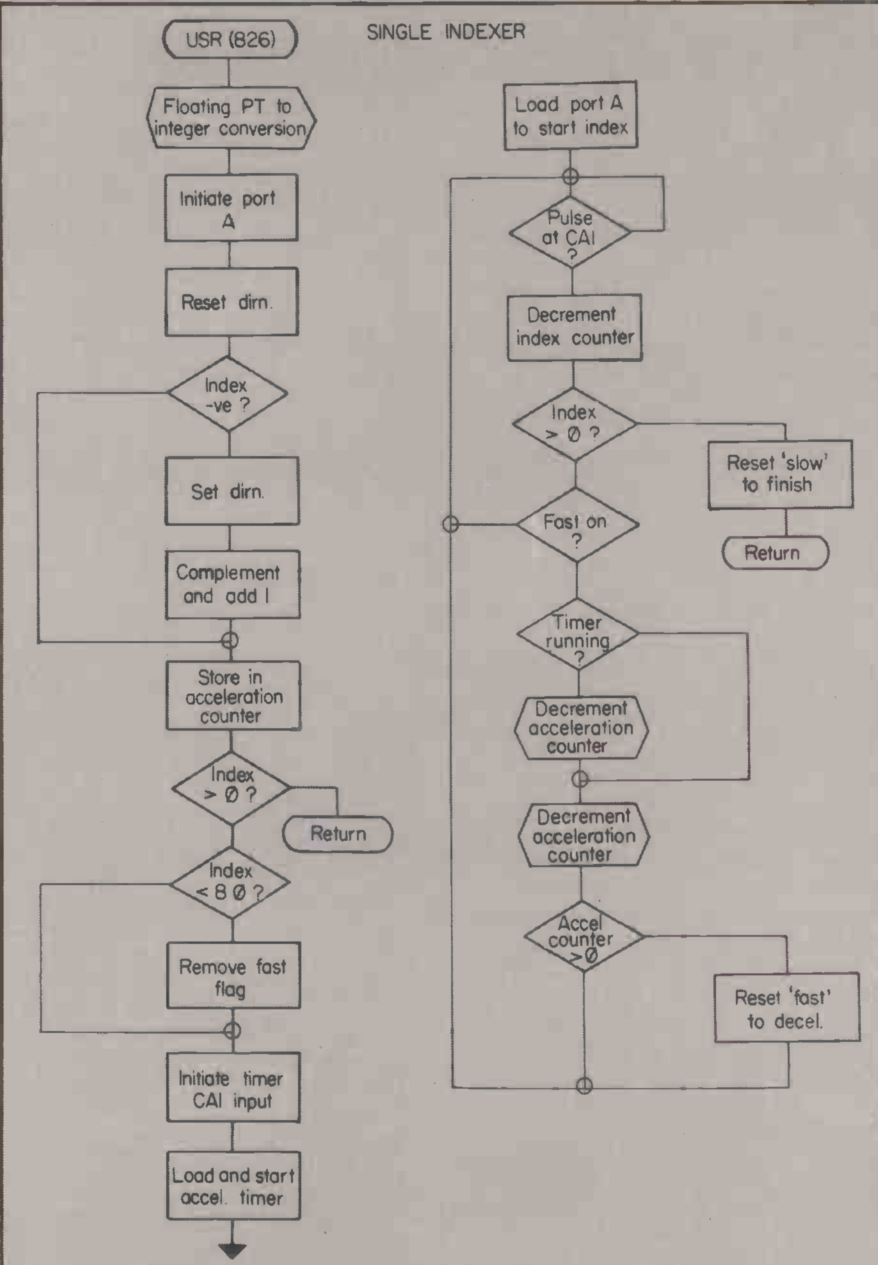


Figure 2: Single Indexer

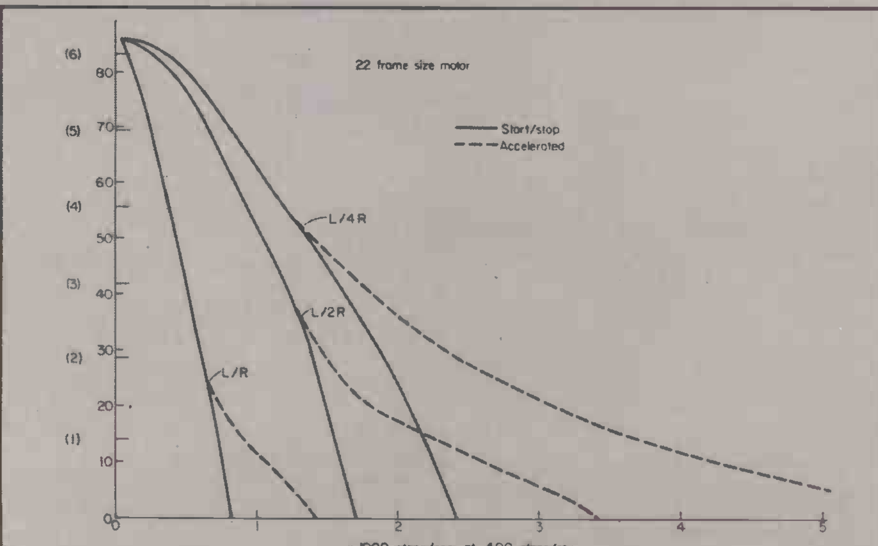


Figure 1: 22 frame size motor

The total torque is then the sum of these two torque values.

Gearing

Gearing of the motor to the load can be advantageous. Any gearing multiplies the motor torque by the gear ratio (G), but divides the effective inertia by the gear ratio squared (G^2). This therefore improves the loading of the motor, but requires G times the motor speed to keep the system speed the same. Gearing will always incur some losses and more motor torque is required to make this up. Despite this, advantages are to be gained from gearing, and where possible the effective inertia of the system should be equal to the motor's rotor inertia for maximum power transfer.

Drive card

The drive used here is a PKS 1186 bipolar L/R drive. The coils of the motor are driven from two bridges of four transistors each, the four coils being wired as two pairs. The use of a bridge enables the current to be driven through the coils in either direction **(figure 6).**

The oscillator to step the phases is incorporated on the card. Two inputs control this oscillator and are termed 'fast' and 'slow', variable resistors setting the frequency. The 'S' input gives frequencies in the range of the start/stop curve and thus will instantaneously produce and terminate motion. The 'F' input runs the oscillator into the motor's slew region and here the clock is accelerated, or ramped. This ramping is fixed by a capacitor on the card, but the acceleration time may be increased by addition of further capacitance. The sequence of the phase switching is controlled by the card with the 'dirn' input governing the stepping direction of the motor.

The card operates, and derives its cmos 12 volts, from one supply which is nominally 24 volts. No other supplies are necessary for operation.

Indexing

The algorithm used to control the positioning of the motor uses two counters and a timer. The timer is set to time the period in which the motor is accelerated, and this combined with one of the counters gives the deceleration point. This point is required to allow enough time, or steps, in which to decelerate the motor to a frequency at which it may be stopped without loss of rotor synchronisation.

During the timer period, the acceleration counter (AC) will be decremented from the total index value twice for each motor step pulse. The other counter, index counter (IC), is decremented only once for each pulse.

We start the index by loading AC and IC with the number of steps to run. The timer is loaded with the time taken to reach full speed. 'Fast' and 'slow' are taken low to start the clock and the timer initiated. For each step pulse AC = AC—2 and IC = IC—1, in basic syntax. This will continue until the timer times out or AC = 0. If AC = 0 we must have been constantly accelerating and moved half the distance.

If this is so, we will arrive at IC = 0 if we now decelerate at the same rate. If the timer times out we start to decrement AC only once for each step pulse as IC. When AC now reaches zero, and if we had reached full velocity before the timer finished, then we have a difference between IC and AC that is equal to the acceleration distance. Thus if we decelerate at this point, we will again reach zero speed as IC = 0.

In practice we know that the motor in its start/stop region I.E. 'slow', may be stopped instantaneously without error. This being so, we decelerate to 'slow' and run to the end, IC = 0, at slow speed. Zero on AC controls the 'fast' input to the drive, removing 'fast' when AC = 0. Two profiles for a short index, AC = 0 before timeout, and a long index are shown in **figure 4.**

Computer implementation

To implement the indexing algorithm on a computer, the counters become consecutive memory locations and the timer may be an interrupt-driven counter or a hardware counter controlled by software.

The listings shown here are for a Pet computer using the 6522 via to give the timer function and port I/O's for drive card control.

The first listing and flow-chart shows a single-axis control direct from a basic program with the index value passed by the USR function. This allows +/- 32767 steps as the index range, the value converted from a floating point number to an integer by the $D0A7 subroutine. If a negative value is passed, the 16-bit integer is complemented and 1 added to find the absolute value and the direction output is set.

The timer values TL and TH are set by the program but may be modified with poke commands to 1013 and 1014.

The use of 'fast' to control the step pulse oscillator leads to a small problem for short indexes. When 'fast' is applied, the acceleration capacitor immediately starts to charge, so even if 'fast' is removed quickly, the clock will output pulses after 'fast' has gone. This gives extra pulses on these small moves. To overcome this, the index is checked for a value of (80 steps. If so, the index is performed with 'slow' only.

The remainder of the flow diagram is that of the indexing algorithm. The pulses generated are flagged by their negative edges in the 6522 IFR AS CA1 transitions. The program loops on this test waiting for a result. This gives a 7usec response to 'interrupt' where as if the IRQ interrupt was used, a large overhead would be in-

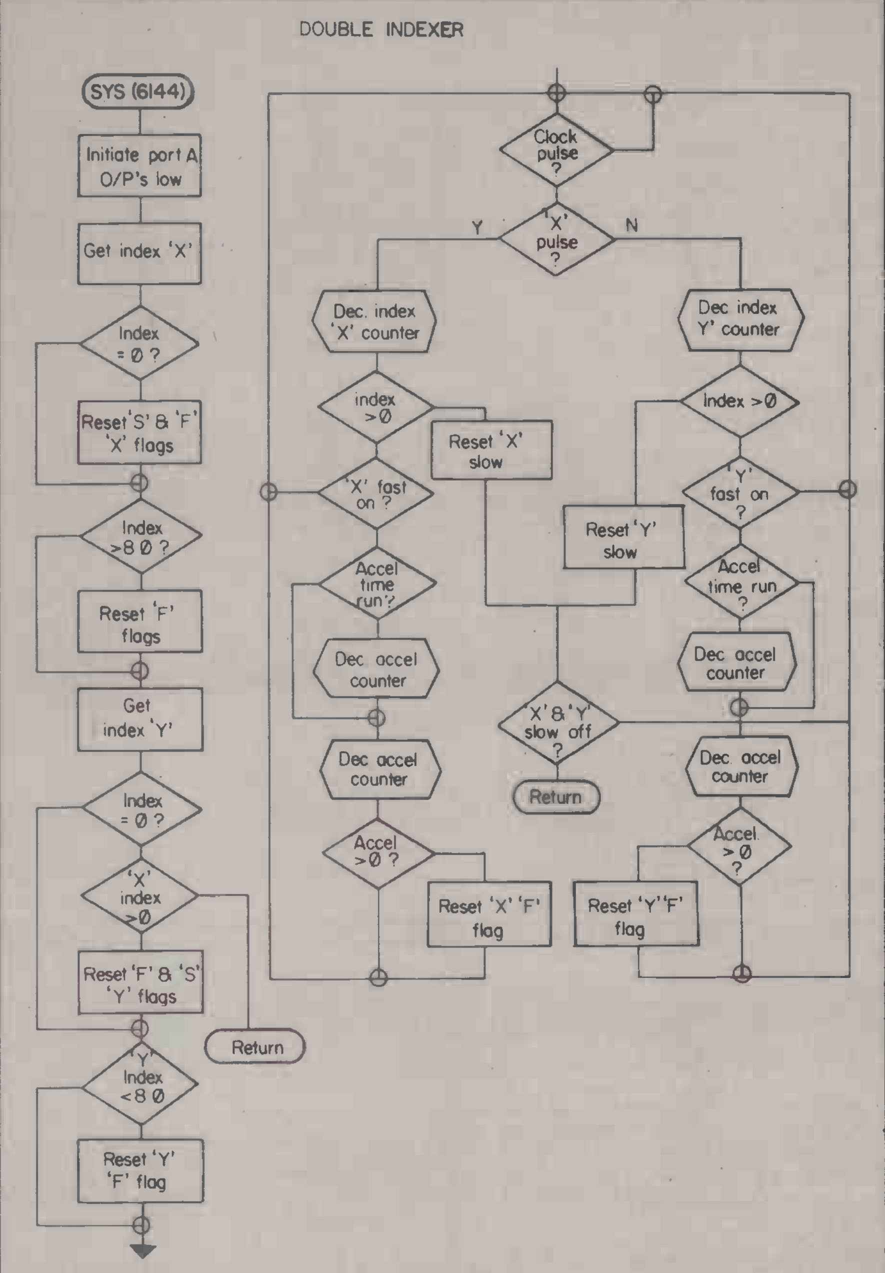


Figure 3: Double indexer

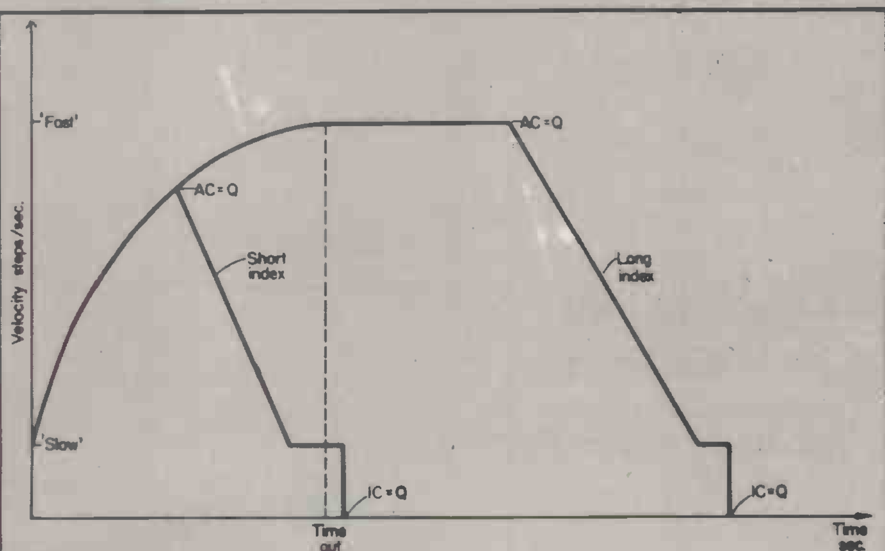
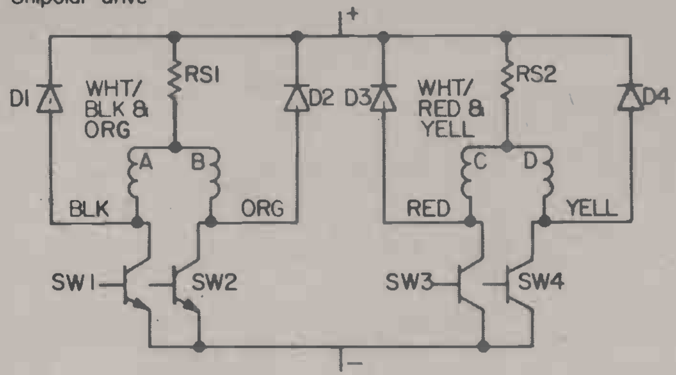


Figure 4: Profile for short and long index

CONNECTION DIAGRAM

Unipolar drive



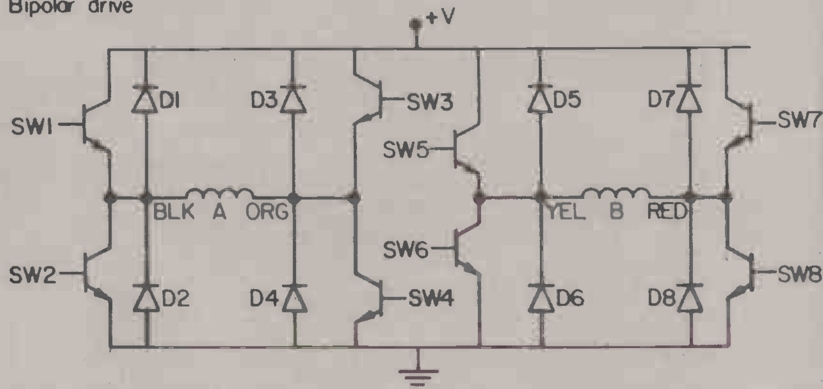
Full-step

Step	Coil A	B	C	D
I	I	0	0	I
2	I	0	I	0
3	0	I	I	0
4	0	I	0	I
5	I	0	0	I

Half-step

Step	Coil A	B	C	D
I	I	0	0	I
2	I	0	0	0
3	I	0	I	0
4	0	0	I	0
5	0	I	I	0
6	0	I	0	0
7	0	I	0	I
8	0	0	0	I
I	I	0	0	I

Bipolar drive



Full-step

Step	Coil A	B
I	I	I
2	+I	−I
3	−I	−I
4	−I	+I
I	+I	+I

Half-step

Step	Coil A	B
I	I	I
2	+I	0
3	+I	−I
4	0	−I
5	−I	−I
6	−I	0
7	−I	+I
8	0	+I
I	+I	+I

Figure 5: Connection diagram

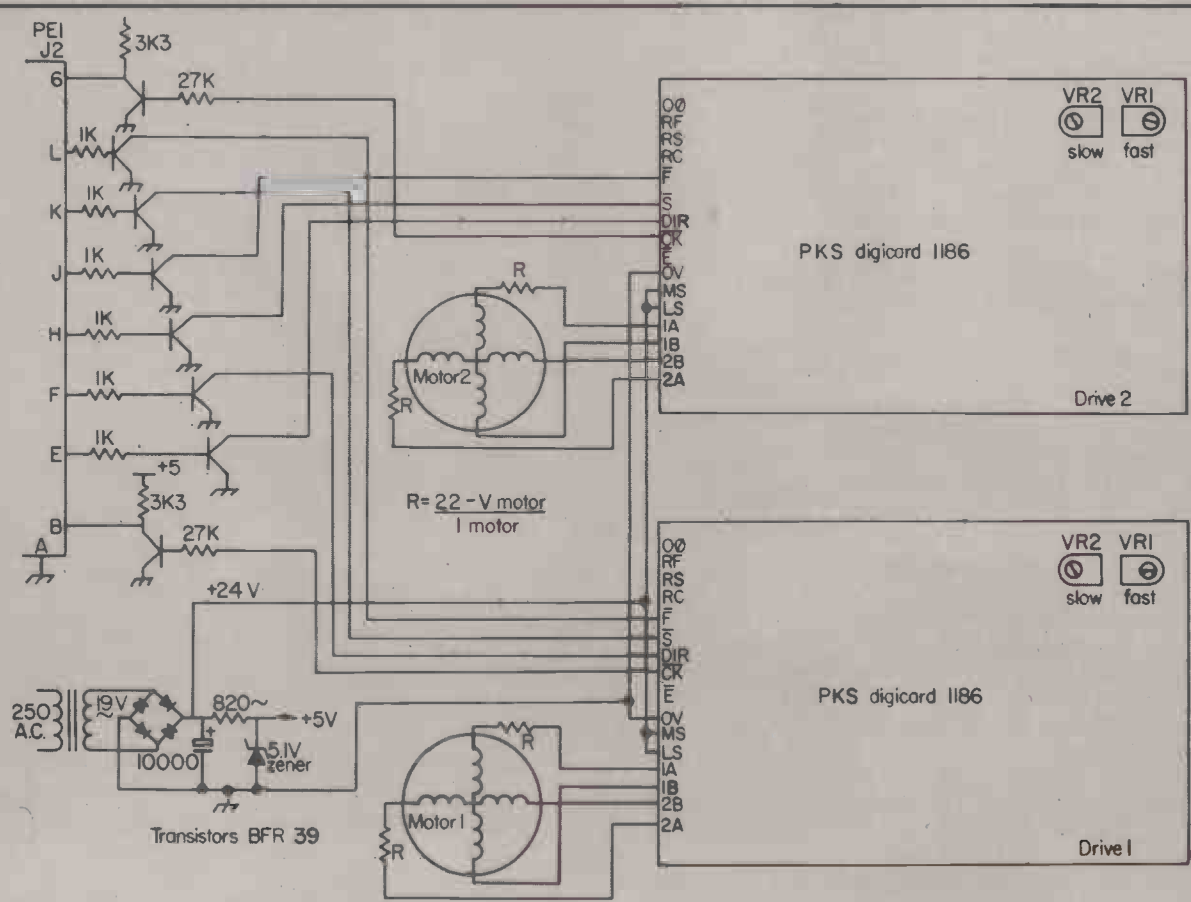
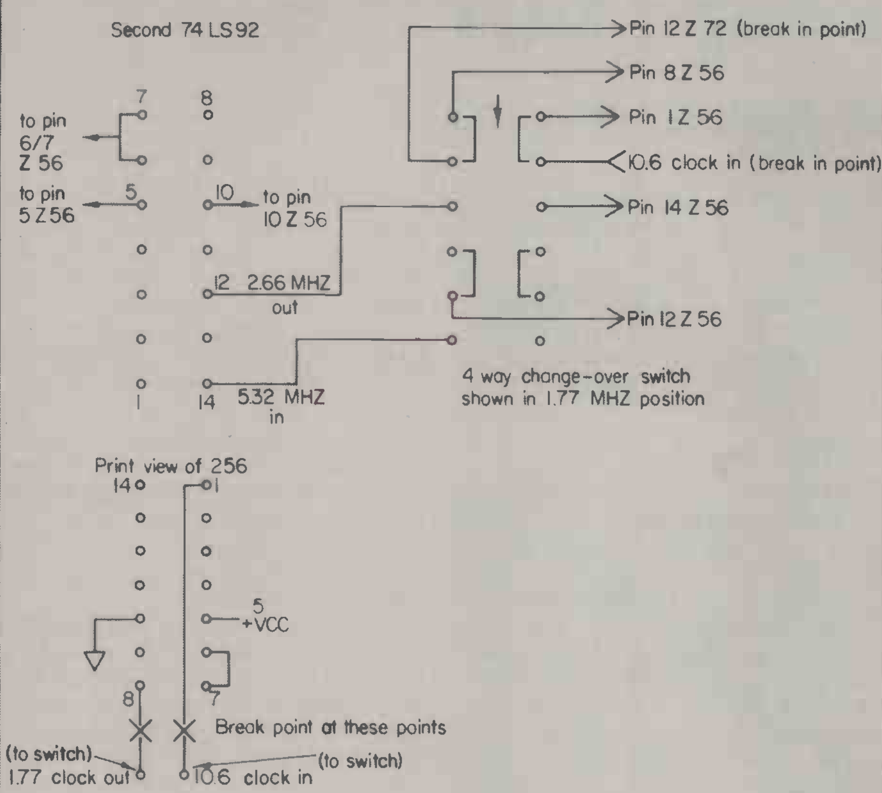


Figure 6



NB: A switch is needed since tapes will not load at different speeds. If the switch is operated while the processor is on, it will lock up and you will have to switch off.

Figure 7

curred, saving all the registers as the Pet operating system does.

The second listing is just a doubling of the first to allow two simultaneous moves. The USR function is difficult to implement for two parameters to be passed so 'mailboxes' are used. Instead a small basic subroutine:—

```
10INPUT"index x";X
20INPUT"INDEX Y";Y
30GOSUB10000

10000AX%=ABS(X):XH%=AX%/256:XL%=AX%AND
255
10010AY%=ABS(Y):YH%=AY%/256:YL%=AY%AND
  255
10020IFSGN(X)=—1THENS=SOR8
10030IFSGN(Y)=—1THENS=SOR4
10040POKE84,S:POKE6438,XL%:POKE6439,XH%:POKE
  6440,YL%:POKE6441,YH%
10050SYS(6144):RETURN
```

loads locations 6438 — 6441 ($1926 — $1929) with the two indexes. Sys(6144) transfers operation to the indexing program. The program transfers these values to zero page and performs the indexing as before. Two flags CA1 and CB1 are now used to detect the pulses generated by the two aces. Sign is provided by 'S' in the basic program and no negative conversion is necessary.

Due to the length of the double index program, the second cassette buffer cannot be used. Instead the top memory is lowered to 6144($1800),POKE134,0, POKE135,24, and the program assembled above here.

Interfacing

The PKS 1186 drive-card logic is all 12 volt cmos. To make the 5 volt port I/O's compatible, simple open collector transistors were used. A 5 volt supply for the CA1,CB1 input pullups is required and derived from the drive card voltage by a 400 MW zener diode.

The complete connection diagram for two drives is shown in **figure 5**.

A package is being offered that consists of a drive card, a motor and the listings shown here on tape ready to run on a PET. The cost of this is £55 and will give the same performance as shown in this article. The supplier is: PKS Designs Ltd, 40 Nuffield Rd, Poole, Dorset.

That old clock keeps turning . . .

by Anthony Butcher

THE CLOCK with moving hands idea rang many bells and we were deluged with programs to do it. Here is the best-documented, though we don't guarantee it will work, since our TRS-80 is having a tantrum and we haven't been able to key-in the program. It is from 14-year-old Anthony Butcher, of Ware, Herts.

Moving hands

The program can be accommodated on a Level-11 machine with 4KB. On first running the program a circular array of numbers (1 to 12) will appear, and shortly afterwards, the clock hands, which begin at one minute past twelve. The hands move on the principal that one is blanked out with RESETs, and then immediately afterwards, another is formed with SETs, but a little further around the face.

This happens first for the minute hand, and then the lower hand, after which a delay of about 27 seconds takes place — to achieve exactly one minute between each cycle — after which the minute hand moves again, so the cycle continues. The program obviously leaves room for improvement — for example, so that the clock can be started at any time, obviously making it easier to synchronise.

In line 20 of the program, FY is the scale factor (58/24), X and Y the co-ordinates for the centre of the clock face, and R the radius. Note that C is a double precision variable because, as it is used to determine the position of the hour hand, very small increments are required — see line 120 — which, due to the graphics resolution, results in a visible movement on the screen only every five or six movements of the minute hand.

Lines 30-35 display a circular clock-face but are not necessary, so can be omitted. Line 40 is the loop for the position of the minute hand, 2/3 being the correct increment to result in it making 60 movements around the face in each cycle; 100 closes the loop and 110 jumps back and begins again after each time round.

The "BP loop (50-76) is used to take all possible radii from O to R and re-set the graphics blocks there (70-75) where that radius intersects with A, hence the "-B" in lines 60-65, which determines the co-ordinate; 78-90 are much the same, except that PI/(2/3*R) is added to A; the line to be set, therefore, always slightly further around the face than the line to be reset.

Circles

The extra statements on lines 60, 65, 80 and 82 are to check for any points going off-screen, which should not happen if R«57, and so can be omitted. The extra "SET"s in lines 85 and 210 are to provide hand of more even thickness all round the screen, due to the shape of the graphics blocks, although they require extra "RESET"s so as not to leave odd blocks left on as the hands go round. The RESET in line 87 is also required due to this, as otherwise the impression of a circle would be left behind by the minute hand.

Lines 120-220 form the hour hand. The principle is much the same as 40-90 and 100, except that smaller increments are used; the hour hand is only half the length of the minute hand (130 and 180) and that the previous position (. . .-PI/(16*(R/2))) is re-set and the present one set. Line 230 sets the time delay (about 27 seconds) and 240 returns to line 95, 100 loops back to 40 and so the process continues. Despite line 250, the END can never be reached, the clock having to be stopped with BREAK.

The program

```
10 CLS
20 PI = 3.14159:FY = 2.41667:R = 45:X = 64:Y = 58:C    = PI
30 PRINT    109,"1";:PRINT    310,"2";:PRINT    569,
"3";:PRINT    758,
"4";:PRINT    940, "5";:PRINT    991,"6";
35 PRINT    915,"7";:PRINT    713,"8";:PRINT    518,
"9";:PRINT    265,"10",
:PRINT    82,"11";:PRINT    31,"12";
40 FOR A = O TO 2*PI*STEP PI*/(2/3*R)
50FOR B = O TO R
60 RX = INT(X + SN(A)*R-B):IF ABS (RX-63.5) » 63.5
THEN 76
65 RY = INT(Y/FY-(R-B)*COS(A)/FY): IF ABS (RY-23.5
» 23.5
THEN 76
70 RESET (RX,RY) :RESET(RX-1,RY) :REST (RX,RY-L):
RESET (RX + 1,RY) :RESET(RX,RY + 1)
75RESET (RX + 1,RY + 1) :REST(RX-1,RY + 1) :RESET
(RX-1,RY-1):
RESET (RX + 1,RY-1)
76NEXT B
78 FOR B = O TO R
80 SX = INT (X + SIN(A + PI//2/3* R))*(R-B)): IF
ABS (SX-63.5)
»63.5 THEN 90
82 SY = INT(Y/FY-(R-B)*COS(A + PI/(2/3))/FY):
IF ABS(SY-23.5) » 23.5 THEN 90
85 SET (SX,SY) :SET(SX + 1,SY)
87IF B = O THEN RESET (SX + 1,SY)
90 NEXT B
95 GOSUB 120
100 NEXT A
110 GOTO 40
120 C  = C  + PI/(16*(R/2))
130 FOR B = R TO R/2 STEP -1
140 RX = INT(X + SIN(C -PI/(16*(R/2))*(R/2-B))
160 RY = INT(Y/FY-(R/2-B)*COS(C   -PI/(16*(R/2)))/FY)
170 RESET (RX,RY) :RESET) RX:1,RY
:RESET(RX,RY;1):
RESET (RX + 1,RY) :RESET (RX,RY + 1)
172 RESET(RX + 1,RY + 1) :RESET(RX + 1,RY-1_RESET
(RX-1,ry-1):
RESET (RX-1,RY + 1)
175 NEXT B
180 FOR B = R TO R/2 STEP-1
190 SX = INT(X + SIN(C   )*(R/2-B))
200 SY = INT(Y/FY-(R/2-B)*COS(C   )/FY)
210 SET(SX,SY :SET(SX + 1,SY)
220 NEXT B
230 FOR D = 1 TO 6700:NEXT DE
240 RETURN
250 END
```

SOFTWARE BUYERS' GUIDE

This month we begin a new, regular feature. We feel there is now enough software for small business systems to be worth a Buyers' Guide. This will be supplemented by regular reviews of particular packages, in the same way that our hardware Buyers' Guide is supplemented by machine reviews.

The material is presented alphabetically by name of supplier. This may not be the most helpful method of indexing, but it is hard to think of a better. If we listed packages by the machines they run on, we would have to have multiple entries, with deleterious effects on pine forests needed for the extra paper; if we list by application, we would have to divide many entries up into half-a-dozen fragments.

The notation 'CP/M' means that the program will run on any machine using the CP/M disc operating system — Rair Black Box, North Star, Research Machines, etc.

The packages listed here cost between £50 and £1000, so we have excluded most of the small programs already available on cassette. In general, a machine will need at least 32K of RAM, discs and printer to use these programs.

Suppliers of relevant software not listed here are welcome to send details to the Editor.

by Mike McDonald

INITIALLY the microcomputer was intended to become another 'home entertainment' product. Early in 1978, the first shipments began to enter the UK and the term computer-store was the 'in word'.

Since then the micro has made a significant impact on the data processing world and also the education industry. The one place it has yet to conquer is the home, the very market it was originally designed for.

It is this shift of emphasis that has brought the microcomputer from its very simple hardware configuration to the present-day small business system look. With this metamorphosis has come the requirement for commercial applications software; it did not really exist a year ago.

Prime functions such as ledger systems, invoicing, stock control and management information have been the targets of recent developments. The tip of the commercial software iceberg is beginning to form.

Beginnings

The micro-processor chip was originally conceived in the early 70s as a process-control device to replace the traditional electro-mechanical methods.

It was not until 1976 that its potential was seen as a CPU in a larger configuration amounting to a desk-top computer. In 1977, US companies such as Apple Corp, Tandy Corp and Commodore Business Machines put on the market machines specifically aimed at the home user.

The need to keep the price down to a consumer level meant economies in the design and manufacture. Equipment such as the audio cassette recorder as a low-cost storage device was 'pilfered' for use in this new breed of computer.

American systems were not radically altered, apart from the power supply, for sale in the UK. Interest in this country came from three main sources; the electronics hobbyist, Data Processing industry programmers, and education. Alas, the 'home user' was non-existent in the UK, where disposable income is nothing like that enjoyed by the American consumer.

Equipment problems soon became apparent in the form of slow data transfer rates, inconsistent loading and high error rates from the cassette recorders, failure of economy components such as keyboards and

operating system software bugs and glitches.

The original OEMs to enter the market are now introducing their second-generation machines, with improvements in both hardware and software and more peripheral options.

System software (such as the operating system and high-level language) was written, in many cases, by the OEMs concerned, who did not have previous experience in such areas. This led to a wide variety of operating systems and monitors with no proven track record and, in some cases, major errors.

Some manufacturers held their systems on ROM which, had the advantage of protection from user corruption (enabled by the availability of PEEK and POKE commands). The disadvantage of this arrangement lies in the inability to load other versions of operating systems or high level languages unless the user was familiar with machine code routines.

The alternative loading systems software into the core from the tape or disc held the greater disadvantage of being easily corrupted by the user or his programs and also needing extra RAM to hold it.

Until floppy disks became more widely available, this software was often loaded from cassette storage, taking up to 20 minutes, and subject to load errors and data checks. In the same way each manufacturer offered his own version of Basic.

'Plug-in' programs

The revival of this language is indeed a good thing, as Basic is still considered by many to be the easiest language to grasp quickly.

Pascal has received considerable attention — it meets the criteria of small core space and its minimally non-procedural, but it has yet to make any major inroads on offerings from the leading suppliers.

Applications software was virtually non-existent when the personal computer was first made available. Surprisingly, the OEMs had not prepared adequately for this; they did not realize that the home user would require programs to turn his purchase into an useful machine.

Five distinct sources now provide a range of programs that can be 'plugged into' many of the 30-odd systems available today.

1. User groups: The user groups were founded primarily either by the manufacturers for a mass of information concerning internal workings of the machines and problems with them that many of the new owners were experiencing. Early systems were poorly documented and manufacturers had not organised after-sales support for their untried products. Independent groups even set up in competition with the OEM backed user group.

As problems were solved, the groups were able to spend more time on creating and distributing software.

The first programs written by the users included games, utility routines, and statistical and mathematical functions.

There were also the basic programs often used as demonstration modules on small systems and mini-computers which were quickly adapted to the micro and in general became readily available for swapping.

The standard of the software varied from appalling to fair. Very good software needs to be written for the system intended and experience was the missing ingredient.

Games received the greatest time and attention, firstly because of the limited amount of usable memory. Most systems initially only offered 4 or 8Kbytes of memory. Programs for business applications need not necessarily be large, but often a greater proportion of memory is needed to store information handled by the program as in, for instance, ledger transactions.

The other problem was that computer architecture of this type was very new and programmers had to spend a reasonable amount of time learning the operating systems and determining what was and was not possible with the limited core and I/O facilities of the personal computer.

Writing games software is a good exercise in this respect — the requirements and rules are local knowledge for the programmer and his — or her — attention can be focussed on achieving the required result.

An interesting aspect of the microcomputer is the fact that the small core capacities (a maximum of 65535 bytes can be addressed with the 8-bit processors chosen by most OEMs) has created a new form of programming that is based on a discipline of byte scraping or efficient core utilization.

User groups are now fairly well organised and offer members a reasonable range of games and utility software at cost prices. There is not a great deal of interest in by business user in many of the existing user groups, but as commercial software becomes more widely available and used, it is likely that we will see sub-groups forming or possibly dedicated user groups for the businessman.

2. Distributors: As distributors were appointed by the OEMs, many found the lack of software a distinct disadvantage when selling systems to inexperienced people. Also the potential was seen early for the commercial system based on a personal computer and many sales were made on the premise that peripherals would soon become available, allowing upgrade of the basic hardware.

With the advent of such upgrades, the distributors set about organising software to sell to the user base and also to enhance the product into a total package hardware and software.

Some of them employed programmers as part of an investment in developing commercial applications packages. Others hired the services of software houses to do the design and coding.

The rest either have not entered this market, being content with hardware alone, or have approached the new users offering to act as marketing agents for any original programs written. This method is attractive since little investment capital is required. Much of the commercial software becoming available has been produced this way.

Now that the hardware is capable of commercial processing, the rush is on to produce 'good' packages, for slae to the business community.

3. Consultants and software houses: Neither of these sources are particularly new to this particular market. The microcomputer presents an excellent opportunity for the application of the wealth of experience gained by such organisations in the standard business systems software field.

Not all consultants are experienced or software houses perfect, but the user should expect a reasonably high standard from a company with an accredited name. Experience in the more traditional mini-computer area is relevant to the new breed of hardware and the user is wise to ask about a particular supplier's background.

Several software houses have been formed specifically to produce programs for the microcomputers and seem to be succeeding. A good example of this is PETSOFT, now called MicroACT, formed by Julian Allason.

Mr Allason started the company specifically to write programs for the Commodore Pet and was then taken over by ACT of Birmingham, a large bureau business with significant experience in the mini/micro scene.

Petsoft remains as a company primarily concerned with games, educational and miscellaneous software and MicroACT concentrates its efforts on the more commercial applications mentioned earlier.

Some firms also offer consultancy with a Turnkey solution which will consist of programming a chosen machine to a user's specific requirements. This is usually costs more but that can't be helped if a package cannot be found to suit the need. In this case the user should look for professionalism as well as experience in a supplier and make sure that the system is fully specified before coding begins. This will ensure that nothing is assumed or left out of a development, and that costs should not vary drastically from the original estimates.

4. Manufacturers: It is unfortunate that manufacturers were later entrants into the software scene. The OEMs have the advantage of the expert knowledge of their hardware and are in a good position to write efficient and sound programs for their equipment. Their main disadvantage is lack of experience in commercial application, although this can be bought-in.

Manufacturers are now beginning to release commercial packages for supply with their systems in an effort to gain a niche in what will become a very lucrative game and also to acquire a 'total product' capability to offer the business person. Some have written their own software and others are using software houses. OEMs have already established user groups to market software to, and to get libraries from.

5. The Press: The media have generally contributed greatly to the software scene. Since the launch of the microcomputer, many home-grown publications have appeared offering sensible articles on programming techniques, file management, and business applications.

When there was not a great deal of software available, they published source listings for games and useful applications, creating a new and novel approach to computing. The result was the breaking-down of the mystique of the computer world and can only be regarded as healthy.

American publications were about the only benefit brought over with the personal computer, and some of these have become relatively technical publications for those interested in systems software techniques.

The media have also acted as a strong voice, by way of hardware reviews, in getting the OEMs to correct faults. Many of today's readers are tomorrows user's, so bad publicity is bad news for the supplier.

Another novelty on the computing scene are the books of instruction in Basic programs and program listing that are popping up. These have proved to be highly popular.

Given the multiple supply sources of applications software, the user can begin to concentrate on the best possible configuration needed to meet his requirements. Hardware improvements, combined with dealer experience, will alleviate bug-hunting.

More often than not, the question of capacity will remain the prime question of microcomputer. Other makes of peripheral such as floppy disks and printers, are available for tagging onto proprietary makes of computer, and often offer improved throughput, capacity, efficiency, or reduced cost.

These hardware options should be considered, as they can often double the capacity of the system. The only question must be whether the software package being considered will work with the peripherals.

Software capability

Having determined that capacity is adequate, not just for current needs but also, future expansion, then the next aspect will be the software's capabilities. Many of the packages now available are low in price but fixed in format — they cannot be tailored to the user's requirements.

This is important, as it can cause a company to alter its method of working, which may be adequate, to a system not suited to its particular problem.

An example of this might be the modification of a stock numbering system to a computer-based system that would not indicate particular information previously shown or, worse still, would have less scope for growth and expansion.

Another aspect of computerisation that is often overlooked and yet represents a major cost element is that of data take-on. This is the initial keying and loading of existing information onto the system to allow day-to-day running to begin.

This will not be applicable if the system is phased-in slowly, say in the case of ledgers, against a manual system. From a certain point onwards, all new information is loaded and the files are built up slowly.

The disadvantage lies in the inability to report fully on the true current situation.

The advantage comes in the familiarisation process which allows users to aquaint themselves with the running techniques and check the workings against the manual system until confidence is gained and a full conversion date is chosen.

Packages will vary from source to source in terms of capacity, facilities for data entry and modification and reporting. Only the user will be able to determine exactly what will suit his particular purposes but beware of 'future developments'. If a facility you require is 'currently being developed', ask to see it first before you buy.

All commercial package offerings should have an associated security system. This should take the form of file duplication on a frequent and regular basis with a control form or log sheet (old/current/new), to ensure that files can be recovered against accidental loss caused by human or hardware failures.

The other aspect of security is file protection. Built into the program/s should be a check of file details to prevent processing to occur to the wrong file or diskette. This is particularly important in multiple diskette based systems.

Always try and get 'hands-on' experience of a package before buying it. A good program will be 'bomb proof' — it cannot be interrupted by miskeying, and it should not fall apart or display unintelligible messages as a result of abuse of the keyboard.

Data entry input should be verified by the program for validation of numeric or alpha fields and range checks should be made against numeric quantities such as part numbers, account numbers, transactions etc. The program should not accept invalid entries at the time they are keyed, given the above constraints.

A trait of the personal computer are the RESET, STOP, or INTERRUPT keys on the keyboard. Make certain that depression of this key does not affect a program. It should always be disabled by the software and the only exit from a program that is carrying out file handling should be the one shown in the manual.

Documentation is an equally important subject, especially with off-the shelf programs where no user training is given. It should be clear and concise, indicating all possible system responses to each operation.

If there are difficulties to be encountered, then these should also be covered in the manuals, detailing error messages and probable cause of the failure.

If training is available, then it is recommended the user spends the small amount extra for this. It can often prevent misunderstanding of fundamental issues.

It is also wise to ensure that more than one person in your organisation is capable of operating the equipment. This point is often overlooked.

Some package suppliers offer pre-printed continuous stationery for use with the software. While obviously more expensive than plain stationery, forms will make life easier for the user in the day-to-day running of the system and aesthetically more pleasing.

Support for the software, especially in these early days, is very important, so find out what level of support is available either from the dealer or original authors of the package, and what sort of turnaround can reasonably be expected. Support can take the form of upgrades to the original programs or an ad-hoc advisory service to cope with the user's difficulties or queries.

It is essential to have a maintenance contract for all the hardware used in the running of prime commercial applications, especially where the hardware comes from several sources. The important thing about the agreement is the response time to a repair call — assuming an on-site repair can be made. As equipment becomes more widely used, perhaps other users can be approached about mutual backup.

Finally, the best possible assessment of any software package can be sought from an installed user. Suppliers should always be capable of supplying a reference user — the more the better — for you to visit. Have doubts if they cannot.

Summary

The market for the low-cost computer with suitable commercial applications is beginning to bloom and will spread to cover all aspects of the business community. Both hardware and software are breaking price barriers in an attack from the bottom upwards on the traditional data-processing industry.

Desptie these low prices, software should be no less perfect than its predecessors used on larger machines. To Computerise the prime functions of a business is to computerise its life-blood, and there can be no room for error.

In the coming days of do-it-yourself computing, the user wil be responsible for the selection of his system and must make sure that sufficient common sense is exercised in that process to diminish potential problems. Although there are few packages yet, things are moving quickly towards a buyer's market and competition will be keen.

If you are bewildered by the hardware software options and alternatives, then there is always a broad base of professional advice available, for a fee, to head you on the right track.

Let the buyer beware!

ALGOBEL COMPUTERS — payroll

APPLE

Conforms to I.R. specifications offering the following: calculation of pensions, tax, NI, overtime, holiday, bonus, and additions on a weekly, monthly, fortnight, or four-week basis. Payslip, wages book, coin analysis, and annual tax prints. Capacity — 45 employees on single disk or 445 on dual disk.

Price: £235

33 Cornwall Buildings, New Hall Street, Birmingham B3 3QR.

COMMODORE BUSINESS MACHINES — stock control

PET

This is a package for use on the new generation of PET with dual disks and printer. Information held is stock number, reference, description, current level, quantity on order, allocated quantity, cost and sales price, re-order level, total sales year to date, and unit of sale. A general-purpose housekeeping routine is provided to make global changes. Reports on demand cover stock list with highlighting of low/re-order items and totals for value at cost and sale, re-order report, stock-take report producing stock-take dockets for manual use. An interactive extract-and-print search facility is included, with searching on any field or part-field. Capacity is up to 1300 items.

Price: £150

818 Leigh Road, Slough Industrial Estate, tel Slough 74111.

COMMODORE BUSINESS MACHINES — business information system

PET

One of a few packages becoming available to allow the user to establish his own management information system without the need to learn a programming language. The user defines to the system the structure of his file and is given general-purpose search, display, and print routines to access his information base. Applications suited to this type of program are personnel records, prospect lists, subscription records, mailing lists, registers, stock files. Two print routines are provided with this package giving a print-label run and a general-purpose report. There is room in the program for user-supplied print formats. Searching is carried out on and off the fields and an index file is created for print purposes. These packages would not be used where calculation of fields is required. Individual records can be quickly accessed and displayed on the screen. Functions include insert, delete, modify, recover and free records.

Price: £150

COMPUTASTORE — payroll

PET

Weekly or monthly system with calculation of standard additions and deductions as well as after-tax adjustment facility. Pre-printed duplicate payslip stationery available. Master file reporting as well as department analysis. Coin analysis is standard and an upgrading service is provided for rate changes.

Price: on application

16 John Dalton Street, Manchester M2 6HG, tel 061-832 4761.

GRAFFCOM SYSTEMS — payroll

CP/M

This package has been designed to HM Inspectorate of Taxes specification and updates are being incorporated when required. A weekly or monthly system allows payments as cash, cheque or giro transfer. Features include contracted-in NI, cash payroll list, special deductions, pre-event holiday pay calculation, as well as the standard calculations. Reports simple and include employee master file details and payroll log. Capacity — 250 employees.

Price: £500

52 Shaftesbury Avenue, London W.1, tel 01-734 8862.

GRAFFCOM SYSTEMS — company purchases system

CP/M

This is a purchasing control system and records all purchase invoices and carries out purchase accounting (purchase ledger). Features include VAT analysis reports, cost-centre coding, batch totals on input transactions, and interfacing with GSL's general ledger system and name and address system. Capacity: 540-7000 invoices (depending on disks).

Price: £450

GRAFFCOM SYSTEMS — company sales system

CP/M

This is a sales ledgers system that is also compatible with other Graffcom packages, ie nominal ledger and names and address system. Volumes are similar to those shown above. Invoice details may be entered directly against a user chosen reference or account number or from the GSL order entry and invoicing package. Payments, and credits/debits are entered against an invoice number which are referenced to an account number. Facilities are: aged debtor analysis, VAT analysis, cost-centre coding, batch totalling, and reports on keyed entries: payments discrepancies, ledger, aged debotrs, and VAT are available.

Price: £450

GRAFFCOM SYSTEMS — name and address system

CP/M

This is basically a mailing system that can be used to hold address information for the accounting packages. Up to six fields are stored for each entry with name, address, telephone, contact, and two user-definable fields. Reporting is left for the user to design and specify depending on requirements ie mail labels, directory lists etc. Capacity varies from 800-5000 entries depending upon the disks used.

Price: £250

SHOPWINDOW

GRAFFCOM SYSTEMS — stock control system

CP/M

This stock reporting system allows details to be entered against each stock item showing: description, product code, unit, unit price, quantity on hand/on order/minimum. Stock movement reports may be produced for any period, with a comparison with those for the previous period. Features include on-line display of current situation for any one item, detailed reports of stock movements and analysis, and interfacing with GSL's order entry and invoicing system. Capacity is in the range of 520 items up to 6000 items, subject to storage.

Price: £350

GRAFFCOM SYSTEMS — order entry and invoicing

CP/M

This package maintains order details and invoicing until completion of the transaction. Invoices are generated for part orders and part quantities within item, subject to stock availability. Sales analysis reports show movements by product code, or classification within any period. This package interfaces with the name and address system, the stock control system and the sales accounting packages. Functions are: add new orders, update orders, remove orders, produce invoices, sales analysis, and security back-up routine. Capacity ranges from 500 to 5000 active orders, subject to mass storage system.

Price: £350

GRAFFCOM SYSTEMS — lease rental and hire-purchase system

CP/M

This is an unusual package to control agreements and contracts that are payable at regular intervals at fixed amounts. The program handles four kinds of agreement — lease, rental, hire purchase and maintenance, with payments by invoice, standing order or cash. this package interfaces with the GSL sales system and name and address system. The system can calculate all payment types over any period and post these directly to the sales ledger system, for the appropriate period. Features include: cost-centre coding, various payment periods, on-line display of current agreement details. Reports are: agreement report, payment invoices, mailing labels, cash payments worklist, bank reconciliation list, and a sales ledger list if used with the company sales package.

Price: on application

GRAFFCOM SYSTEMS — time recording system

CP/M

This is designed for service companies where the commodity is man-time. Information is gathered from employee time sheets and bills entered into the system. Billings can then be produced showing weekly costings and expenditures. Analysis can be weekly, fortnightly, monthly for account and sub-account codes and activities. Up to 100 activity codes may be assigned with a unique rate. This package can be interfaced with the sales accounting system for invoicing and also to the order entry system.

Price: on application

GREAT NORTHERN COMPUTER SERVICES — general ledger

Z80/8080

This is a double-entry booking system originally written by Serendipity Systems Inc (USA) and converted for UK use by the GNCS. Features include user-defined chart of accounts, month-end and year-end totals routines, data validation, and reports include: daily summary journals, monthly receipts, cash disembursements, and sales journal, chart of accounts, operating statement by user/department, and balance sheet and historical activity reports by account code or job number. Capacities will depend on hardware used.

Price: £275

GREAT NORTHERN COMPUTER — retailer stock control

Z80/8080

This is a simple stock-control routine aimed at the retail user where movements are high and reporting is more detailed. Stock items are coded to user requirements with an alphanumeric code. Information is held on description, price, cost, minimum level, current level etc, with an update routine. Reports are produced for stock items — on hand, on order and on file, items at or below re-order level, week-to-date sales, month-to-date sales, three-month sales analysis, and year-to-date totals. There is also a user-specified report generator for special requirements.

Price: £275

15 Wellington Street, Leeds LS1 4DL, tel 0532 450667.

GREAT NORTHERN COMPUTER — client billing

Z80/8080

This is a man cost control system for service-type industries. The user can define client numbers, service codes and case numbers. Features include: auto-calc of activity by service code, auto-billing of fixed monthly charges, auto-account ageing. Reports are produced for clients list with ageing and last-payment details, master list of service codes and activities, list of current transactions both released and held, by clients and case numbers, and client statements and billing statements.

Price: £330

GREAT NORTHERN COMPUTER — job order control

Z80/8080

This package is suited for the one-off job environment and offers: user-defined customer and order numbers, order detail information and staus entry, update of current records, partial shipment entry, and full data input validation. Reports include individual order details, lists of open orders and status, by customer type, overdue, and dates, and invoices with mailing labels for completed orders.

Price: £275

GREAT NORTHERN COMPUTER — appointments system

Z80/8080

This software package is aimed at the medical world and comes in the form of an individual system or group practice system. The program maintains records of appointments for each of several practitioners over 15-minute intervals. The group system holds details on appointments for groups (up to eight per 15-minute interval). There are user-defined practitioner schedules and reserved times and days. Data is entered interactively and look-up is available by time or by patient/client name with truncation/masking. Schedules can easily be modified and search is provided for free periods, by time of day. Reports are produced by individual practitioner by day and time utilization by practitioner by month. Load units can be pre-determined for the group system and load units assigned to a 15-minute interval.

Prices: £220, individual system, £275 for group system.

GREAT NORTHERN COMPUTER — integrated business system

Z80/8080

This is a consolidation of the Serendipity covering: general ledger, payroll, accounts payable, and accounts receivable system. The latter three programs produce a file containing debit or credit amounts with GL account numbers, transaction date, user-assigned reference number and appropriate employee/customer/vendor number. Whenever the daily entry program of the General Ledger is run, the file can be read in the reset. Facilities and features are those already stated for the other systems.

Price: £995

GREAT NORTHERN COMPUTER — accounts payable

Z80/8080

This ledger package offers the following features: user-defined payee numbers, interactive data entry and edit functions, automatic calculation of discounts, adjustments entry for retired goods, user-defined age categories, bill review program, statements and check listings, and a master payee list with aged balances and audit list of cheques paid.

Price: £275

GREAT NORTHERN COMPUTER — accounts receivable

Z80/8080

This sales ledger again is sourced from Serendipity and has: user-defined customer numbers and service codes, user-defined default fees, calculation of activity by service code, finance charging, account ageing, ability to change past-due balances. Reports on master customer list, lists of service codes and activity on a daily, monthly, or yearly basis and, of course, statements.

Price: £275

G.W. COMPUTERS — general

PET
Z80/CPM
6800

A suite of 24 programs covering most business applications including: stock, invoicing, sales ledger, purchase ledger, incomplete records accounting, tax analysis, payroll and management information from the above. Each program covers either an entry, display or print against capacities of four companies, four bank accounts, 50 agents, 999 customers/suppliers, 1000 stock items, 200 employees; subject to disks.

Prices: Versions 1, 2, 3, & 4 increasing in complexity, £275 — £575

89 Bedford Court Mansion, Bedford Avenue, London W.C.1, tel 01-636 8210.

PROFCOMP — incomplete records accounting

NORTH STAR

The package is aimed at practising accountants and is based on a single-client-per-diskette system, allowing each client to have a chart of accounts and individual formatting. The program allows for eight journal types and one adjustments journal. Reports are parameter-driven by the user and include a general ledger print; by account type, final accounts print and balance sheet. A maximum of 2000 journal entries can be processed in any one pass of the accounts update. A provisional entry routine allows the user to display the effects of the journals on the accounts before they are committed.

Price: on application

107 George Lane, Scouth Woodford, London E.18.

MICROACT (PETACT) — purchase ledger

PET

Very similar to the sales ledger in design and use. A suite of programs provided on a floppy disk with manuals allows the user to update supplier name and address file containing discount rate and payment method (cheque or giro), post transactions to the files, print remittance advice notes, ledger records and account balances, print a creditors list, and carry out month-end summarisation of accounts and clear down of the transactions file. Aged balances, over four months, are displayed for each account accessed. Built-in security system allows simple diskette duplication. All programs are accessed from a menu. Capacities as per sales ledger.

Price: £350

Radclyffe House, 66 Hagley Road, Edgbaston, Birmingham B16 8PF.

MICRODIGITAL — mailing

APPLE

Another Apple-sourced package **Apple Post** is a data base system for the production of mailing lists. Entry and listing of up to 2500 names, address, phone number with masked searching of name field. Label runs can be keyed on name or Zip-code search.

Price: on application

25 Brunswick Street, Liverpool L2 0PJ, tel 051-236 0767.

MICROACT (PETACT) — sales ledger

PET

This package was written for the PET using both the CBM drive and Computhink drive. Entry of invoices, credits, cash and transfers is through an account display routine giving full account details and updated totals. Reports include audit list, aged debtors list, control accounts, and statements. Account enquiry is simple with a print option. Account details can be spread over multiple diskettes in sections. Capacities: 200 accounts per section (diskette) with 700 transactions on the PET disk drive, or up to 2000 accounts and 7000 transactions on the Computhink drive.
Price: £350

MICRODIGITAL — ledgers

APPLE

The **Controller** is a suite of three programs sourced from Apple Corporation comprising general/sales/purchase ledger programs. Each package can have up to 250 accounts with up to 1000 transactions per account. Facilities include summaries of journal accounts, revenue/expenses, balance sheets, income statements, mailing label print, customer/supplier lists, sales commission reports and statement printing (48k min).
Price: on application

STAGE ONE COMPUTERS — Petaid reporting system

PET

Fairly similar in function to the Commodore offering, and again has a very wide application for information retrieval both for look-ups and print runs. This package allows the user to set up his file layout on the screen in a physical format and offers string searching within records and logical testing of matching results. Functions include insert, delete, browse, display, screen formatting, and create.
Price: £120

6 Criterion Avenue, Old Christchurch Road, Bournemouth.

STRUCTURED SYSTEMS GROUP — mailing

CP/M

NAD is offered by a number of dealers on different machines, therefore capacities will vary. The master file can contain a number of user-defined fields such as other contact names, comments etc, and each field can be searched using masking techniques. A file extract facility is available so that secondary files may be created from an extract run. Label runs allow for 1-4 across label printing.
Price: around £50

LP Enterprises, 8 Cambridge House, Cambridge Road, Barking IG11 8NT, tel 01-591 6511 and A J Harding, 28 Collington Avenue, Bexhill-on-Sea, Sussex, tel 0424 220391 and other dealers.

STRUCTURED SYSTEMS GROUP — nominal ledger

CP/M

General ledger system with user-definable reporting system. Standard reports include ledger print, balance sheet, income statement, chart of accounts, accounts distribution, and change in financial position. Full audit trail facility with an automatic back-up system. Statement format can be varied by the user. Batch entry is permitted for ease of data prep and trial balance is standard. Capacity will vary with hardware.
Price: £500

STRUCTURED SYSTEMS GROUP — purchase ledger

CP/M

This package is also compatible with the nominal ledger system and can transmit data across to the NL. Data entry is pre-formatted to a SSG pay-voucher system. The package can compute discounts, schedule payables by vendor or date, summarise expense activity, and print checks. A release program allows user-defined pay dates and amounts to be entered with analysis reports on aged balances and cash requirements. A check register is held for audit purposes. DMS provides formatted data entry routines on the VDU with full data validation.
Price: £460

SHOPWINDOW

STRUCTURED SYSTEMS GROUP — sales ledger

CP/M

An open-item package again offering customised statements. Reports include: aged trial balances, statements, reminder letters, sales reports, and transaction journals. Ageing is over 30, 60 or 90 days and processing can be carried out on a cyclic basis over 26 days to separate base by billing date location, status or size. Fully compatible with the nominal ledger.
Price: £400

TRIDATA MICROS — sales ledger

TANDY TRS 80

Written specifically for the UK, this ledger offers: update of customer file, transaction entry and update, display or list invoices and credit notes. Reports include statements, aged debtors control list, VAT analysis, sales day-book, cash day-book, customer names and addresses, labels, debtors list. Cash input and allocation is permitted and VAT rate change is possible. Capacity unknown, but 32K min with two disk drives required.
Price: £100—£225

Smithfield House, Digbeth, Birmingham, tel 021-622 6085.

TRIDATA MICROS — purchase ledger

TANDY TRS 80

Similar in design to the sales ledger, this package offers: supplier file create/update, hold/release payment, creditor control report, creditor list, remittance advice printing, cheque list, VAT analysis report, purchases day-book listing, suppliers name and address label and print list, and alteration of VAT rates.
Price: £100-£175

TRIDATA MICROS — nominal ledger

TANDY TRS 80

Functions available — nominal postings and updates, trial balance, profit-and-loss account, options, and file maintenance. It is not known if this package integrates with the sales and purchase systems.
Price: £175

TRIDATA MICROS — stock control

TANDY TRS 80

A simple stock package containing details of stock items, levels, and adjustments. Facilities available for updating master stock file, stock issues and receipts and minimum re-order levels. Other information held are prices and references. Reports are produced for stock movements, re-order situations, stock list, etc.
Price: £150

TRIDATA MICROS — payroll

TANDY TRS 80

The payroll program allows for creation of new employee records and deletion, amend employee record, amend parameter file (calculation rules), amend totals file, display of spare numbers file, calculation and print of payslips, coin analysis, print totals, year-end summary, and amendments to the package.
Price: £200

TRIDATA MICROS — order entry/invoicing

TANDY TRS 80

This package ties into the stock control offering and the sales ledger system to give order-entry functions and control with amendment and enquiry facilities. Reports produce invoices and order information.
Price: £225

A stand-alone invoicing program is also available to be used in conjunction with the stock and sales ledger systems to print invoices and at the same time reduce stocks and update the sales ledger.
Price: £75

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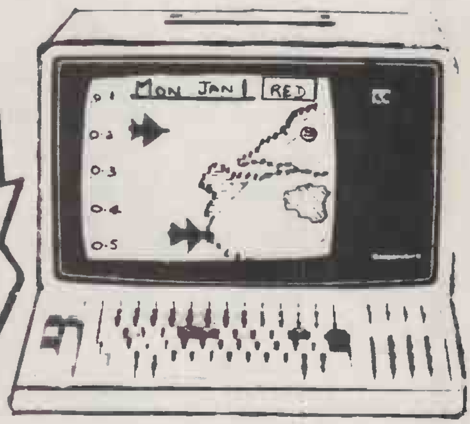

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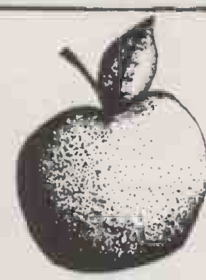

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DIGITAL RESEARCH

CP/M* FDOS — Diskette Operating System complete with Text Editor. Assembler. Debugger. File Manager and system utilities. Available for wide variety of disk system including North Star, Helios II. Micropolis, ICOM (all systems) and Altair. Supports computers such as Sorcerer, Horizon, Cromemco, Ohio Scientific, RAIR Black Box, Research Machines, Dynabyte, etc. .... £75/£15

CP/M version 2 (not all formats available immediately) NEW .... £95/£15

MP/M .... £195/£25

MAC — 8080 Macro Assembler. Full Intel macro definitions. Pseudo Ops include RPC, IRP, REPT, TITLE, PAGE, and MACLIB. Z-80 library included. Produces Intel absolute hex output plus symbols file for use by SID (see below) .... £55/£10

SID — 8080 symbolic debugger. Full trace, pass count and break-point program testing system with back-trace and histogram utilities. When used with MAC, provides full symbolic display of memory labels and equated values .... £45/£10

ZSID Includes Z80 mnem NEW quires Z80 CPU .... £50/£10

TEX — Text formatter to create paginated, page-numbered and justified copy from source text files, directable to disk or printer .... £45/£10

DESPOOL — Program to permit simultaneous printing of data from disk while user executes another program from the console .... £30/£1

MICROSOFT

BASIC-80 — Disk Extended BASIC Interpreter Version 5, ANSI compatible with long variable names, WHILE/WEND, chaining, variable length file records .... £155/£15

BASIC Compiler — Language compatible with Version 5 Microsoft interpreter and 3-10 times faster execution. Produces standard Microsoft relocatable binary output. Includes Macro-80. Also linkable to FORTRAN-80 or COBOL-80 code modules .... £195/£15

FORTRAN-80 — ANSI '66 (except for COMPLEX) plus many extensions. Includes relocatable object compiler, linking loader, library with manager. Also includes MACRO-80 (see below) .... £205/£15

COBOL-80 — ANSI '74 Relocatable object output. Format same as FORTRAN-80 and MACRO-80 modules. Complete ISAM. Interactive ACCEPT DISPLAY, COPY, EXTEND .... £325/£15

MACRO-80 — 8080/Z80 Macro Assembler. Intel and Zilog mnemonics supported. Relocatable linkable output. Loader, Library Manager and Cross Reference List utilities included .... £75/£10

XMACRO-86 — 8086 cross assembler. All Macro and utility features of MACRO-80 package. Mnemonics slightly modified from Intel ASM86. Compatibility data sheet available NEW .... £155/£15

EDIT-80 — Very fast random access text editor for text with or without line numbers. Global and intra-line commands supported. File compare utility included .... £45/£10

EIDOS SYSTEMS

KISS — Keyed Index Sequential Search. Offers complete Multi-Keyed Index Sequential and Direct Access file management. Includes built-in utility functions for 16 or 32 bit arithmetic, string/integer conversion and string compare. Delivered as a relocatable linkable module in Microsoft format for use with FORTRAN-80 or COBOL-80 etc .... £190/£15

KBASIC — Microsoft Disk Extended BASIC with all KISS facilities, integrated by implementation of nine additional commands in language. Package includes KISS REL as described above, and a sample mail list program. .... £295/£25
To licensed users of Microsoft BASIC-80 (M BASIC) .... £215/£25

MICROPRO

Super-Sort I — Sort, merge, extract utility as absolute executable program or linkable module in Microsoft format. Sorts fixed or variable records with data in binary, BCD, Packed Decimal, EBCDIC, ASCII, floating, fixed point, exponential, field justified, etc. etc. Even variable number of fields per record! .... £125/£15

Super-Sort II — Above available as absolute program only .... £105/£15

Super-Sort III — As II without SELECT/EXCLUDE .... £75/£15

Word-Master Text Editor — In one mode has super-set of CP/M's ED commands including global searching and replacing, forward and backwards in file. In video-mode, provides full screen editor for users with serial addressable-cursor terminal .... £75/£15

Word-Star — Menu driven visual word processing system for use with standard terminals. Text formatting performed on screen. Facilities for text paginate, page number, justify, center, underscore and PRINT. Edit facilities include global search and replace, read/write to other text files, block move, etc. Requires CRT terminal with addressable cursor positioning .... £255/£15

Software with Manual / Manual Alone

GRAFFCOM

PAYROLL — Designed in conjunction with the spec for PAYE routines by HMI Taxes. Processes up to 250 employees on weekly or monthly basis. Can handle cash, cheque or bank transfer payments plus total tracking of all year to date figures. Prints emp master, payroll log, payslips and bank giros. Requires CBASIC-2 .... £475/£15

COMPANY SALES — Performs sales accounting function. Controls payments of invoices and prints sales ledger and aged debtors report. Suitable for any accounting period. Comprehensive VAT control and analysis of all sales invoices. Requires CBASIC-2 .... £425/£15

COMPANY PURCHASES — Performs purchase accounting function. Controls invoices, credit & debit notes. Prints purchase ledger, aged creditors report and payment advices. Comprehensive VAT control and analysis of all purchases. Interfaces with the NAD system. Requires CBASIC-2 .... £425/£15

GENERAL ACCOUNTING — Produces Nominal Ledger, Trial Balance, P/L and Balance Sheet. Define your own coding system. Interactive data entry plus optional data capture from Company Sales and Company Purchases. Requires CBASIC-2 .... £375/£15

STOCK CONTROL
Maintains stock records, monitors stock levels to ensure optimum stock holding. Details include stock desc., product code, unit, unit price, quantity on hand on order/minimum. Stock analysis reports can be weekly, monthly, quarterly etc. Interfaces with Order Entry & Invoicing system. Requires CBASIC-2 .... £325/£15

ORDER ENTRY & INVOICING
Performs order entry and invoicing function. Handles invoices for services and consumable items, part orders and part quantities. Sales Analysis report shows sales movemets and trends for user-defined period Interfaces with Stock Control. NAD and Company Sales systems. Requires CBASIC-2 .... £325/£15

NAD — Complete control of all your names & addresses including suppliers, clients, enquiries etc. Assign your own coding system and select all output via the report generator. Will print anything from mailing labels to directories. Requires CBASIC-2 .... £225/£12

COMPLETE ACCOUNTING PACKAGE — Combined Company Sales, Company Purchases, General Accounting, and NAD systems NEW .... £950/£45

SALES ORDER PROCESSING PACKAGE — Combined Stock Control, Order Entry and Invoicing and NAD systems NEW .... £550/£30

STRUCTURED SYSTEMS GROUP

ANALYST — Customised data entry and reporting system. User specifies up to 75 data items per record. Interactive data entry, retrieval and update facility makes information management easy. Sophisticated report generator provides customised reports using selected records with multiple level breakpoints for summarisation. Requires CBASIC-2, 24 x 80 CRT, printer and 48K system NEW .... £125/£10

LETTERIGHT — Program to create edit and type letters or other documents. Has facilities to enter, display, delete and move text, with good video screen presentation. Designed to integrate with NAD for form letter mailings. Requires CBASIC-2 NEW .... £105/£15

NAD Name and Address selection system — interactive mail list creation and maintenance program with output as full reports with reference data or restricted information for mail labels. Transfer system for extraction and transfer of selected records to create new files. Requires CBASIC-2 .... £45/£12

QSORT — Fast soft/merge program for files with fixed record length, variable field length information. Up to five ascending or descending keys. Full back-up of input files created. Parameter file created optionally with interactive program which requires CBASIC-2. Parameter file may be generated with CP/M assembler utility .... £50/£12

SOFTWARE SYSTEMS

CBASIC-2 Disk Extended BASIC — Non-interactive BASIC with pseudo-code compiler and runtime interpreter. Supports full file control, chaining, integer and extended precision variables etc. .... £75/£10

GRAHAM—DORIAN SOFTWARE SYSTEMS

APARTMENT MANAGEMENT SYSTEM — Financial management system for receipts and security deposits of apartment projects. Captures data on vacancies, revenues, etc. for annual trend analysis. Daily report shows late rents, vacancy notices, vacancies, income lost through vacancies. etc. Requires CBASIC-2. Supplied in source code. .... £300/£25

INVENTORY SYSTEM — Captures stock levels, costs, sources, sales, ages, turnover, markup, etc. Transaction information may be entered for reporting by salesman, type of sale, date of sale, etc. Reports available both for accounting and decision making. Requires CBASIC-2. Supplied in source code .... £300/£25

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☐ Ⓛ Ⓜ **CASH REGISTER** — Maintains files on daily sales. Files data by sales person and item. Tracks sales. Overrings, refunds, payouts and total net deposits. Requires CBASIC. Supplied in source code .... £300/£25

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☐ Ⓛ **STANDARD CIS COBOL** — ANSI '74 COBOL standard compiler fully validated by U.S. Navy tests to ANSI level 1. Supports many features to level 2 including dynamic loading of COBOL modules and a full ISAM file facility. Also, program segmentation, interactive debug and powerful interactive extensions to support protected and unprotected CRT screen formatting from COBOL programs used with any dumb terminal .... £400/£25

☐ Ⓛ **FORMS 2** — CRT screen editor. Automatically creates a query and update program of indexed files using CRT protected and unprotected screen formats. Output is COBOL data descriptions for copying into CIS COBOL programs. No programming experience needed. Output program directly compiled by CIS COBOL (standard) .... £100/£12

OTHER

☐ **PASCAL/Z** — Z80 native code PASCAL compiler. Produces optimised portable reentrant code. All interfacing to CP/M is through the support library. The package includes compiler companion macro assembler and source for the library. Requires 56K and Z80 CPU. Version 2 includes all of Jensen/Wirth except variant records .... £155/£15 NEW

☐ Version 3 Upgrade with variant records and strings expected 2/80 .... £205/£15

☐ Ⓜ **PASCAL/MT** — Subset of standard PASCAL. Generates portable 8080 machine code. Symbolic dubugger included. Supports interrupt procedures and BCD arithmetic for real variables. CP/M file I/O and assembly language interface supported. Lacks sets, Enumeration and Record data types. Manual explains BASIC to PASCAL conversion Requires 32K .... £65/£17 NEW

☐ Source for PASCAL/MT run time package. Requires MAC (See under Digital Research) £30

☐ **tiny C** — interactive interpretive system for teaching structured programming techniques. Manual includes full source listings .... £45/£30

☐ Ⓜ **BDS C COMPILER** — Supports most major features of language, including Structures, Arrays, Pointers, recursive function evaluation, linkable with library to 8080 binary output. Lacks data initialization, long & float type and static & register class specifiers. Documentation includes "C" Programming Language book by Kernighan & Ritchie .... £60/£10

☐ Ⓜ **WHITESMITHS' C COMPILER** — The ultimate in systems software tools. Produces faster code than Pascal with more extensive facilities. Conforms to the full UNIX Version 7 C language, described by Kernighan and Ritchie, and makes available over 75 functions for performing I/O, string manipulation and storage allocation. Compiler output in A-Natural source. Supplied with A-Natural. Requires 60K CP/M .... £325/£20 NEW

☐ Ⓜ **POLYVUE/80** — Full screen editor for any CRT with XY cursor positioning. Includes vertical and horizontal scrolling, interactive search and replace, automatic text wrap around for word processing, operations for manipulating blocks of text, and comprehensive 70 page manual .... £70/£12 NEW

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☐ Ⓛ **ALGOL 60 Compiler** — Powerful block-structured language featuring economical run time dynamic allocation of memory. Very compact (24K total RAM) system implementing almost all Algol 60 report features plus many powerful extensions including string handling, direct disk address I/O etc. Requires Z80 CPU .... £110/£12

☐ Ⓜ **Z80 Development Package** — Consists of (1) disk file line editor, with global inter and intra-line facilities; (2) Z80 relocating assembler, Zilog Mostek mnemonics, conditional assembly and cross reference table capabilities; (3) linking loader producing absolute Intel hex disk file for CP/M LOAD, DDT or SID facilities .... £50/£12

☐ Ⓜ **ZDT** — Z80 Debugger to trace, break and examine registers with standard Zilog/Mostek mnemonic disassembly displays. Facilities similar to DDT £20 when ordered with Z80. Development Package .... £30/£7

☐ **DISTEL** — Disk based disassembler to Intel 8080 or TDL/Xitan Z80 source code, listing and cross reference files. Intel or TDL Xitan pseudo ops optional. Runs on 8080. .... £35/£7

☐ Ⓜ **DISILOG** — As Distel to Zilog Mostek mnemonic files. Runs on Z80 only .... £35/£7

☐ Ⓜ **TEXTWRITER III** — Text formatter to justify and paginate letters and other documents. Special features include insertion of text during execution from other disk files or console, permitting recipe documents to be created from linked fragments on other files. Has facilities for sorted index, table of contents and footnote insertion. Ideal for contracts manuals. etc. .... £75/£3

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☐ Ⓜ **POSTMASTER** — A comprehensive package for mail list maintenance. Features include keyed record extraction and label production. A form letter program is included which provides neat letters on single sheet or continuous forms. Requires CBASIC .... £75/15 NEW

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☐ **XYBASIC** Interative Process Control BASIC — Full disk BASIC features plus unique commands to handle bytes, rotate and shift, and to test and set bits. Available in integer, Extended and ROMable versions.
Integer Disk or Integer ROMable .... £165/£15
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☐ **SMAL/80** Structured Macro Assembley Language — Package of powerful general purpose text macro processor and SMAL structured language compiler. SMAL is an assembler language with IF-THEN-ELSE, LOOP-REPEAT-WHILE, DO-END, BEGIN-END constructs .... £40/£10

Ⓜ **SELECTOR III-C2** — Data Base Processor to create and maintain multi Key data bases. Prints formatted, sorted reports with numerical summaries or mailing labels. Comes with sample applications including Sales Activity, Inventory, Payables, Receivables, Check Register, and Client/Patient Appointments, etc. Requires CBASIC Version 2. Supplied in source code. .... £185/£12

☐ **CPM/374X Utility Package** — has full range of functions to create or re-name an IBM 3741 volume, display directory information and edit the data set contents. Provides full file transfer facilities between 3741 volume data sets and CP/M files .... £125/£7

☐ Ⓜ **BASIC UTILITY DISK** — Consists of (1) CRUNCH-14 Compacting utility to reduce the size and increase the speed of programs in Microsoft Basic and TRS-80 Basic. (2) DPFUN — Double precision subroutines for computing nineteen transcendental functions including square root, natural log, log base 10, sin, arc sin, hyperbolic sin, hyperbolic arc sin, etc. Furnished in source on diskette and documentation .... £30/£10 NEW

☐ Ⓜ **THE STRING BIT** — Fortran character string handling. Routines to find, fill, pack, move, separate, concatenate and compare character strings. This package completely eliminates the problems associated with character string handling in FORTRAN. Supplied with source .... £30/£10 NEW

☐ Ⓜ **BSTAM** — Utility to link one computer to another also equipped with BSTAM. Allows file transfers at full data speed (no conversion to hex), with CRC block control check for very reliable error detection and automatic retry. We use it! It's great! Full wildcard expansions to send *.COM, etc. 9600 baud with wire, 300 baud with phone connection. Both ends need one. Standard and M versions can talk to one another .... £75/£5 NEW

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(Illustration. Central Processing Unit, Monitor and Disc drive TRS - 80 Model II)

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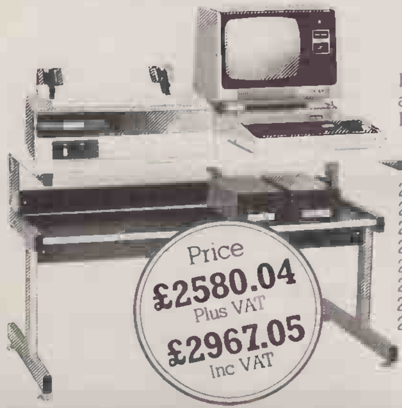

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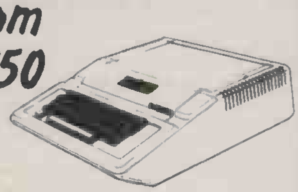

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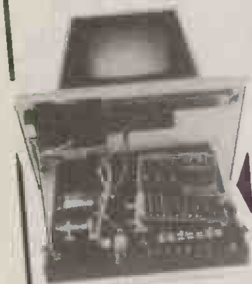

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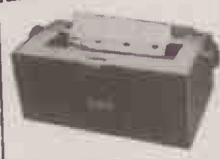

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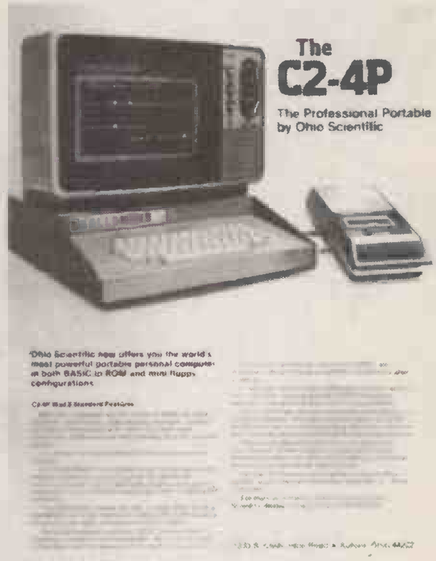

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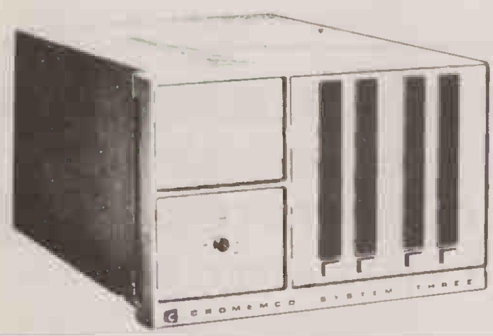

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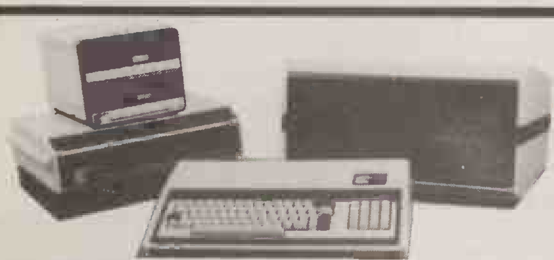

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MICROPROCESSOR ● Z80A which will run at 4MHz but is selectable between 2/4 MHz.

HARDWARE ● Industrial standard 12" x 8" PCB, through hole plated, masked and screen printed. All bus lines are fully buffered on-board.

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• Circle No. 271

February

●1 **Pascal — the language of microsystems.** Venue: Wembley Conference Centre, Avon Suite. Intensive one-day course during Microsystems 80 — the major conference and exhibition at Wembley. Fee: £85. Contact: IPC, tel: 01-261 8437 or ICS Publishing Company (UK) Ltd, Pebblecoombe, Tadworth, Surrey, KT20 7PA, tel: (03723) 79211.

●4-5 **Fundamentals of Microprocessors.** Venue: London. For staff with little or no detailed computer hardware background. Gives participants a sound, practical understanding of microprocessors and how they work to form complete systems. Fee: £230 + VAT. Contact: The Course Registrar, Infotech International Ltd, Nicholson House, Maidenhead, Berkshire SL6 1LD, tel: (0628) 39101.

●4-6 **Microprocessor Workshop.** Venue: Birmingham. Designed for engineers with little or no knowledge of microprocessors. The course is based on the AIM65 bord and introduces all aspects of software development by practical programming sessions. Fee: £195 + VAT. Contact: Microsystems Consultants Ltd, PO Box 65, Camberley, Surrey GU15 1QN, tel: (0276) 27417.

●4-8 **Tools and techniques for systems development.** Venue: London. Five-day course on the major methods and techniques of software engineering. Fee: £495 + VAT. Contact: Keith London Associates, 6 St Albans Road, Codicote, Hitchin, Herts, tel: 0438 820309.

●5-8 **Digital image processing.** Venue: London, Royal Horseguards Hotel, Whitehall Court, London, W1A 2AU. Gives information on industrial, scientific and military applications and provides a comprehensive introduction to state-of-the-art digital image processing techniques. Fee: £470 + VAT. Contact: ICSP (UK), Pebblecoombe, Tadworth, Surrey, KT20 7PA, tel: 03723 79211.

●6-8 **How to program microprocessor systems in assembler.** Venue: London. Designed for engineering and software staff with a fundamental knowledge of microprocessor systems; enables the participant to produce reliable, efficient programming using the facilities of his own specific microprocessor system. Fee: £340 + VAT.

●11-15 **APL.** Venue: Cannock, Staffs. The course is designed to enable staff with some experience to program in this powerful and increasingly utilised language. Fee: £245 + VAT. Contact: Compower Training School, Cannock, Staffs, WS11 3HZ, tel: Cannock 2511.

●13 **Principles of teleprocessing and VTAM/SNA concepts.** Venue: Cannock, Staffs. A one-day seminar designed to introduce these topics to operations staff. Fee: £50 + VAT. Contact: Compower Training School, Cannock, Staffs, WS11 3HZ, tel: Cannock 2511.

●14-15 & 28-29 **Introduction to Microprocessing.** Venue: Bedford. Designed for participants from a wide range of backgrounds who need to acquire the intuitive 'feeling' needed to implement or supervise the implementation of microprocessing in their work environment. Fee: £95 + VAT. Contact: Mike Hughes, Microprocessor Training Centre, Texas Instruments Ltd, Manton Lane, Bedford, MK1 7PA, tel: 0234 67466.

●15 **Introduction to computers and their applications.** Venue: London. Provides an awareness of the potential for computer application within the small company, and provides participants an opportunity to use main-frame and microcomputers in an informal small-group environment. Fee: Members, £50 + VAT; non-members, £60 + VAT. Contact: London Chamber of Commerce and Industry, 69 Cannon Street, London, EC4N 5AB, tel: 01-248 4444.

●15-17 **Home computing II: Basic and beyond.** Venue: Woodlands Park, Woodlands Lane, Stoke D'Abernon, Cobham, Surrey, KT11 3QB. Second part of course on home computing, for those who wish to enhance their style and extend their knowledge and programming abilities by using hex and decimal machine codes. Fee: £30 Contact: Norman Day, Woodlands Park Residential Education Centre, Woodlands Lane, Stoke D'Abernon, Cobham, Surrey, KT11 3QB, tel: Oxshoot 2215.

●18-22 **Interactive testing (CMS).** Venue: Cannock, Staffs. Enables programmers to use a terminal to develop, edit, compile and test their Cobol programs. Fee: £245 + VAT. Contact: Compower Training School, Cannock, Staffs, WS11 3HZ, tel: Cannock 2511.

●20-22 **Advanced microprocessor prototyping laboratory software.** Venue: Bedford. Designed for the technician or engineer who can write 9900 assembly language programmes and can use the FS 990/4 development system. Enables the participant to debug target system software and hardware. Fee: £250 + VAT. Contact: Mike Hughes, Microprocessor Training Centre, Texas Instruments Ltd, Manton Lane, Bedford, MK1 7PA, tel: 0234 67466.

●21 **How to negotiate computer contracts.** Venue: London. Designed to make delegates aware of the pitfalls, and how to avoid them, in negotiating contracts with manufacturers. Covers difficulties which face new users and endeavours to enable them to achieve their objectives. Fee: Members: £19 + VAT. Non members: £24 + VAT. Contact: The London Chamber of Commerce and Industry, 69 Cannon Street, London, EC4N 5AB, tel: 01-248 4444.

●25-26 **Microprocessor-based systems for instrumentation and measurement.** Venue: London. Shows how microprocessors can be used to enhance the performance of instrumentation and measurement systems and will be equipped with the practical knowledge to design such systems incorporating microprocessors. Fee: £230 + VAT. Contact: The Course Registrar, Infotech International Ltd, Nicholson House, Maidenhead, Berkshire, SL6 1LD, tel: 0628 39101.

●26-29 **Fiber optic communication systems.** Venue: London. Designed for engineers, scientists and managers involved in the planning, design and practical implementation of all types of communication systems. Covers the fundamental principles of fiber optic-based systems. Fee: £470 + VAT. Contact: ICSP (UK), Pebblecoombe, Tadworth, Surrey, KT20 7PA, tel: 03723 79211.

●26-29 **Filetab.** Venue: Cannock, Staffs. Filetab is report generator and file maintenance package designed by NCC. Gives instruction for the TAB-N (ICL) version. Fee: £215 + VAT. Contact: Compower Training School, Cannock, Staffs, WS11 3HZ, tel: Cannock 2511.

●26-29 **Structured Programming.** Venue: Royal Horseguards Hotel, Whitehall Court, London, SW1A 2EJ. Course in scientific and engineering applications. Will enable participants to gain a clear understanding of the concepts and applications of structure methodology, and develop skills which will enable the production of reliable, well-documented and maintainable programs. Fee: £470 + VAT. Contact: ICSP (UK), Pebblecoombe, Tadworth, Surrey, KT20 7PA, tel: 03723 79211.

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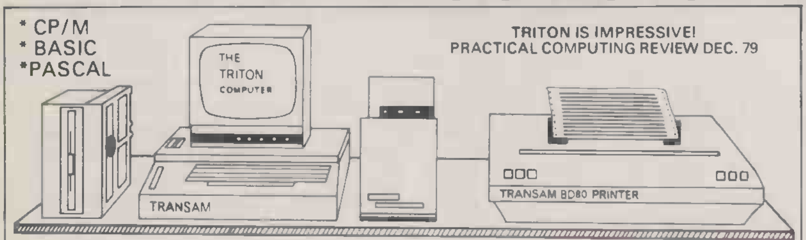

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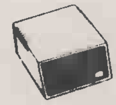

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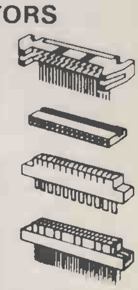

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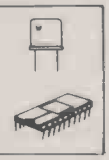

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A PRACTICAL GLOSSARY

Continuing the terminological gamut with P

Prefix multipliers

This is a bit of maniac fun, some of the most useless information you could hope to acquire. You might have noticed that scientists and jargon generators generally like to express numbers by a factor of 10. Here's what they mean:

prefix	symbol	meaning
deci	d	10
hecto	h	100
kilo	k	1000
mega	M	1,100,000
giga	G	1,000,000,000
tera	T	1,000,000,000,000

Note the difference between 'k' and 'K'. One means 'times 1,000'; the other means 'times 1,024'. Why such an odd number? It's 2^{10}, and is handy, being so nearly 1,000 — in working decimal to binary conversions.

Getting smaller, you get:

centi	c
milli	m
micro	μ
nano	n
pico	p

There are two more, 'feinto' and 'atto', meaning 10 followed by 14 and 17 zeros respectively, but you can safely forget them.

Processor Technology

A pioneer and an early casualty of the US personal computer business, manufacturer of the well-liked Sol system which featured several novel ideas, including an operating system in ROM. Processor Technology was also one of the first companies to make S-100 boards as accessories for the Altair computer. The company went into liquidation this year.

Proprietary software

Programs for which the legal title is held by someone other than the user. The point is that in law you are not allowed normally to copy, re-sell, or amend someone else's program. The question of who 'owns' software is still in the air, though you would have to change someone else's programs very thoroughly to claim them as your own.

Prototype

Prototyping is the development phase in a microprocessor-based product. We tend to see only the man-machine end of computing, with people creating and running programs as the normal use of a micro system. Most microprocessors are used in products where they are almost invisible, like sewing machines, ovens, cars, automatic manufacturing, and even pocket calculators.

To develop the software for these you need a *prototyping system*, which is a programmable version of your chosen micro configured with a terminal and some storage. You will probably have a PROM programmer attached, too; that allows you to correct your program and then burn it into a PROM which will be buried eventually in the end-user product along with your micro.

Obviously the first fruits of this process will be a *prototype;* because you will be expecting errors, you will produce only a few and you will spend a good deal of time checking them.

Power fail

Or rather, 'power-fail option' or 'power-fail/re-start' or 'power-fail/auto-re-start', since it is obvious what power failing will mean. The better class of computer includes a device which monitors the power level. When voltage drops below a pre-set figure, this hardware option signals an imminent power failure an uses the milliseconds available to store the current contents of all important registers in some kind of non-volatile memory.

This could be core or battery-powered MOS. When the power can be returned, the registers are all re-instated so that things can proceed as before.

Practical Computing

What can one say? Thanks for buying it, and don't stop now.

Preventative maintenance

Things go wrong with computers, and when they do they can be expensive to repair. Even small personal computers should have regular service with the aim of preventing any faults, rather like car services.

Printer

Check *matrix* and *line* printers. A printer is a device which prints information sent from a computer on to paper. The principal examples are matrix printers — characters formed by dots when a pin thumps an inked ribbon on to paper; chain or band line printers — fast, noisy and expensive; thermal printers — dots formed by heating points on treated paper; electron sensitive printers — much the same but using electricity; daisywheel or petal printers — good-quality output; and ink-jet — complicated but possibly the coming thing.

Printwheel

Same as *daisywheel*, when that term is used to refer specifically to the print element, the removable disc-like bit with the characters formed on it.

Private line

Also called leased line or private wire. It is possible to rent your own telephone line from the Post Office. You have to specify where it goes from and to, of course, but once you have it, you can send data to the other end at any time.

With ordinary public telephone systems you pay by 'connect time'. You might not make contact when you want and you will suffer all the inevitable electrical interference as well as any crossed lines and poor connections. None of that applies if you lease a private line. You will pay for the privilege, of course.

Procedure

In programming, this word will probably be used to mean a sequence of steps required to solve some problem. You might meet it in the phrase 'procedure-orientated language'; synonymous is 'problem-orientated language'.

Either way, it means a programming language in which the way you write programs reflects directly the process of solving a problem. The obvious example is something like Algol, where a statement in a program is an explicit algorithmic sequence of operations to be done. Most high-level programming languages are also procedure-orientated, some more formally than others.

Processor

Same as CPU. That portion of the *computer* which processes instructions. To back-track slightly, a computer comprises processor, internal memory, some kind of input-output device(s), and probably some external storage. Programs are received by the processor from an input source, from memory, or from storage; they are decoded by the processor, probably with reference to system software held in memory; they are executed by the processor, which probably will involve calling information from memory or backing store on which operations are performed; and the results are despatched by the processor to an appropriate destination, like an output device or a disc store.

The terms 'computer' and 'processor' are employed usually rather more loosely, though, and are treated frequently as being synonymous. To some extent they are; many, but not all, of the essential characteristics of a computer system derive directly from the characteristics of the processor. Even so, it is important to realise that the processor is only one element in the system.

Production control

Running a manufacturing organisation is another classic case for computerisation. The problem is to meet orders placed; applying computers means that everything is so organised that the customer receives the goods on time. Other benefits might include faster delivery, less capital tied-up in inventory, and better use of machinery.

On the other hand, to obtain all those benefits you have to integrate every possible factor. This will involve sales forecasting, planning what raw materials and other resources you will need, and when; deciding what levels of stock-holding you require; and so on. It can all become big and complex; you might need a big computer to cover it all, and you might have to be a big company to derive any benefit from the outlay on your system.

Smaller companies and smaller computers can have parts of the full idealised system, of course — forecasting and stock control are the obvious examples. Anyone who can produce a flexible, full-blown production control system on a micro ought to clean up.

Production run

Like running a program, as opposed to test runs.

Programme

A collection of ads and the case list for which you pay exorbitantly when you pay your thrice-annual visit to *No Sex Please We're British*.

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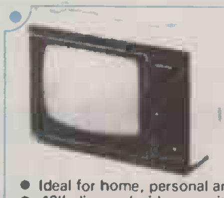

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NEC Spinwriter NEC's high quality printer uses a print "thimble" that has less diameter and inertia than a daisy wheel, giving a quieter, faster, more reliable printer that can cope with plotting and printing (128 ASCII characters) with up to five copies, friction or tractor fed. The ribbon and thimble can be changed in seconds.
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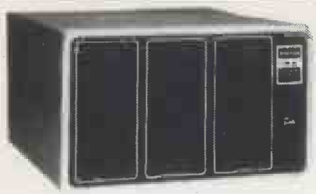

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We've researched the under-£1,000 80-column dot matrix printers currently available, and have made some key comparisons in the chart to the right. Check it out.

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If you want to print graphics or feed single sheets of paper through your printer, we can't help you. But if you want as much data buffer storage as you can get, a 9 × 7 dot matrix for better looking characters, a condensed character set that's great for printing multiple columns of numbers, a readily available low cost ribbon, and documentation that includes complete schematics and troubleshooting procedures, then we can help you a lot. And we can offer you something else that's new to the low-cost printer market. Our 30 day BUY BACK guarantee. If you buy a MICROTEK printer and are unhappy with it, for any reason, you can return it within 30 days for a full refund. It's that simple.

Does MICROTEK really outperform them all? You be the judge.

CHECK THIS CHART...

Features	MICROTEK MT-80P	Anadex DP-8000	Centronics 730-1 (Radio Shack 26-1154)	Super Brain LP-80	Integral Data 440	MPI 88T
9 × 7 Dot Matrix	Yes	Yes	No	No	No	No
Sustained thruput for full lines	70 LPM	84 LPM	21 LPM	63 LPM	42 LPM	60 LPM
Selectable condensed character set	Yes	No	No	No	Yes	Yes
Full function VFU	Yes	Yes	No	No	Yes	No
Built-in self test	Yes	No	No	No	Yes	No
Graphics option	No	No	No	No	Yes	No
Accepts single sheets of paper	No	No	Yes	No	No	Yes
Ribbon costs	£1.00	£4.50	£4.75	NA	£1.05	NA
Cost of 2k/4k buffer	£15/£28	£12.25/ £24.50	NA/NA	NA/NA	115*/NA	NA
Unit price	£495	£575	£559	NA	£585	NA

* Memory buffer alone not available, includes graphics option

Comparison data from manufacturer's current (September '79) literature.

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