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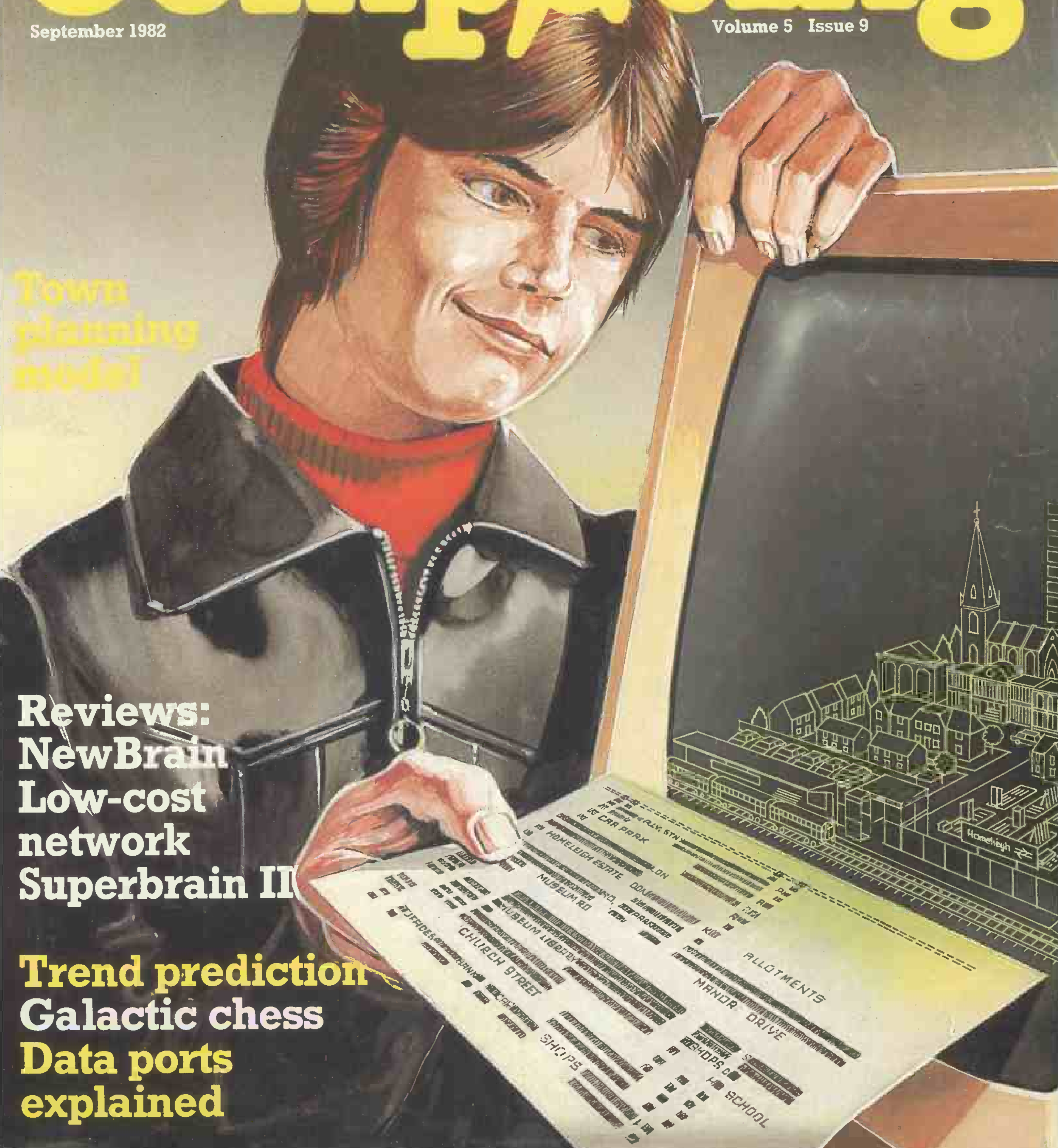
Practical Computing

September 1982

Volume 5 Issue 9



Town planning model

Reviews:
NewBrain
Low-cost network
Superbrain II

Trend prediction
Galactic chess
Data ports explained


NEW MODEL
LOWER COST
WRITEMASTER
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Published by IPC Electrical Electronic Press Ltd, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS. Tel: 01-661 3500. Telex/grams 892084 BIPRESG.
Typeset and printed by Eden Fisher (Southend) Ltd, Southend-on-Sea.
Distributed by IPC Business Press (Sales and Distribution) Ltd, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.
Subscriptons: U.K. £12 per annum; Overseas £18 per annum; selling price in Eire subject to currency exchange fluctuations and VAT; airmail rates available on application to Subscription Manager, IPC Business Press (S & D) Ltd, Oakfield House, Perrymount Road, Haywards Heath, Sussex RH16 3DH. Tel: 0444 459188.

ISSN 0141-5433

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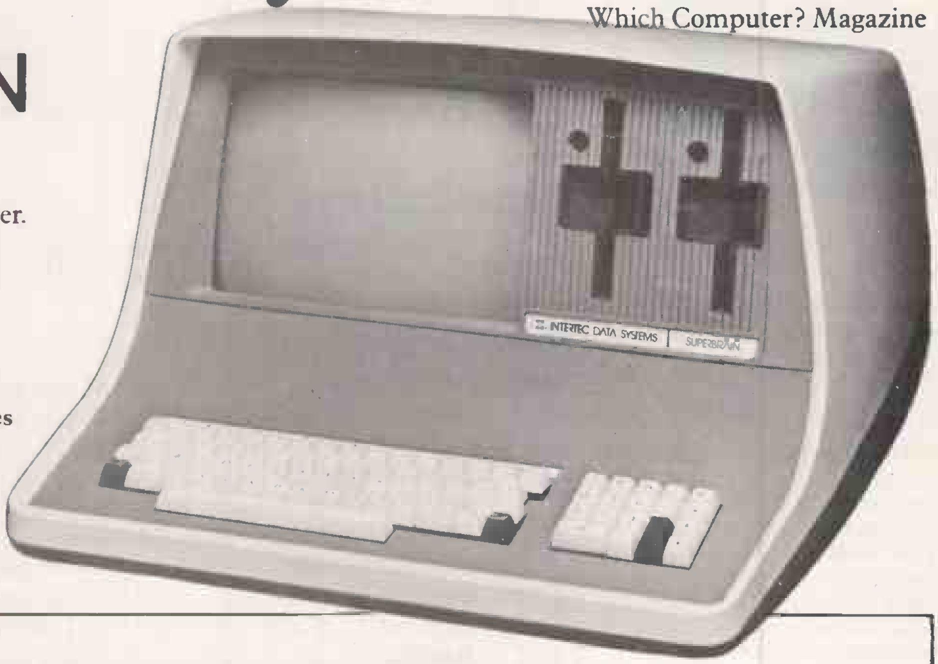
Which Computer? Magazine



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7448	40
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74151	50
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LS42	28
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LS245	70
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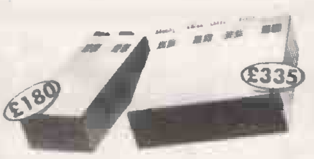

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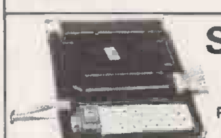

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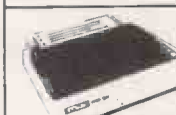

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4 80MHz	200	24 930M	325
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7 168MHz	160	116 0M	300

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(Speed Block type)	PCB Plug with latch Strt Pins	Angle Pins	Female Header Socket	Unshrouded PCB Plugs Str pins	Angle pins
2x5 way	90p	99p	85p	60p	65p
2x8 way	130p	150p	110p	70p	78p
2x10 way	145p	166p	125p	80p	92p
2x13 way	175p	200p	150p	95p	110p
2x17 way	205p	236p	160p	110p	135p
2x20 way	220p	250p	190p	125p	150p
2x25 way	235p	270p	200p	150p	175p

JUMPER LEADS: Ribbon Cable Assembly DIL PLug (Headers)

Single Ended Lead, 24" Long

Length	14pin	16pin	24pin	40pin
24"	145p	165p	240p	380p
Double Ended Leads				
6"	185p	205p	300p	465p
12"	198p	215p	315p	490p
24"	210p	235p	345p	540p
36"	230p	250p	375p	595p

ID Header Socket Jumper Leads

24"	20pin	26pin	34pin	40pin
1 end	160p	200p	260p	300p
2 ends	290p	370p	480p	525p

DIL SOCKETS

	Low Prof	Wire Wrap
8pin	8p	25p
14pin	10p	35p
16pin	10p	42p
18pin	16p	52p
20pin	22p	60p
22pin	25p	70p
24pin	25p	70p
28pin	28p	80p
40pin	30p	99p

RIBBON CABLE

Ways	Grey	Colour
	Price per Foot	
10	12p	22p
16	25p	32p
20	25p	40p
26	35p	52p
34	48p	60p
40	55p	70p
60	75p	115p

DIL PLUGS (Headers)

	Soldr	IDC
14pin	38p	95p
16pin	42p	100p
24pin	88p	130p
40pin	195p	218p

AMPHENOL PLUGS

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	Female Strt. Pins	Female Angle Pins	Male Strt. Pins	Male Angle Pins
DIN41617 31way	170p	—	—	175p
41612 A+B 2x32way	280p	305p	200p	295p
41612 A+C 2x32way	290p	310p	210p	300p
41612 A B C 3x32way	350p	370p	250p	290p

EDGE CONNECTORS

TWO ROWS	1"	.156"
2x10way	—	135p
2x15way	—	140p
2x18way	180p	145p
2x22way	199p	200p
2x23way	210p	—
2x25way	225p	—
2x28way	210p	
2x30way	245p	—
2x36way	295p	—
2x40way	315p	—
2x43way	395p	—

D CONNECTORS: Miniature

Male	9 way	15 way	25 way	37 way
Solder	80p	110p	160p	250p
Angle	160p	210p	250p	355p
Pins	120p	130p	195p	295p
Female				
Solder	110p	160p	210p	350p
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IDC 25way plg. 385p; Skt.450p.

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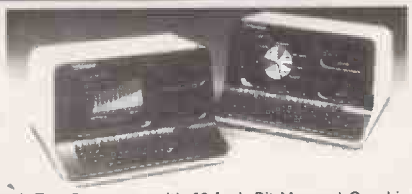

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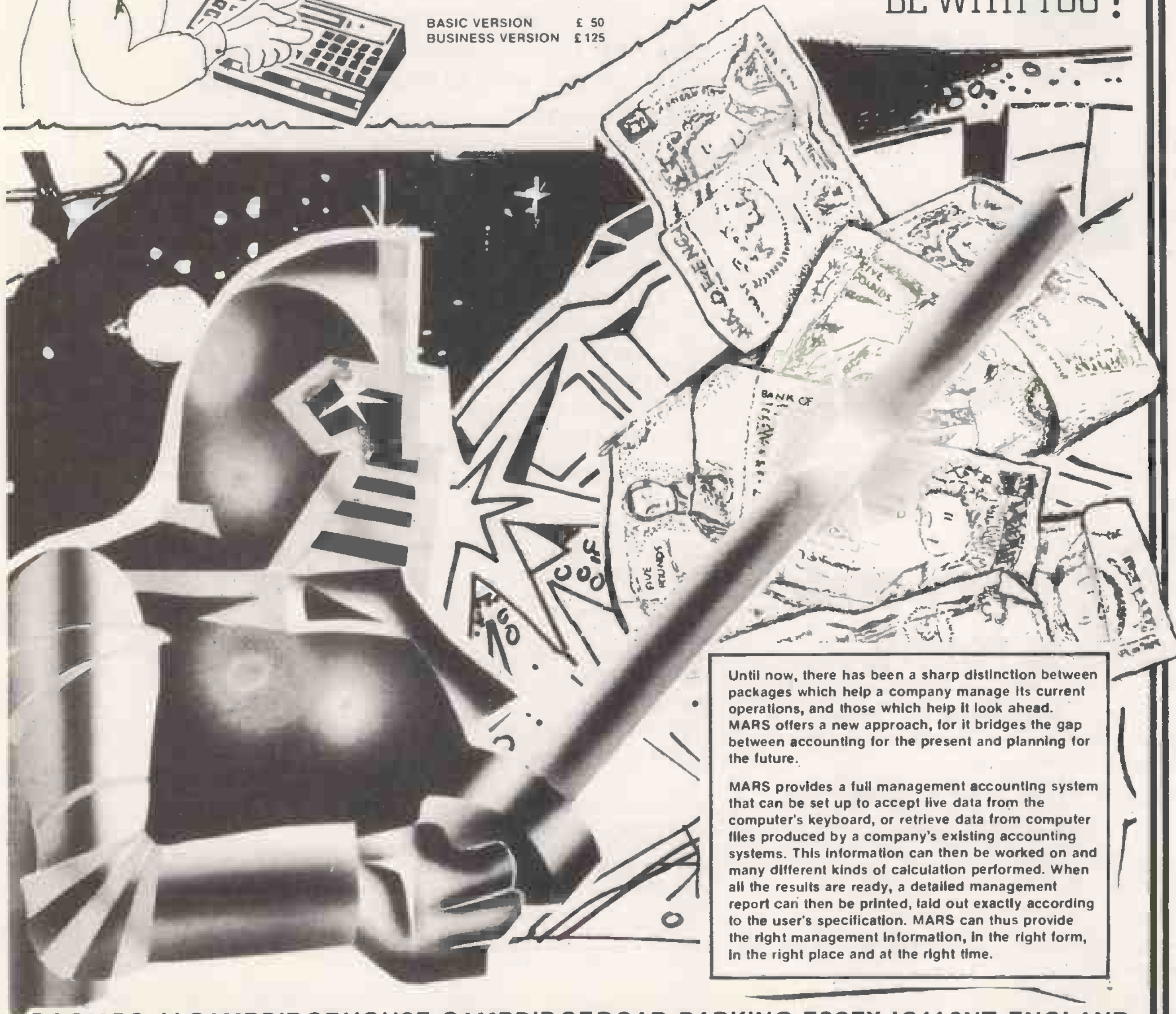

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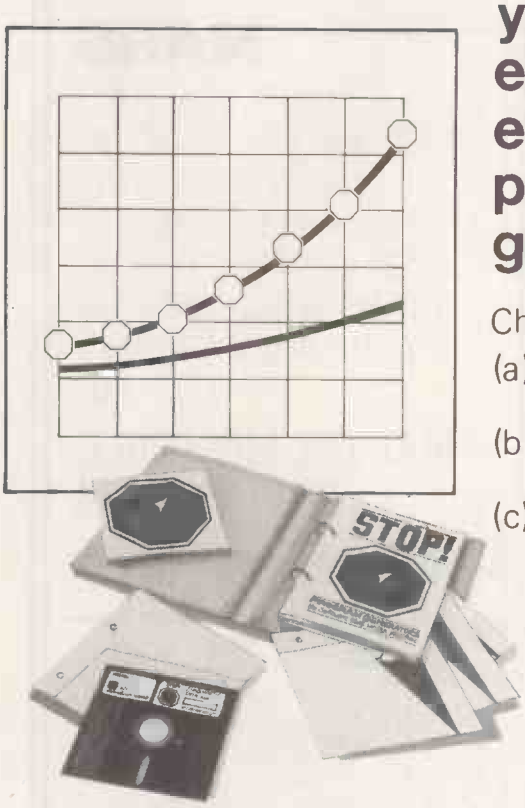

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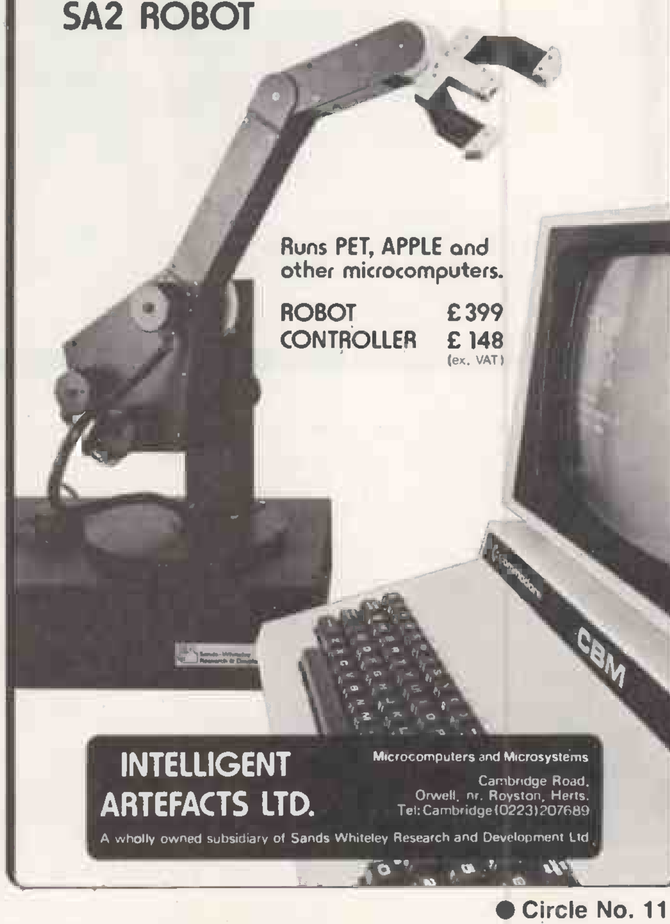

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Do not over estimate the expert system

TO JUDGE by the hype, the future of the entire western world now hangs on expert systems. As one understands the matter, an expert system is designed to help the feeble human intellect when confronted with complicated diagnostics.

The patient has a splitting headache, spots on the ankles and a bad case of split ends. Is it that scourge of 18th-century mariners, dengue; or merely a hangover with fleas and a poor after-shampoo hair conditioner? The expert system recommends taking the patient's temperature: if high, then quarantine is indicated, if low, a raw egg in Worcester sauce.

Alternatively, you are master of an oil rig. You are woken in the middle of the night by a red glare at the porthole of your cabin, shouts and yells and explosions. What do you do? Naturally, with a single bound you are at the keyboard of your trusty micro, running an expert system set up to cope with the whole problem. "Is it November 5?" the shrewd little fellow asks. With a sigh of relief you sink back into slumberland as the gigantic structure slides hissing beneath the waves.

Dispensing for the moment with their aura of magic, what is happening here? Let us assume that we live in a logically perfect world where everything is either true or not true. The medical system could be set up as a database. It could have records in it like:

```
SYMPTOM = Headache
SYMPTOM = Spots on ankles
SYMPTOM = Split ends
SYMPTOM= High temperature
DISEASE=Dengue

SYMPTOM = Headache
SYMPTOM = Spots on ankles
SYMPTOM= Split ends
SYMPTOM = Low temperature
DISEASE=Fleas with hangover and poor hair conditioner
```

However, in real life classical logic seldom applies. You can hardly ever say: "If A then B," and if you can do not need a computer to tell you what to do next. A slightly more realistic model of life would be "If A then 80 percent chance that B." Classical statistics might make one think the converse: "If not A then 20 percent chance B," and "If not A then 80 percent chance not B."

Real life resolutely refuses to follow the 100 percent view of probability. Instead of jigsaw puzzle pieces of knowledge that interlock along infinitely thin saw cuts of conceptual distinction, real life is an uneasy sea of ignorance on which bob a few unrelated floes of meaning. If you are not standing on the floe marked "A" it does not mean, as classical statistics would have you think, that you must be standing on "not A". In practice you are back where you started, dog-paddling in the sea of ignorance.

To illuminate this problem, think back to the troubled bunk of the oil-rig manager. A red glare at the porthole is a 99.999 percent certain indicator of trouble. A soothing black view of the night does not, on the other hand, give a 99.999 percent certain indication of a good sleep. To the experienced oil-rig manager, an absence of red glare means little or nothing.

So far so good, and one can see that it will not be out of the question to write a program that accepts symptoms, asks for probabilities that they are real, follows up the clues and asks more questions before suggesting a number of diagnoses and possible actions to be taken. The symptoms may not, of course, be medical ones. They might be mechanical or economic or drawn from any field of expertise in which people are presented with ill-defined indicators on which action has to be taken.

From another point of view, an expert system is just a fuzzy index to an operator's manual. "What do I do if I am 32 percent sure the core temperature is too high; 83 percent sure that the cooling water relief valve is jammed shut; 100 percent sure I'm at Three Mile Island?" Answer: "RUN".

This is where the whole thing breaks down. An index is only a way to find information; if the information is no good, then the index is no good either. As one understands the current thinking on Three Mile Island, the operators would not have been able to cope even if they had understood the signs presented, and had been able to look up the appropriate page in the manual. The appropriate page was not there. The designers of the system had not foreseen the concatenation of mishaps that actually occurred.

All expert systems rely, for their most important part, on the actual information they contain about what to do, on human input — not to put too fine a point on it, they rely on experts. As life becomes more complicated one is more and more frequently reminded that the people most likely to get things wrong are experts. Moreover, they are experts asked not only about the significance of A and B and C and D, but also for statistical estimates of the reliability of these observations, as made by non-experts.

The difficulty of collecting the necessary kind of information makes the software look easy. Yet, if expert systems are to play a useful part in human affairs it has to be done. It amounts to wiring every human being into a total on-line data-collection system, simply to acquire the information base you need in order to make sensible predictions. The alternative is to let the expert system learn as it goes along.

The drawback to that is obvious — how many oil rigs can you afford to burn while the computer learns its trade? The less obvious drawback is the volume of material it has to survey. After all, the diagnosis for dengue is the result of thousands of doctor-years of observation all over the world over three centuries or more. The mechanism for bringing this information together into one succinct line in a textbook may be crude and fallible but we have found out how to do it. We have not the slightest idea of how to make computers do the same thing, and none of the necessary machinery.

This is not a spiteful attempt to discredit expert systems as such. If they are regarded as soggy databases, there is no doubt that they can be made to be useful in many well-limited areas of human decision. The danger comes when they, and other AI techniques billed for stardom in the "fifth generation" machines are hyped up as the final solution to the world's problems. The enthusiasts may be forgiven for overstating their case: one would hope that governments would realise that information of the sort these systems need just does not exist and will be very difficult to collect.

Charlatans appear whenever it is proposed to spend large sums of money on impossible objectives. Some quite impressive specimens are rallying to the cry of "fifth generation"; one hopes that, in its eagerness to be up with the hunt, our Government is not taken to the cleaners by them. It would not only be annoying to see money spent on silly jokes; in our enthusiasm to leapfrog over current technology into oblivion, we may neglect some perfectly worthwhile projects whose only drawback is their usefulness.

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

Prestel too expensive . . .

MUCH AS I admire your erudite comment on the failure of Prestel I cannot but think the explanation is much simpler — it priced itself out of the market.

Who in his right mind is going to pay for a telephone connection charge, an expensive adaptor to the TV, and then a fee for the use of the service when they already have Ceefax and Oracle? The service should have been financed by the advertisers as is ITV.

Norman Law,
Urmston,
Manchester.

. . . but not dead yet

I HAVE JUST seen the June issue of *Practical Computing* and the totally erroneous conclusion about Prestel's future contained on page 41. Borrowing the mantle of Mark Twain, I must say that the report of our death is an exaggeration.

Prestel is continuing to grow and offer more services and facilities all the time; we now have a user base of over 17,000 in more than 20 countries worldwide and with the recent advent of Gateway will be able to offer more varied and personal services in the coming months.

Peter Wynne-Davies,
Prestel Headquarters,
London.

Too hasty?

UNSEEMLY HASTE to be the first to publish for the BBC microcomputer seems to tempt people not to read their manuals or experiment fully before committing themselves. In particular, the routine presented by John Gordon and Tony Shaw — *Practical Computing*, June 1982 — to append procedures to programs is unsound and over-complex.

BBC Basic provides two functions, Top and Lomem, which normally store the address of the first free byte of memory. The difference is that while Top always contains this address, Lomem can be varied under program control. Thus loading into the address given by Lomem does not guarantee continuous text.

Updating Lomem after a *Load can be done either with Old or with Renumber. The routine reduces to this:

```
LOAD "PROGRAM"
PRINT~TOP-2
EBC
*LOAD "PROC1" OEBC
OLD
```

which is sufficient if there is no clash of line numbers. Otherwise merely substitute Renumber for Old, and you can carry on ad infinitum.

John Caulfield,
London SW18.

Computers for handicapped

WE ARE a Cheshire home for the physically handicapped, and have recently bought an Apple II microcomputer, now being adapted for use by severely handicapped operators. It is to be used as an aid to solving some very basic problems and for recreation:

- Communication — between residents and staff, or between the residents themselves;
- Letter writing — through word processing, etc.;
- Games — from chess through to Space Invaders.

We intend to set up a central library of programs, specifically for use by handicapped operators, and adapt programs to suit their physical capabilities. The library will be available to all interested parties or who wish to donate and borrow programs. At present we are looking for programs in three formats: program listings; Apple II floppy discs; TRS-80 cassettes. Floppy discs and cassettes will be returned.

The idea is to provide a link between all organisations and individuals who are working in the field of computing for the physically handicapped. We would welcome enquiries from schools, colleges and residential homes, etc.

If interested, please write to me, enclosing a stamped addressed envelope.

Robin Nixon,
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Kent TN2 4NB.

Potential threat

I WAS INTERESTED to read the interview with Clive Sinclair in the July issue, particularly with regard to his Microdrive and portable machines. The Japanese are at present marketing a microdrive in the U.S.A. which uses 3in. discs with 0.5Mbyte capacity, unformatted, per disc.

There is an 18lb. portable, less than half the size of the Osborne 1, with integral discs giving 0.72Mbyte of disc space, formatted, and an 11.4in. by 8.5in. by 1.75 in. machine weighing less than 4lb., with integral printer and micro-cassette. The display is a flat screen 120-by-32 dot matrix, 20 by 4 characters.

It would seem that if the Japanese and Americans decide to import to Britain, Clive Sinclair's market could be severely dented before he even has his wares ready.

Cliff Burgess,
Bedford,
Texas.

Name finder

THE ONE-LINE program in June's "Open File: Tandy Forum" for finding the name of an unknown program ends with a new statement. This might be alright for readers with exceptional reflexes, but the rest of us should delete New from the program as it serves only to clear the screen.

P V Bamfield,
Brighton,
Sussex.

Unsatisfactory service

IN VIEW OF your recent article on Clive Sinclair I thought you might be interested in my experience with his company and its so-called service department:

May 6, 1982 — despatched one non-working ZX-81 and printer power pack as the power pack had been found to be in excess of the voltage quoted on the circuit board and was showing signs of overheating.

May 17 — receipt acknowledged only after I had written to query it.

Whitsun — new power pack appeared in plain, brown, padded envelope; as not adequately packed it arrived chipped, and with no documentation whatever.

June — silence.

June 28 — rang number given on card enclosed with original packaging — ZX-81 purchased from W H Smith, printer from Sinclair; could not trace our computer, eventually located it listed as a printer repair. Said they would ring back.

June 29 — rang again, and was told I should have taken it back to Smith's not sent it to them. Asked to speak to supervisor who would not come to phone; no point, they had sent the computer on to Smith's repair department at Southend. Asked for phone number. Eventually extracted information that it had been sent in sack six. Refused to give date or why I had not been notified that computer had left their premises. Phone number unobtainable.

Immediately rang branch of W H Smith from where ZX-81 had been purchased — Hemel Hempstead — and explained to the manager the predicament. Very helpful, explained they did not have a service department but contracted out the repairs and said he would sort it out for me.

(continued on page 35)

(continued from page 33)

Manager rang back same day to say that contractors had seven unopened sacks of material received in last fortnight and no documentation from Sinclair. Were now opening sacks and dealing with those accompanied by correspondence, and would let me know if there were any further problems.

July 2 — surprise and delight, computer returned in working order much to our relief as it had something like £100 of added hardware.

I have nothing but praise for W H Smith and its contractors and should like to thank them. However, on June 30 I cancelled an order for a Spectrum placed with Sinclair at end of April.

**Moira Walker,
Wheathampstead,
Hertfordshire.**

Visual phenomenon

AN UNUSUAL visual effect that takes place on the Commodore 4016 model computer has just come to my notice. I typed three Basic lines, but when I ran the program the characters displayed were wiped off the screen slowly, and reappeared slowly a couple of seconds later.

Three-line program.

```
5 PRINT"J"
10 PRINT"PRACTICAL COMPUTING 1982"
15 GOTO5
```

Can anyone provide an explanation for this effect. Touching the space bar or shift slows this effect down, and inserting more or fewer characters in line 10 speeds it up.

**Jayne Bartlett,
Poole,
Dorset.**

Taxation pitfalls

I REFER to the article "Keeping Income Tax in Check" in the June issue, and must say that the errors and inadequacies reflect the hazards and pitfalls awaiting the programmer with little or no experience in this complicated subject. Many of the procedures in taxation are governed by written and unwritten rules of practice and it is only too easy for a brave effort to come fundamentally adrift from established principles.

There are technical inaccuracies in the article and the program, and I should like to point out the following general major errors and omissions:

- Working abroad: It is not necessary to work abroad for the whole tax year to qualify for the 100 percent deduction. If an individual leaves the U.K. in, say, September and is abroad for at least 365 days, a 100 percent deduction for the period to the following April is available. The program only allows a 25 percent deduction in such circumstances.
- Married during 1981/82: All the information given in relation to the treatment of wife's income for those married during 1981/82 is incorrect and applies only to the years up to 1976/77. Refer to section 36, Finance Act 1976 for further details.
- Treatment of married women: The program allows a married woman to be regarded as a single person, if she wishes. This is true regarding her earned income, but there is no possibility of treating the wife's unearned income as not belonging to the husband for tax purposes.
- Tax payable and recoverable: The object of the program is apparently to advise the individual of net tax payable/repayable for the year 1981/82. This figure is somehow calculated independently of tax deducted under PAYE or tax paid under direct assessment. The resulting figure is meaningless, and hopefully users would be aware that further calculations are necessary before writing to their Inspector of Taxes.

My own firm has been involved in writing tax programs, including personal tax, for the professional accountant who tends to be apprehensive that a microcomputer can cope with his complex work. Elizabeth Acraman's article shows how easy it is to be unaware of or overlook points which a tax practioner would regard as fundamental.

**James Ferguson,
Paisley,
Strathclyde.**

BCPL correction

ONE LINE of the illustration of BCPL in Feedback, *Practical Computing* July 1982, was unfortunately incorrect. It should have read:

```
LET offgrid() =
  xlen<0 | xlen>16 | ylen<0 | ylen>16
```

**John Richards,
RCP Ltd,
Blewbury,
Oxfordshire.**

WordStar on Apple

UNLIKE JACK MCLEISH — Feedback, *Practical Computing*, July 1982 — I have managed to install Wordstar 3.0 on an Apple II. The printer is a Centronics 737-2 connected by the Apple Centronics interface card A2B0007.

During installation I selected "Any Teletype-like printer", "none" as the communications protocol and "CP/M list device" from the printer driver menu. This is the same selection as Jack McLeish made and yet all seems to be functioning perfectly for me.

The only obvious difference is in the use of parallel rather than Centronics card. But provided Jack McLeish has wired the jumper block on his card correctly in accordance with the instructions for Centronics printers on page 9 of the Apple parallel printer interface manual which comes with the card, this should work too.

If checking the jumper-block wiring does not help, he might try disconnecting and then reconnecting all connections between slot 1 of the Apple and the printer. Ours printed gibberish at first, simply due to a poor electrical connection.

**Henry Brown,
Newcastle upon Tyne.**

Joystick modified

THROUGH A Shop Window advertisement the February 1982 *Practical Computing* I bought from T Garland & Son of Manchester, a joystick which I thought would work on all my games, instead of having to use arrows, space bar, etc.

It arrived and I loaded the software, but I was really disappointed when all it would do was draw lines vertically and horizontally. The accompanying limited instructions to convert existing programs were of no use since I am no expert, and could not attempt any alterations. So I wrote to the makers and received a telephone call from Mr Garland who offered to modify some of my software to work with the joystick. Since then, the firm has modified my joystick and most of the software I have.

To my amazement this was all done free of charge, and they should be complimented.

**Marcel Hudon,
Basford,
Nottingham.**

Learning to talk

THE APPROACH to natural language by Chris Naylor in *Practical Computing*, June, may be able to derive a lexicon, but I doubt it will ever derive any semantic rules. He claims to simulate continuous speech but fails to use phonetics, and omits spaces and punctuation, which represent clear audio cues in real speech.

Another problem is the idea that humans learn a language simply by being exposed to it. Babies learn their phonetic alphabet this way, but at the "mama" stage adults start teaching nouns by pointing at objects and naming them. Adjectives and verbs are later combined with known nouns, and by the age of five a child knows conjunctions, prepositions, etc., but may be unsure of their correct use. From this time professionals expand the lexicon and teach syntax and semantics.

An important area not addressed is the relation of language to reality. To his program, "dog" is a three-character string occurring more often than it would in a random stream. To a human, it is the sum of all previous experiences involving dogs. We use a huge on-line relational database to give meaning to words; computers will need a similar structure to work in natural language.

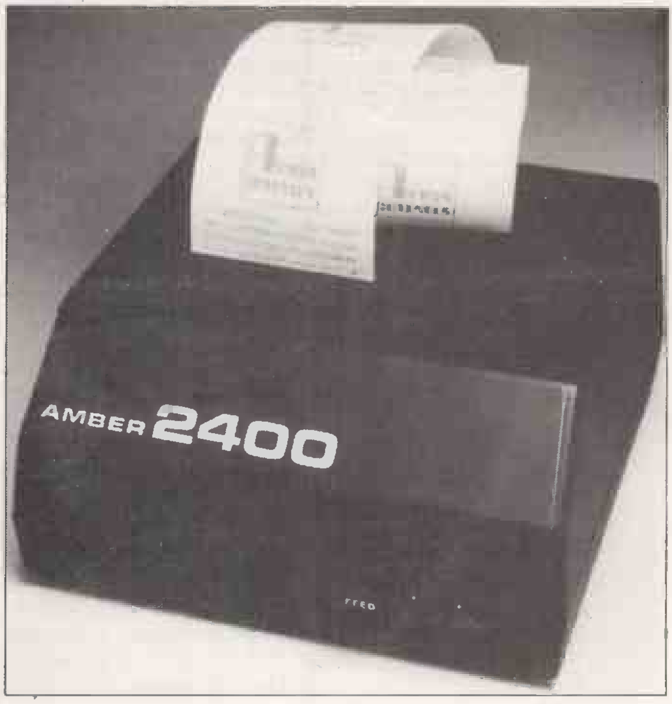
**David Budd,
Hulme,
Manchester.**

Plain paper printer

A £70 PRINTER which prints on to plain paper rolls is available from Amber. Up to now, low-cost printers have generally used thermal or electrostatic paper, which makes them quite costly to run and the material does not appeal to everyone. The Seikosha at about £230 was previously the cheapest to use normal white paper.

The secret of the Amber 2400's low cost is in the logic used to drive the printing mechanism. Only four needles are used. These are widely spaced and oscillate horizontally across the paper to build up each line of dots. A character line is constructed over several passes; 24 characters, the normal line length, take 0.7 seconds.

The paper roll is only 58mm. wide, but the printer can do lower and upper case, expanded characters and dot graphics. Acorn, BBC, Pet, TRS-80, UK 101 and ZX interfaces are available. Amber Controls can be contacted at Central Way, Walworth Industrial Estate, Andover, Hampshire. Telephone: 0264 65951.



Mini-winnie extended

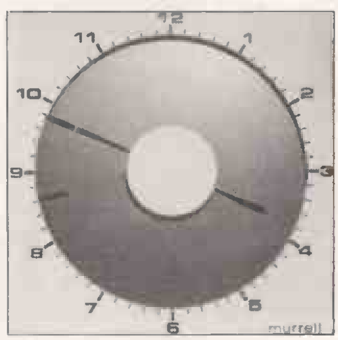
TWO NEW DRIVES extend the Rodime mini-winnie range to include 40 and 53Mbyte versions. The two new drives are designated the RO-206 and the RO-208 respectively. The sizes quoted by Rodime are slightly misleading as the capacities of the drives become 31.5 and 42Mbyte respectively when formatted in the industry standard of 256 bytes per sector and 32 sectors on each track.

The 206 and 208 are enhanced versions of the RO-200 series, and use Rodime's two-chamber design. They can be incorporated in a microcomputer, taking up the same amount of space as a minifloppy drive. The higher capacity has been achieved by use of a high-resolution stepper motor giving a track density of 600 tracks per inch. The units also use more of the disc surface.

For further details contact Rodime, Nasmyth Road, Southfield Industrial Estate, Glenrothes, Fife. Telephone: 0592 774704.

Traditional clock

THE MURRELL CLOCK SYSTEM is a patented liquid-crystal analogue clock. It displays the traditional hands that have been associated with clocks for hundreds of years. However, just because it is traditional it does not mean that the clock face is old-fashioned. A clock face with hands is a far more efficient way of displaying time than the supposedly modern digital display.



This particular clock face has the added advantage of interfacing to most small computer systems, enabling the time/calendar to be read and used within the computer for various tasks. The clock supplies hours, minutes, seconds, day, date, and month.

The Murrell clock has been developed by Murrell Dynamics Limited, a development company which is looking for interested companies to make licensing agreements. For more details about such agreements, or the clock itself contact, N J Murrell, Murrell Dynamics, 9 Haston Crescent, Kinnoull, Perth PH2 7XD. Telephone: 0738 38276.

English financial system

PLANNERCALC is a computerised financial-modelling system, available for only £39. The system is apparently easier to use than competing systems because the rules are entered in easy-to-use English, the highest-level language of all.

The system uses the now familiar spread-sheet approach, with a window that can be rolled in any direction. The user can enter new figures or rules, and their effects can be seen immediately.

Comshare, the system developer, sees Plannercalc as the entry point into Comshare's micro software range; a more sophisticated system called Masterplanner is the next step up. Models developed on Plannercalc can be transferred directly across to Masterplanner, and the extra features then become available.

Both systems will run on most micros which operate under CP/M. However they need 64K of memory, an 80-column screen, and either 5.25in. or 8in. floppy discs. Because of the low price, Plannercalc will be supplied via mail order and bulk purchases. For details contact Comshare, 32/34 Great Peter Street, London SW1P 2DB. Telephone: 01-222 5665.

Newsagents' package

SUPERNEWS is a computer system for newsagents, and it retails for only £990. The package is based on the Newsround package produced by the same company for the Superbrain computer and is aimed at the smaller newsagent who cannot justify the capital costs involved in purchasing such a system. The system comprises a Vic-20 computer, memory expansion, disc drive, and printer. It will plug into any TV set which then becomes the system monitor.

Facilities provided by Supernews include over 600 accounts per disc, 300 titles, both morning and evening newspaper rounds, weekly and monthly accounts, substitutions and shortfalls. The system will produce lists of debtors and printouts of statements, wholesale orders and round lists, among others.

The Computer Room will maintain the equipment and will lend a replacement machine in the event of a breakdown. The Computer Room is located at 87 High Street, Tonbridge, Kent. Telephone: 0732 355962.

ERA launch is no handicap

THE GOLF WORLD is about to be plunged into turmoil with the introduction of new handicapping rules, probably from January 1, 1983. This will impose a sizeable workload at the 2,750 golf clubs around the U.K., as golf handicaps are calculated from the results of past competitions. So it is a convenient time for ERA Consultants to launch its Clubmaster package, based around the portable Osborne microcomputer.

For £2,500 you buy the Osborne itself, an Epson MX-80 printer, all the usual Osborne software such as WordStar and SuperCalc, and the Clubmaster package. Clubmaster can be used to record scores during competitions, print out scoresheets and update and report handicaps. The system was designed by Keith Roberts, a category 1 amateur golfer based at Disley Golf Club, Cheshire.

For major events the system can display a comprehensive Leader Board, and with a £50 adaptor the Osborne will display this on up to 12 TV sets. The membership and subscription side of the system can handle 26 categories of member and 10 methods of payment, and will cope with 700 to 1,000 members on an unexpanded Osborne. Subscription bills, membership lists and reminder letters can be produced.

In addition, ERA has set up various golf-club oriented financial applications on SuperCalc. More details can be obtained by contacting Keith Roberts, ERA Consultants, 4 Devonshire Park Road, Davenport Park, Stockport SK2 6JW. Telephone: 061-480 8927.

Micros and the disabled

MICROCOMPUTERS have turned out to be a boon to the handicapped, or so we are told. Whenever prizes are handed out by this or that august body as their contribution to IT year it is likely that a project intended to benefit the disabled will figure among the winners and on the subsequent flurry of press releases arriving in our office. It is a safe and worthy area for sponsors to be involved in, and clearly a welcome opportunity to associate new technology with something other than unemployment in the public mind.

But do any of these systems work? Can you deliver usable, practical improvements to people's daily life with the stuff this magazine is about? For the first time disabled people will be giving their views at a one-day course which is to be run by the Spastics Society.

The course is aimed at technical people interested in using their time and experience to make or modify aids for the disabled. The location is Neath Hill Professional Workshop in Milton Keynes, which is itself a business venture run by severely disabled people, producing a variety of software products and trading as an Apple dealer.

The course is on Saturday, September 25 and costs £6.50. More details from The Spastics Society at Castle Priory College, Thames Street, Wallingford, Oxfordshire OX10 0HE. Telephone: 0491 37551.

Pet package is used to simulate Simplex D

ONE APPROACH to making the process of computerising as painless as possible is to closely simulate a familiar and well-tried manual system. The Simplex D cash book has been around for years and is used in many small businesses, especially in the retail sector. The user of the Micro-Simplex package, which runs on the 8000-series Pet, enters figures into an exact screen replica of the Simplex D cash-book page.

Once the data has been loaded on to the machine, summary and year-end accounts can be readily produced, something it is difficult to do manually. Receipts can be analysed over 10 departments and the package can handle any of the nine VAT schemes currently available for retailers.

The basic software package costs £395, with additional modules to handle VAT reporting, unpaid bills and outstanding invoices at £50 each. Leasing the whole system including Pet and printer would work out around £15 per week. Micro-Simplex is working on connecting the system up directly to the TEC MA 19 cash register.

Details from Micro-Simplex, 8 Charlotte Street West, Macclesfield, Cheshire, SK11 6EF. Tel: 0625 61500.

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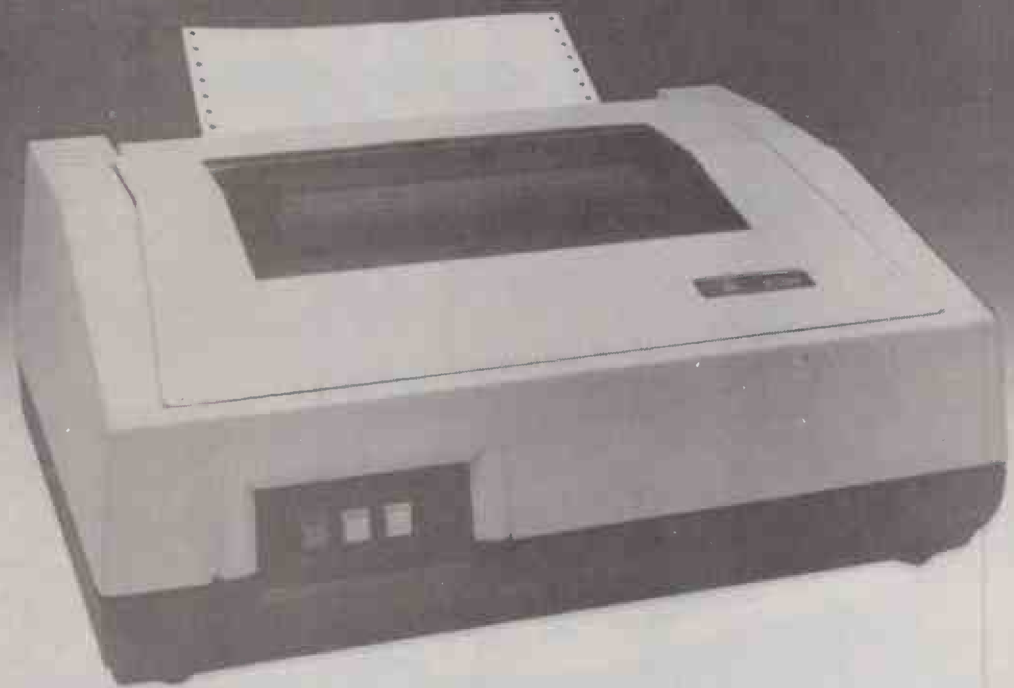

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● Circle No. 137

A taste of Apple IV?

Thomas J Lawrence, Apple's European manager.

TOP APPLE people were around recently in London for a series of briefings to prepare the way, John the Baptist fashion, for what they term their Fourth Generation machines. The only revelation to emerge was that Keith Hall, Apple's new U.K. marketing boss and formerly with Commodore, had slashed 231 dealers out of approaching 600 from Apple's approved list in his first six weeks in an effort to tighten up the dealer network.

Rumour has it that the new Apple IV will be a 68,000-based 16-bit machine, clearly aimed well up-market for Apple. It comes with 1Mbyte of RAM and 1·5 Mbyte of built-in floppy storage. With printer and screen the system will sell for around £5,000, placing it at the top of the professional-executive market slot which Apple sees as the growth area for personal computers.

The most interesting thing about it is the operating system, which is not the ubiquitous Unix but a special Apple-written product. The user interface resembles that of the cult language Smalltalk, developed at Xerox's Palo Alto Research Centre and currently available only very expensively on the Xerox Star executive work station. Keystrokes are minimised by having the user control the system with a hand-held mouse; everything is made ultra simple by simulating sheets of paper on the screen and pointing with the mouse to graphically descriptive function boxes.

The very high-resolution graphics are not in colour. Apple thinks only 10 percent of the potential users are interested in colour, and in this they take issue with the Japanese, whose new machines all seem exploit colour. But the Apple printer will be able to dump the 400-by-800 resolution graphics directly to paper, which may be more important to professional users.

The system is likely to come with a considerable body of software included in the price, continuing the trend of the Apple III; this probably means word processing, spreadsheets, communications and some accounting applications, as well as software development aids.

Apple believes that fourth-generation machines will only sell on the back of good software. "Hot hardware won't win the battle", as European vice president and manager Tom Lawrence said at a recent briefing.

The launch date is unlikely to be before February 1983. Shadowy machines exist now, but Apple does not intend to go off at half-cock as — it half-acknowledged — with the Apple III.

If all this is true it is to be welcomed. Apple is not going to waste the capabilities of 16-bit CPUs and cheap memory by emulating CP/M or some other historic artifact. It reintroduces a bit of excitement after the bog-standard CP/M box, and the now endless rows of Unix look-alikes, which may well end up appealing more to programmers than to the end-user. Apple is sticking with its original personal-computer concept — the machine you would like to own yourself to do business on — though unfortunately you do need to be a rather up-market person to afford one.

The CX-80 Colour printer can now be provided with an optional interface which allows hard copy to be printed, in colour, from a Prestel terminal. Fitting the interface does not interfere with the printer's operation, which is as a computer colour output printer connecting to the computer via the RS-232 or parallel interface. Black-and-white Prestel printers are also available. For details contact DN Computer Services on 061-643 0016.

Long-term program storage

MANY PROGRAMMERS want a simple way of permanently storing a program in memory. Obvious applications are to keep a favourite piece of system software in ROM or to build very cheap turnkey systems which do not need discs. A convenient way of doing this for one-off or low-volume systems, which does not involve using any PROM programming hardware or special software routines, is available from Cambridge Microelectronics.

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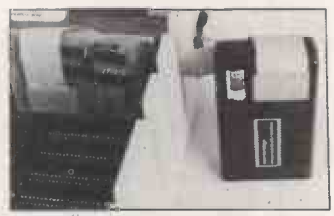

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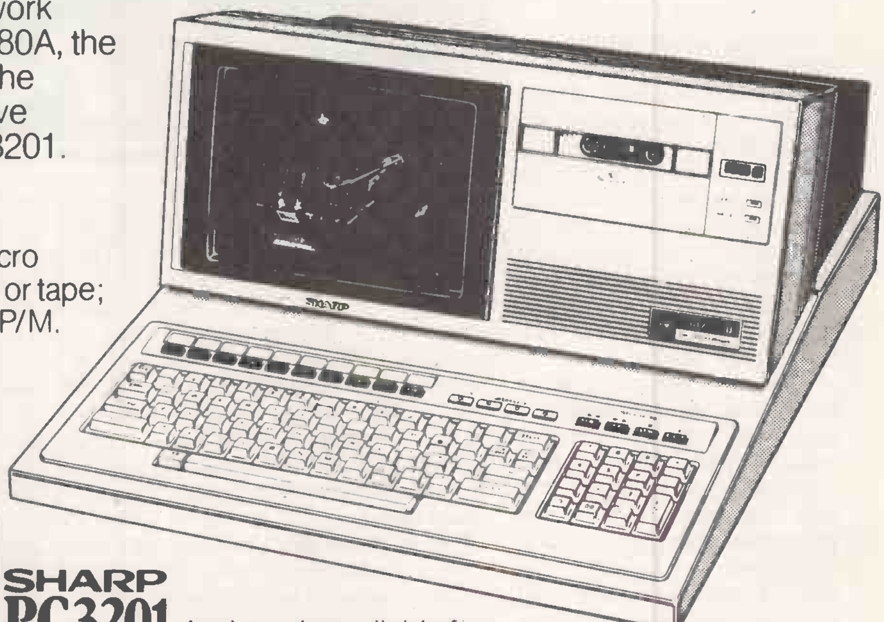

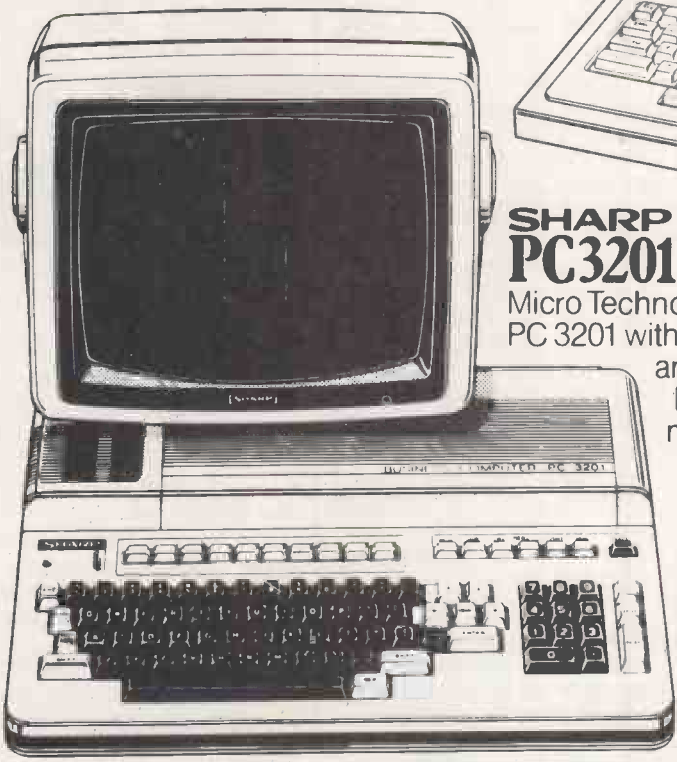

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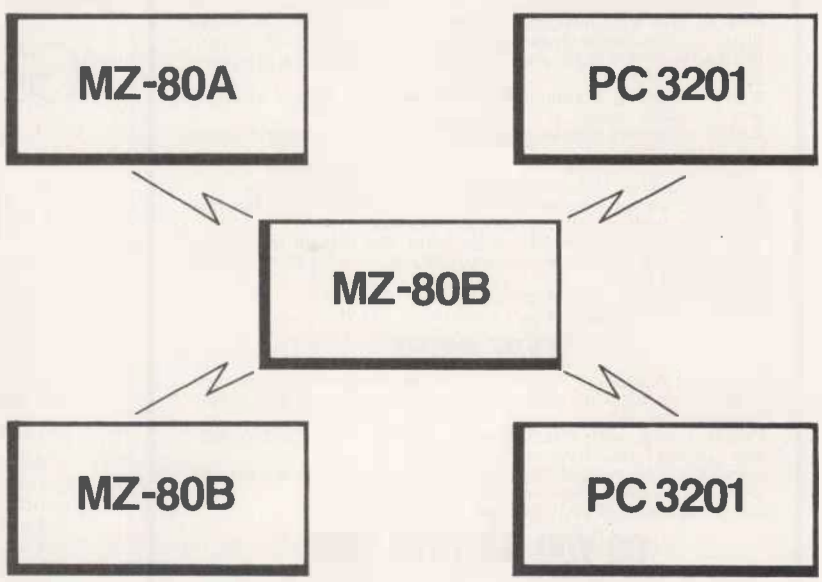

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NEWBRAIN

David Watt looks at the micro which was announced two years ago but has seen the light of day only in the summer of '82

THE NEWBRAIN computer was first announced during 1980, more or less when the Acorn Atom and the Sinclair Z-80 were being launched. At the time there was great excitement, but people lost interest as months went by and no machine appeared. In August 1981 Newbury Laboratories, the NewBrain's originator, sold the project to Grundy Business Systems, who finally launched the first two models in May this year.

Model A is the simpler version with 32K of RAM and 29K of ROM at a price of £199, while Model AD has a single-line 16-character display for an additional £30. Also available is a battery back-up module costing £59, which will provide an hour's continuous operation in the event of a power failure.

A machine with integral rechargeable batteries, designated ADB, is promised for the second half of 1982. Grundy claims the batteries should provide up to four hours of life when using the display, and will preserve memory for up to 20 hours. The standard software supplied in ROM includes enhanced ANSI Basic, a versatile screen editor, floating-point mathematics routines which are accurate to 10 significant figures, and powerful graphics.

A model AD machine was supplied for this review. The first thing that catches the eye is the styling and the quality of construction. In a two-tone brown, moulded ABS case the machine has been designed to take up as little space as possible on the laboratory table or office desk. It measures 11in. by 6in. by 2in. It has a separate power supply in a sturdy metal case which is obviously designed to stand up to accidental knocks if placed on the floor.

Keyboard pattern

The keyboard is laid out in the usual QWERTY pattern, with extra cursor-control keys at the bottom to either side of the space bar. The keys have an excellent feel and are mounted with the standard typewriter spacing so it is possible to touch-type.

The extra keys are marked as follows: Control, Graphics, Repeat, Insert, Home, →, ←, ↑, ↓, Escape, Video Text, and Stop. The Graphics key allows additional characters to be generated including the standard viewdata characters. The Video Text key, not used at present, is designed to be used in conjunction with a teletext module which is to become available some time in the future.

Above the keyboard, on the right, is a 16-character vacuum fluorescent display, giving an excellent range of viewing angles. At one point during the review a problem arose with the display. Two segments in each character glowed continuously and with varying intensity, but the problem was rectified of its own accord.

The display may be used as a window on a line of up to 288 characters, the → and ← keys being used to scroll horizontally. The display line may be used by itself or together with the full screen display. The quality of the screen display is excellent. A small 10in. monitor was provided with the system, but the NewBrain may also be used with an ordinary TV set. These will display 40- or 80-character lines, and the clarity of 80 characters per line is comparable with a standard VDU. Characters are easy to read on the television, the only problem being the loss of lines at the top and bottom of the screen, which is a common problem when using televisions. It is usually possible to adjust the set or to restrict oneself to using the visible lines. There is no loss of characters to either side.

At the back of the machine are a variety of connectors. From left to right these are: the power input; a 50-pin expansion bus; UHF TV and monitor; RS-232C printer; bidirectional RS-232C Modem and two tape cassette recorders. The Modem has software-selectable speeds between 15 and 9,600 bits per second. The connectors are a special design and it will only be possible to obtain plugs and leads from the supplier. There are no power or reset switches either on the power supply or the computer. If you crash the system, which is possible by opening the tape cassette as the main input stream, you have to reset by pulling the power plug out of the NewBrain.

Internally the components are packed very neatly on two and a half boards. The boards attach to a black metal plate, which acts as an efficient heat sink, stretching the entire width and depth of the NewBrain and bent at the back to form a backplate holding all the connectors. The plate becomes very warm if the machine is left on for a while, showing that it acts as an efficient method of transmitting heat away from the internal circuits.

Communications options

The NewBrain has been designed for expansion. A module may be attached which provides additional communications in the form of four input and one output analogue ports, a parallel-input and parallel-output port and two additional RS-232 bidirectional ports. This module must be used if you wish to attach additional memory or other modules, the exception being the battery module. Additional memory modules will be available in sizes of 64K, 128K, 256K or 512K, and a total of four modules may be attached giving over 2Mbytes of memory. The additional memory is addressed by paging. This is all controlled by the expansion module.

A variety of additional software will also be available in ROM, including: a statistical package; text processing; CP/M; Comal; and Z-80 assembler.

An enhanced version of ANSI Basic has been provided in ROM. The Basic is unusual in being, as termed by Grundy, a dynamic compiler. This means each line is immediately compiled into tokenised form when the Newline key is pressed, and is stored in this form. No compilation is done when the program is run. However the Basic still acts like an interpreter in other respects, allowing statements to be executed immediately if no line number is input, or the program to be interrupted, amended and then to continue executing at will.

There are none of the structured programming constructs which have now become popular with many programmers, such as Do-Until, While-Wend, Case or If-Then-Else, and variable names are restricted to one or two characters. A mathematics package handles floating-point arithmetic accurate to 10 significant digits. Strings may be up to 32,767 characters long, and numerical string arrays may have one or two dimensions and have up to 5,375 elements subject to there being enough memory.

A useful feature is the capability of trapping interrupts, which are caused by pressing the Stop key, but using On Break Goto. It means it is possible to prevent programs from being accidentally interrupted. The standard facilities for examining, changing and executing machine-code routines are provided in the shape of Peek, Poke and Call, and special single-line functions may be defined using Def.

Error messages are of the form:

ERROR 70 AT 50:2

which means an error occurred in the second statement of line 50. The line: statement feature is useful, but explicit error messages would be better than numbers. It is difficult to remember the 90 or so error numbers, which range up to 255.

Input and output are handled by the generalised operating system called IOS. Devices are opened using the statements Open, Openin or Openout. A data stream, device number, port and parameter string may be specified. Each of the parameters Datastream, Device or Port may be in the range 0 to 255, allowing great flexibility in the use of devices. Currently only 12 device drivers are available:

0 Screen display
1 Tape cassette 1
2 Tape cassette 2
3 Vacuum fluorescent display line
4 VF line and screen display
5 Keyboard
6 Keyboard with immediate return, allowing each key stroke to be identified
7 User port
8 Line printer
9 Serial Modem port
10 Dummy device
11 Graphics display

Clearly there is plenty of scope for adding new devices to the system. The port number may be used for opening multiple copies of a device. The parameter string allows the selection of various options depending on the device being used.

Tape storage

Load, Save, Merge and Verify commands are provided for using tapes. Data is transmitted at 1,200baud, about 120 characters per second. A standard Panasonic tape recorder was provided with the review system and worked perfectly.

Specifying a Load, Merge or Verify without a file name causes the first file located to be read, whereas if a particular file is requested, the names of other files are displayed on the screen until the required file is located and read. For some reason it is not possible to interrupt tape commands using the Stop key; instead you must press *.

An excellent editor is provided with the system. It can be used with the screen or VF line display or both together. The screen editor may be opened with up to 255 lines of 40 or 80 characters per line. It is possible to go to any line in the editor page, alter a portion of the line and then press Newline which causes Basic to immediately compile and execute the changed line.

A large number of facilities are available directly from the keyboard. The only problem is many of the functions require the use of special combinations of keys, pressing Control, Graphics or Shift together with other special keys, and it is easy to forget the particular combination required. Mike Wakefield of Grundy says they have considered the use of a plastic overlay on the keyboard showing the various functions, which would solve this problem although it may make the keyboard look more cluttered.

The graphics package is impressive, although it was only a pre-release of the software and several facilities were not available. Opening a graphics display is a complex procedure as it must be linked to an already open edit screen display. Low or high resolutions are available depending on whether 40- or 80-character lines have been specified for the edit display, and a wide or narrow graphics display may be selected.

Four-colour plotting

A narrow display only occupies the central four-fifths of the screen, which can save a certain amount of space in memory. The height of the graphics display is specified by selecting from 10 to 250 graphics lines in multiples of 10, 10 graphics lines being equivalent to one normal line. The maximum number of displayable points is 640 by 250. High resolution is excellent, the only problem being that the contrast has to be turned to maximum in order to display vertical lines. Plotting is executed by manipulating a pen, which has one of four colours, and a direction. The colours can be 0 to leave the point alone, 1 to set it to the foreground colour, 2 to set it to background and 3 to invert the point.

Two Basic commands have been provided to make the use of graphics easier. Plot followed by a series of statements called the plot list enables manipulation of the pen, and Pen can be used to determine the current status of the pen. When the screen is opened horizontal and vertical ranges may be defined, then all plotting is done with reference to the specified units. This means that the resolution selected does not affect the scale of a drawing.

There are 21 commands available for use with Plot. Fill, Axes and Arc were not implemented in the pre-release software. The commands ending in By allow movement of the pen relative to the current position, whereas the other commands move the pen to an absolute position.

Conclusions

- **The NewBrain is a well designed and constructed machine which should easily stand up to the rigours of home, office, laboratory or school use.**
- **The small size of the computer makes it attractive to the business user who does not want to lose too much valuable desk space. At the moment, the lack of disc drives make the NewBrain unsuitable for general business use, but disc drives and CP/M are promised for the future.**
- **The NewBrain could be used as a data-entry device or terminal to a host computer. The power of the NewBrain means it could do much more than the typical VDU.**
- **Although only the pre-release version of the graphics package was available, the high-resolution display was excellent.**

Specifications

Microprocessor: Z-80A running at 4MHz
Memory: 32K RAM expandable to 2Mbytes; 29K ROM expandable to 2Mbytes
Keyboard:
QWERTY with 62 full-size standard-pitch keys
Display:
TV or monitor, 40 or 80 columns by 25 lines. Graphics: low resolution 256 or 320 by 250; high resolution 512 or 640 by 250. Vacuum fluorescent 16 character 14 segment display line, model AD only
Ports:
Two 1200 cassette ports; TV and monitor; RS-232C/V24 bidirectional Modem; RS-232C/V24 Printer
Software:
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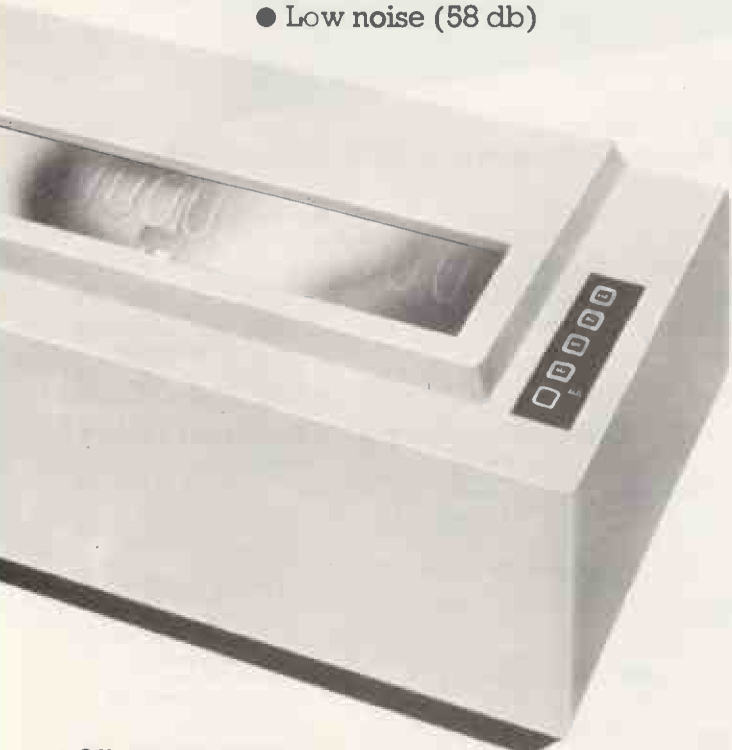

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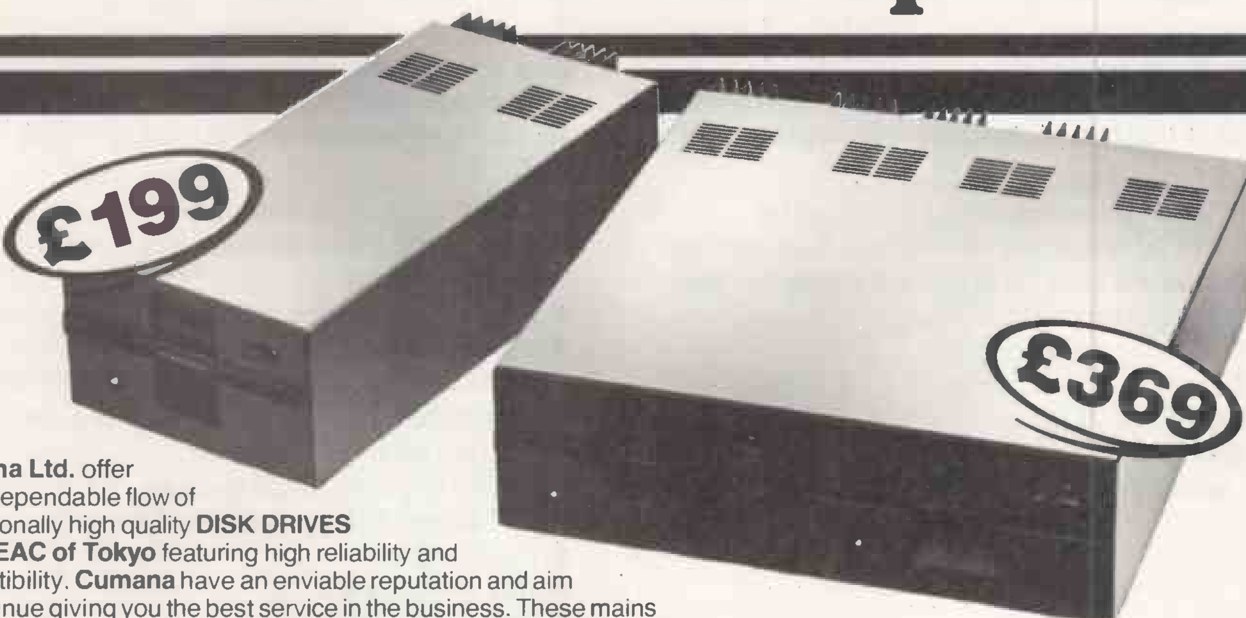

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Son of Superbrain

Ian Stobie investigates Superbrain II, which continues the traditions of the original Superbrain in concept and design.

THE ORIGINAL Superbrain from U.S.-based manufacturer Intertec represented startling value when it was introduced into the U.K. at the end of 1979. Then, for just under £2,000, users got a neat CP/M-running Z-80 based microcomputer, with 12in. 80-by-24-character screen, 64K RAM, full keyboard with numeric keypad and two double-density 5.25in. floppies, all neatly packaged in a single box. Moreover, the Superbrain boasted the innovation of a second Z-80A to look after the discs, which made overall operation of the system exceptionally quick.

Changing market

The Superbrain has subsequently established itself as a standard, budget CP/M machine, and there are now some 5,000 Superbrains in use in the U.K. Yet technical advances have continued and the face of the market has been changed by the entry of the giants of the computing and office-equipment industries. The Superbrain was good value when it was launched. Is the Superbrain II equally good value now?

The Superbrain II has several improvements and new features, but in concept and appearance it is clearly the same machine. The new features are an improved display, a built-in battery-operated real-time clock, and repricing of the whole package.

The displayed character set incorporates true descenders on letters like g, j and p, for the first time. This merely puts right what was a deficiency in the original display. Blinking, underlining, half intensity and reversed characters can be displayed. A range of optional character sets in Eprom chips is available from Intertec. One of these can now be installed to function as an alternate character set, selectable on a character-by-character basis under program control. It is also possible for the user to define special character sets and save them on disc, though the process is rather laborious. These features may well be of greater interest to system builders than to the ordinary user.

Microsoft Basic 80 as well as CP/M 2.2 is now provided as standard in the price, which has been dropped by about 25 percent: the cheapest model JD has 350K of disc space, equivalent to the original Superbrain, and costs £1,550. The 700K model QD costs about £1,800 and the 1.4 Mbyte model SD is £2,095.

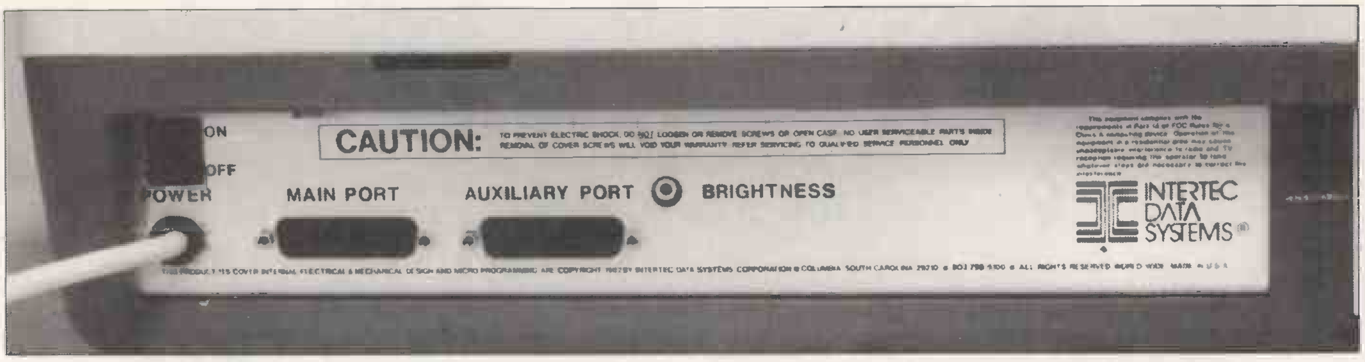
Several different hard-disc units are available from independent suppliers. Icarus, for instance, has a 5.75Mbyte hard disc which fits in the space usually taken up by one of the floppy drives. This brings the cost of the model QD up to £3,950. Intertec's own hard discs are linked to its Compustar multi-terminal network, and are not yet available for the Superbrain. A10Mbyte hard disc and two terminals cost around £4,500.

Although the outside of the new machine looks like the old one, internally it has been completely redesigned, with all new circuit boards. The result is a lower component count, and the similarity, already apparent, between the Superbrain and the Compustar terminal is increased to the point where they are almost identical. An upgrade kit to actually make the Superbrain II into a Compustar terminal has not yet been announced but it looks like a simple and intended step.

Tidy appearance

Setting up and using the Superbrain is easy; since it all comes in one box it is simply a matter of plugging a single 13A plug into the wall. The Superbrain retains its appeal as a kind of CP/M Pet, with no trailing cables or installation problems. A printer can be attached via one of the two RS-232 ports provided.

Once the machine is switched on, the system loads CP/M from the disc in the left-hand drive or, if the drive is empty, displays a message to insert a disc. The current time, provided by the battery-driven clock, is displayed at top right. The clock also keeps track of the date while the machine is turned off, and typing Date will display today's date on



the screen. The day-date clock can be used, for instance, for timing events in seconds or checking if a year is a leap year.

Characters are made up of white dots on a seven-by-five matrix against a black background. The display does not match up to the standards of, say, the ACT Sirius, which costs only a few hundred pounds more. The Superbrain design does betray its age when such ergonomic features are considered. Brightness can be adjusted, but not contrast.

The keyboard is built into the same box as the screen and cannot be detached and moved to a comfortable viewing distance. Most modern machines allow this, even the Osborne 1, and where unionised workers will be operating the machine it is likely to be an obligatory demand.

The keys themselves feel good: touch typists seemed to find them comfortable, and the keyboard light and fast to use. Construction seems generally robust although the machine does have a slightly budget feel about it. The discs make a groaning noise when accessing data. The floppies rotate all the time, whether or not they are being accessed, which may mean increased disc wear. On the review machine the power on-off switch came away from its mounting on a couple of occasions, and was left hanging by two wires.

Specifications

CPU: Twin Z80-As running at 4MHz; one performs all processing and screen-related functions, the other handles disc I/O.
Memory: 64K RAM
Ports: Two RS-232C interfaces
Display: Monochrome 12in. screen with white P4 phosphor, allowing 24 lines of 80 characters; characters formed from five by seven dots on a seven by 10 field and have true descenders, upper and lower case
Keyboard: QWERTY layout generating full ASCII upper and lower-case set
Clock: Battery-operated, providing day, date and time
Bus: Connector for optional S-100 adaptor
Discs: Integral dual 5.25in. floppies, capacity 350K, 700K or 1,400K depending on model
Size: 15in. high by 21.5in. wide by 23in. deep, weight 45lb.
Software included in price: CP/M 2.2, assembler, debugger, Microsoft Basic 80
Other languages: Fortran, Cobol, APL, etc.
Price: £1,550 for Model JD with 350K disc space £1,795 for Model QD with 700K disc space £2,095 for Model SD with 1,400K disc space
U.K. suppliers: Encotel 01-820 5701; GST 0954-81991; Icarus 01-485 5574; KGB 0753-38581; Sun 01-751 6695; and others.

Terminal emulation

CP/M 2.2 is the current release and a very wide range of software is available in Superbrain format. The Superbrain II is completely software compatible with the earlier machine. For some reason specialist engineering and construction-industry software suppliers have found the Superbrain an attractive machine to write for, and a number of companies are listed in *Practical Computing*'s Software Buyers' Guide servicing this market. Communications software is available to make the Superbrain emulate many popular terminals, and the machine is widely used as an intelligent work station linked to a company's mainframe computer.

The system under review was provided by GST Computer Systems and came with Wordbrain, GST's version of WordStar, which is optimised to take advantage of the Superbrain's hardware features. WordStar has become the dominant word-processing package by virtue of its ability to run on almost any CP/M machine. By the same token it takes little account of the particular opportunities each machine offers, and the user interface is therefore rather poor. With Wordbrain, GST has set many of the WordStar operations as single-key commands, making use of the Superbrain numeric keypad as a set of function keys. A novice might find this useful, but to those already familiar with WordStar it would not seem helpful.

GST has also rewritten the screen I/O routines, while preserving compatibility with files set up with other versions of WordStar, making the screen operations must faster. WordStar normally treats screen display as if it were dealing with a terminal, sending over a line at a time along with control characters. GST makes use of the fact the screen is directly mapped from RAM memory to speed this process up dramatically, writing purpose-designed screen-refresh routines in machine code.

These are fairly superficial changes to WordStar, but if you are going to use the Superbrain in this role you might as well have WordStar properly installed. Any user intending to do a substantial amount of world processing may do better to consider a machine with fundamentally better ergonomic features, most importantly a detachable keyboard and a clearer screen display.

Several dealers import the Superbrain into the U.K. direct from Intertec, among them Encotel, GST, Icarus, KGB and Sun; there is no single sales structure in the U.K. It is worth shopping around for the best terms, as prices do vary slightly; more importantly the arrangements for maintenance and repair differ.

Conclusions

- **The Superbrain II belongs firmly to the world of eight-bit Z-80 based CP/M machines. It is an evolution on a design with a proven track record and, with a start price of £1,550, it is still cheap.**
- **If you just want the cheapest CP/M system to run WordStar on then the portable Osborne 1 is also worth a look, considering all the software included in the price, although it is a very different sort of machine.**
- **The inability to detach the keyboard from the screen is becoming increasingly unacceptable, and despite improvements the screen display is not outstanding.**
- **In terms of value for money the new 16-bit machines like the ACT Sirius do represent significantly better performance for their higher price, around the £2,200 to £2,500 mark — providing the software you want is available for them. Among the many competing eight-bit CP/M machines the Televideo 802, NEC PC-8000 and Xerox 820 are examples which you may decide have better ergonomic features, worth the extra you have to pay.**
- **The Superbrain II scores through the considerable body of software which is available for it, covering both standard and highly specialised applications.**
- **There is a lot to be said for the view that first-time users should look for the software first and not worry too much about the machine they use to run it. The Superbrain II is a competent enough machine that does work, although the design is a little dated.**

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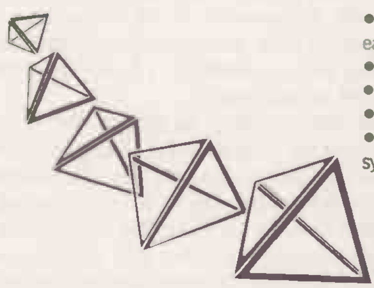

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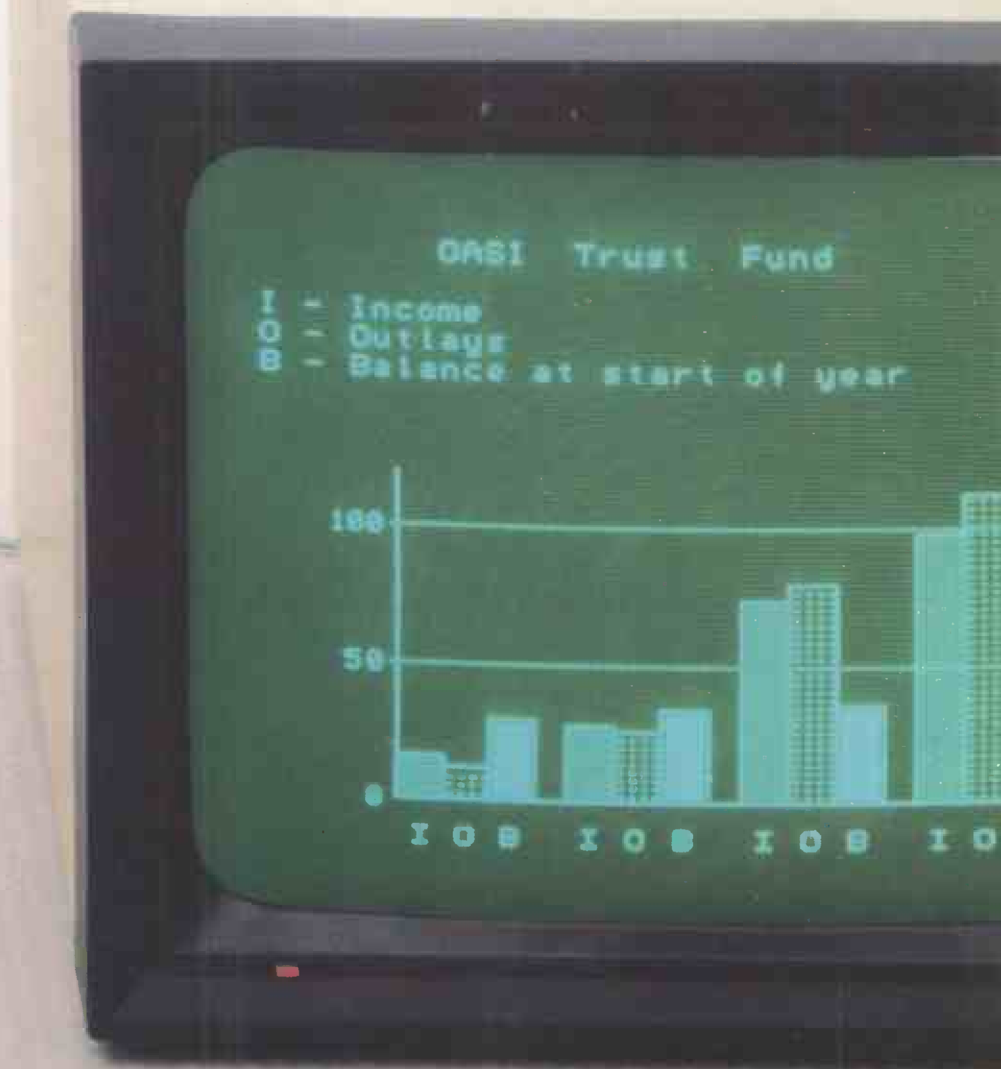

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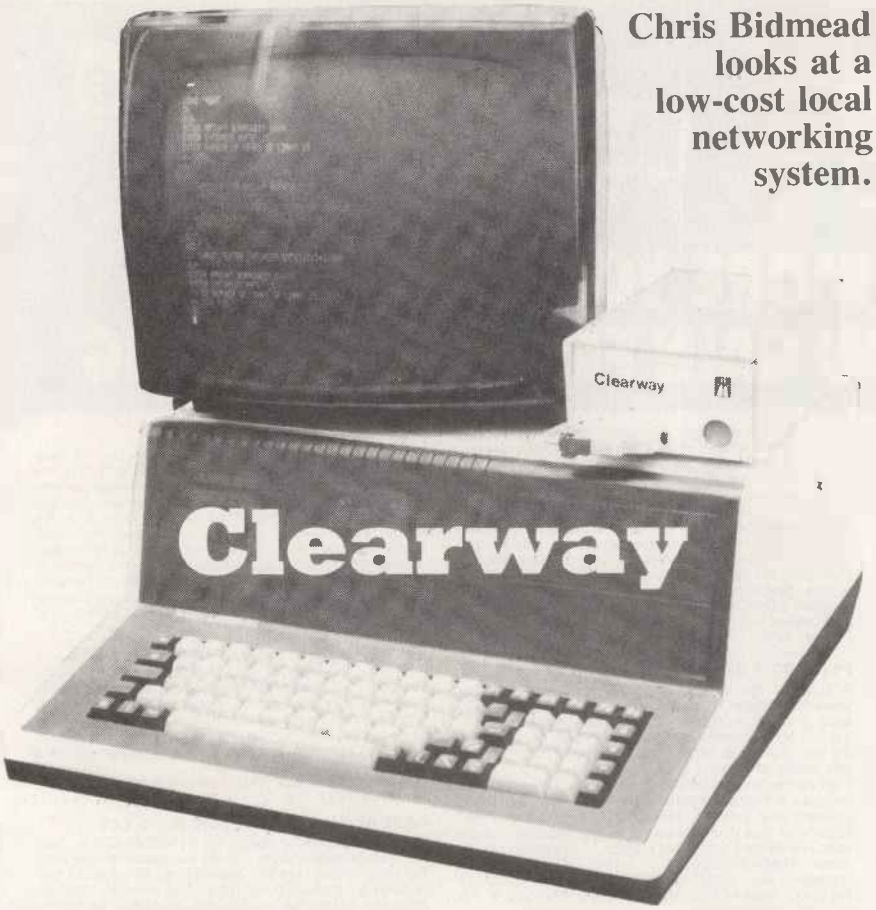

Chris Bidmead looks at a low-cost local networking system.

IN AN OFFICE of our acquaintance two computers currently share two daisywheel printers and a printer/plotter. Actually, the word "share" puts the case a little too simply, and other users whose computer hardware has been bought in piecemeal will be only too familiar with the situation.

One of the daisywheel printers has a Qume Sprint 3 interface, and will only connect with one of the computers. The two other printers are each driven by standard RS-232 lines and are nominally plug-compatible. The snag is that they need careful baud-rate and handshaking resetting when shifted from one computer to another. Connectors have to be unplugged and re-plugged and DIL switches tickled with propelling pencils or other sharp devices. And every time you need to connect the two computers together, out comes the soldering iron.

This is typical of small-scale information technology as it is practised in the early 1980s, and the reality should give some comfort to those who lament the theoretical ruthless onslaught of the microchip. The truth is that the computerised office is recognisably the same chaos as the office of the typewriter and paper-clip. Only the hum is different, and the electricity bills are larger.

It would be a massive stride forward if the many disparate devices could be threaded together like beads on a string, and text sent to printer A, B or C from computer D or E at will. It would also be handy if, with due copyright circumspection, code and text could be exchanged between the two computers. Joy would be complete if there were some assurance that future hardware could be slotted into the system simply and cheaply.

There is a solution, or more properly, a raft of solutions, which are genetically labelled "networking". In the simplest terms the idea is that you hook a series of intelligent "nodes" on a length of common cable, either open-ended or joined up into a ring, and hang your printer terminals and computing equipment off the nodes. While communicating with the local device or devices attached to it, each node must be capable of sending out and receiving data through the communal network, as well as — and this is the clever part — distinguishing from the general traffic along the network those data items intended for it alone.

Each node has some form of address. The general principle is that the nodes time-share the network by sending out or receiving data in short bursts or packets. If that makes you think of the parcel post, the analogy is not at all remote, because each quantum of data has to be wrapped between header and trailer information, with an address somewhere on the front where the nodes can read it. When the parcel arrives at its destination these outer layers are disposed of so that the unwrapped contents can be passed back to the local device in a form it can handle.

There is one very good reason why small offices are not already wired up with a ring of coaxial cable piping round information as readily as the mains ring pumps out electrical power. You can pick up a four-way mains socket in your local electrical store for around £8: the information technology equivalent might cost you £1,000 for just one of the nodes. One figure we were quoted for a typical start-up system was in the region of £12,000.

Such is the price of fully fledged networking with a system like Ethernet. For your money you are given more than just harmony between your in-house Epsons and Osbornes; it buys you the ability to exchange data with the rest of the computing universe — or at least that section of it that has not preferred the other incompatible network systems like Econet and the Cambridge Ring.

Ordinarily hardware reviews need no preamble; readers who do not share some sense of the general desirability of products like computers and printers have probably picked up this magazine in mistake for *Horse and Hound*. But a low-cost local networking system with a price tag of £100 a node needs to be placed in perspective.

Clearway, as designer Greg Walker calls his brainchild, grew out of the tangle of RS-232 cables that began to choke the offices of Real Time Developments of Farnborough. The systems house had been expanding under his managing directorship through the late 1970s. In addition to a computer bureau business, it was marketing a new range of dot-matrix printer and finding time to help a rock band, the Who, with the software and hardware to weave laser patterns around live performances.

Intelligent boxes

The logistics of hooking up the various hardware acquisitions at the home base was beginning to be a problem. The problem became a department, and the department rapidly took on the dimensions of a new product development.

The minimal Clearway system comprises a pair of white nylon-coated metal boxes, each taking up approximately 13cm. by 30cm. of desk space, allowing for protruding connectors front and rear and standing 8cm. high. The front panel consists of a rim-guarded, red reset button, and a small red LED that watches over a standard female V-24 socket. The mains lead and a length of grey coaxial cable terminates in an ordinary stereo jack plug run off from the rear, while between them is a jack socket compatible with the plug.

The first evidence of the intelligence of the device appears on powering up. The LED begins a rapid flickering, described in the manual as the configuration mode pattern, one of 11 diagnostic or informative visual "ringing tones" in its repertoire.

The idea behind the patterns is that the

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LED is lit steadily if the unit is idle and is off if it is busy disconnected from the mains; it gives an occasional blip on certain normally encountered conditions, and becomes agitated should things start to go seriously wrong. Elegant variations on this basic theme give the user a very full idea of the status of each node — see figure 1.

The care with which the diagnostic patterns have been devised was the first

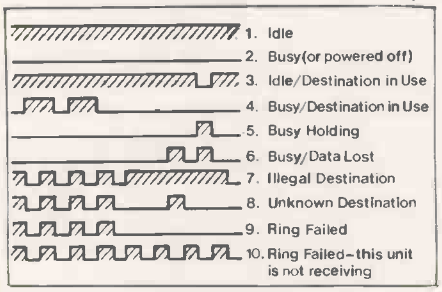

Figure 1. The status of each node.

clue to the generally thoughtful design of the product as a whole. No doubt a liquid-crystal alphanumeric display would have spared the unfamiliar user the occasional dip into the manual to check the status, but a single LED keeps the manufacturing cost down — which was one of the prime design objectives — without stinting too much on the friendliness of the device.

Real Time Developments lent us four Clearway units for our review. In a permanent installation each node is plugged into socket fixtures wired together in a ring running around the walls. There are no special constraints on the conducting material. The Clearway standard is ordinary UHF TV aerial coax, but even three-core mains flex would do.

For our purposes it was enough to daisy-chain the nodes together by inserting the jack plug of one into the socket of the next until the ring is completed — see figure 2. The 9ft. coax lead the manufacturer supplies with each node gives ample spread around a medium-sized room. Supplying the mains power for each node is less convenient, and there were moments when we wished the boxes could have been battery-driven, or somehow fed from the 12V offered up on the RS-232 lines, though with a 30W thirst per box this would hardly have been realistic.

Kicking the straggling mains leads to one side, we were able to survey a room humming with computer power, with a pair of printers on standby — the Qume Sprint 3 type of printer is a parallel terminal, and so out of the game. The Clearway boxes' little red eyes were flickering rapidly, waiting to be configured.

For this process a terminal is needed, though a full duplex printer with a keyboard or a computer with a CRT monitor will do. Making the initial life-giving connection does demand some elementary knowledge of RS-232 theory.

The minimum you need to know about RS-232 full-duplex theory is that data is sent out along one wire and read in along another, the fluctuating voltages being measured with respect to a third wire, known as Signal Ground. The connected devices are looking at the same lines from different ends — the receive line of one is the send line of the other, so the communicants have to decide who is to do what and to whom.

Transmit or receive

There are thus two classes of data devices: data communications equipment, or DCE for short, also known as Modems, or data sets; and data terminal equipment, DTE. Printers are almost always DTE, and as microcomputers spend much of life communing with printers, the micro is usually treated as a DCE device.

RS-232 theory starts with terminals, and the lines are named from that point of view. A corollary of this is that the micro is pictured as sending out its data on the receive line, usually known as Rx, and receiving data on the transmit line, Tx. This sounds foolish enough to be memorable, and should save you a lot of heartache when it comes to making your own connections.

The initial hook-up of the Clearway node was to the RS-232 external communications port of a Vector Graphic computer. When, as in this case, two devices think they are DCE the simple solution is to cross over the Tx and Rx lines. Thus wired, with the flickering

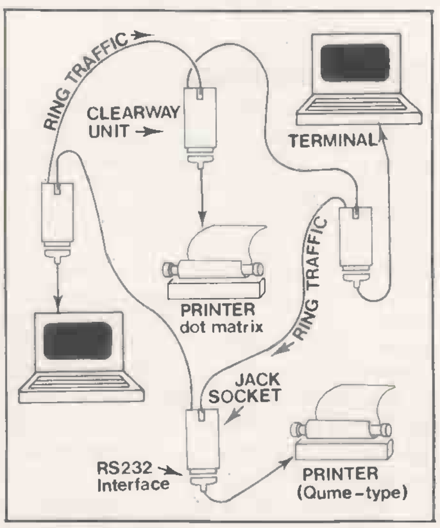

Figure 2. Typical clearway network.

LED indicating Setup mode, the Clearway node is waiting for a Carriage Return from the computer keyboard.

Internal intelligence analyses the character to determine its baud rate, adjusts its own transmission rate accordingly, and responds by sending a status string to the screen and asking for a response:

27-7XB8N33A . . . . (Y/N/Q/?)■

The system is announcing its present configuration and asking if you want to change it, or ask questions about it.

The process of resetting the initialisation string makes a good introduction to what the device can do. The two digits heading the status string indicate that the node has been preset to link up with device number 27. This is not the home address of the node, but the number of the node it is set up to communicate with on the ring.

With only four nodes on the ring it is easier to call them 10, 20, 30 and 40, so we want to change the string. The response N from the keyboard positions the cursor under the initial digit and you begin to build the new string by entering the digits 2 and 0; 10 may be reserved as the home address of the node currently in use.

Parity bit

The next character in the string happens to be "-", a code meaning that connections on this line will "time-out" when there is a gap in transmission longer than 30 seconds, rather than requiring an explicit disconnection through alteration of the command string. Pressing the space bar accepts the preset character into the new string in a way that will be familiar to users of the Microsoft Basic Edit command. The next two characters, 7 and X, are codes for the baud rate at which data will come in from the node to the local device, and the method of handshaking to be used.

Ordinary ASCII text transmissions only need seven bits per character, and it is common practice to treat the unused highest bit as a sort of watchdog over the others, making sure it is set to 0 or 1 depending on the parity — that is, the oddness or evenness — of the number of 1 bits in the transmitted character. The B option, which is the next character in the preset string, signifies that parity setting will not be carried out by the Clearway unit: bytes transmitted from the node to its local terminal will be left unchanged. Parity setting is only carried out one way: the Clearway unit will always make sure that bytes entrusted to it from the local device for transmission are passed on to the ring unchanged.

Node address

The rest of the string is a mirror image of the first half: the next two characters define baud rate and handshaking for data transmissions from the terminal to the Clearway unit, and the two digits that follow establish the address by which this present node will be known to the rest of the system — in this case it is to be set to "10".

The A at the end of the command string indicates that a Control-A character is to be treated by Clearway as a cue to go into reset mode, a convenience that

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allows the unit to be reconfigured from software without recourse to the red reset button on the front. This works for text transmissions because the ASCII control characters, with the exception of Carriage Return, Line Feed, Tab, and possibly Backspace, are not expected in the data stream.

Of course, if you anticipate running across Control-A in the data, as you certainly will if you are transmitting or receiving object code, a reversion to Reset mode in mid flow is the last thing you want. For this reason Clearway allows you to alter the Reset character to any other control code, or disable software reset altogether by putting an @ into this field; Control-@ is ASCII 0.

Intelligible labels

The control string has managed to compress a lot of information, but is not very expressive to the human user. For this reason the dots that follow offer a free-form field that can be replaced by any text that will help you identify the unit. You could write "Vector Graphic" into this field and hit Return, loading the whole command string back into the Clearway unit.

You have to go through the same process for each of the nodes you intend to put on the ring, giving them all home addresses and initial destination addresses. Devices like printers that will not be initiating calls themselves can be given a permanent destination address of 00, which means they will respond to any device that calls them, provided they are not already booked.

The network will now operate as if everything were connected to everything else, with software switches deciding the routeing. This simple and satisfying situation has cost just £400, with a few pence extra for the cable if you wanted to tidy the ring on to the walls.

Data packets

How, you may wonder, do all these signals bat around the ring without hopeless confusion? Part of the answer is the technique of wrapping quanta of data into packets. A similar idea is used on ordinary RS-232 lines, at a single-character level, but even with an elementary data stream like this the problem is only partly solved by wrapping each character fore and aft in "framing bits" to segregate them from their neighbours.

Consider that simple process of communication. At one end of the RS-232 wire is a computer, an ethereal device whose task is patterning tiny electrical charges; at the other a printer with a heavy print head and the responsibility of making an impact on the real world. The computer dances ahead, executing its tasks at something near the speed of light, leaving the printer doing its best to keep up.

Unless it has a way of telling the sending device to hold off while it catches up, the printer is liable to drop characters — hence handshaking. By switching a rudimentary on/off signal on a wire specially set aside for the purpose — hardware handshaking — or by the software equivalent of sending special characters back along the normal transmission line, the printer can let the computer know how well it is coping with the data flow.

The faster the transmission speed, the more necessary this becomes. The Clearway ring speed of 56Kbits/s. is slow by full-scale commercial ring standards which are typically around 10Mbits/s. or more; all the same, it is six times faster than the fastest normal RS-232 speed of 9,600 bits/s. In fact the Clearway ring has a bit transfer rate of something like the speed of a typical mini-floppy disc drive.

To be sure that data is being received at the destination without corruption or loss, the Clearway nodes have a data validation agreement that goes something like this:

- no packet of data is to be transmitted unless the previous packet has been destroyed;
- no packet of data is to be destroyed unless it has been labelled as correctly received;
- only the original sending unit is allowed to destroy a packet.

A fairly complicated requirement is thus reduced to three simple rules. Only one small amendment is needed to prevent the ring filling up with garbage packets under certain conditions: each packet is given an "age counter" in the header that is decremented every time it passes a node. If a packet has been round the ring 256 times without being claimed it is destroyed by the next node that handles it.

Simple approach

The manipulation of the packets is made possible because the Clearway units are small computers, each with its own Z-80 processor, a 32K PROM chip and 2K of battery-backed CMos memory that can hold its data for over a year without external power. A Zilog Dart chip, which consists of a pair of serial-to-parallel protocol converters, takes each packet off the line and brings it on to the internal bus, where the Z-80 can examine it to see whether the data it holds should be passed to the local terminal. If not, the packet is simply returned to the ring with its age-count decremented.

This approach has the advantage of simplicity. No additional rules have to be introduced to define when new packets can or cannot be introduced into the ring. If the Z-80 is examining an incoming packet it will automatically hold up introduction of its own local data until the process is complete. The result is that the gaps between packets become evenly filled as the traffic increases, and the best use is always made of the line.

Full-scale commercial networks go to expensive lengths to avoid what the Clearway units are doing. To insist that each unit computes every packet slows down the traffic, and also means that if one node fails the whole system grinds to a halt. On the basis of our trials it is impossible to pronounce on the first point. According to Greg Wilson, the presence of each unit slows down transmission by two characters per packet; with four nodes in a ring the system suffers an indetectable overhead equivalent to having to process an extra 64 bits at 56,000 bits/s.

Wilson maintains that even with a load exceeding 50 active nodes the ring should show little sign of sluggishness. With the four devices we were lent for review running at full tilt, the network seemed effortlessly transparent, despite the formidable amount of computation going on inside those innocent-looking white boxes.

One-off failure

Disappointingly an RS-232 driver chip on one of the units failed during the course of our trials. Yet it was an easy matter to remove it from the ring and close the other nodes around it, and because of the three data validation rules no data was lost in the process. If this sort of thing happened daily the replugging might become tedious, but the units appear to be built to a very robust standard, and there is no reason to believe that the failure was anything more than a "one-off".

While getting the feel of the system the Vector Graphic was used at Monitor level to readdress the units. For ordinary redirection of output in daily use a simple Basic program easily copes with this under CP/M:

```
10 INPUT "Select CLEARWAY destination
   ";A$
20 LPRINT
   CHR$(5);STRING$(64,13);"N!!!!!!";A$
30 PRINT "You have selected CLEARWAY
   destination ";A$
```

Acknowledgements are due to Jerry Karlin and Peter Cheesewright of Microcosm, whose experience in designing full-scale networks for industry helped us put this low-cost system into perspective.

Conclusions

- **At £100 a node, Clearway is the cheapest local area network system we know of.**
- **The system proved surprisingly simple to set up.**
- **Once in use it should be very easy to extend, up to the logical limit of 99 nodes, although some degradation will become apparent as the load is increased.**
- **If you want to access remote, fast data transfer devices such as disc drives in real time Clearway alone is not enough, and you will probably have to pay a lot more.**
- **The system is made and supported in the U.K.**

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Chris Bidmead finds his ambition to rule the world brought one step nearer by this unusual database-management package.

SUPERFILE

KNOWLEDGE, they say, is power. When office information technology first appeared a couple of years ago it brought the exhilarating feeling of being on the point of taking over the universe. A few weeks getting up to speed, and we would be able to release a New Order upon the world.

It has not yet happened. The only reason Reagan and Thatcher are being allowed to carry on in the interim is that we have hit something of a snag. The truth is, we were badly let down by the software.

With Superfile we may at last be making some progress in the database stakes and, interestingly enough, it did not have to wait for the power of the 16-bitters. The package runs on a Z-80, and does plenty in the way of gobbling up the data you throw at it, and regurgitating the parts you need when you need them. What is really good about it is what it does not do.

Specifically, it does not, as other database-management systems do:

- Ask you the date whenever you enter new data and ask you the date again when you go on to look something up, even though you have not yet returned to the CP/M command line.
- Insist before you start to build your database that you define the total number of fields and the maximum length of every field. Some packages are happy to let you add more fields later — as long as you are happy to go back and type in all the data again.
- Require you to define a field or fields as the key field. With Superfile all the fields are key fields automatically.

The other thing it does not do is run up bills for cables to the States if you hit any snags. SuperFile loads with a logo that says:

SuperFile
Made in England

There is an obvious advantage in getting your software from close to home. Precisely how close to home, it should be explained, is that the Superfile package was developed by the software house of Southdata, under the inspiration and direction of *Practical Computing* editor Peter Laurie.

It began life as an ingenious 12K of code that patches itself into the operating system and then disappears, letting CP/M run normally until a certain range of non-CP/M function numbers call it into being to create and manipulate a large, indexed database file on the logged-on disc.

First name: ....
Last name: ....
Tel. No: ....
Birthdate: ....

Figure 1.

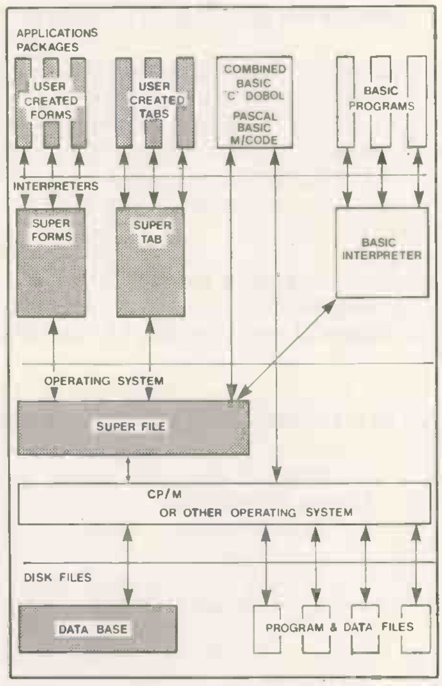

Figure 2. Superfile's structure.

Southdata affectionately called this 12K CP/M add-on "Dub'em", after the driver DBM.COM — standing for Data-Base Manager. It was chiefly designed as a programmer's tool, but there was a no-frills database manipulation module built in, called by writing:

A</look

into the CP/M command line.

Once inside /look you find a number of simple tools to inspect all or any of the records and create new ones. DBM thinks of the data in terms of equations between a set of tags — which it owns permanently, but can be renamed to suit you — and the fields of data that you enter.

Enter a partial equation, and DBM does its best to fill out the whole record. So DBM will respond to:

NAME=harry

by rattling off all the records in the database with a Name tag of Harry. Mercifully, DBM is not a stickler about upper and lower case.

The Southdata team has polished DBM and added a smart software front panel in the shape of a pair of programs called Forms and CForms. The thing now looked a little like DataStar, a file-management system usable by the non-programmer. Yet at the same time, DBM was still there as a programmer's tool if you wanted to build your own hand-tailored system.

Left to itself, DBM runs on any CP/M machine, including CP/M 1.4, by dint of not caring very much how it presents the data on the screen: everything just scrolls. But with the full Superfile package there is now a routine called Setup.Com for organising the necessary adjustments for proper cursor-controlled display on your terminal, rather like the Install.Com routine in WordStar.

Setup is a delightful introduction to the package. It asks you to define how your terminal likes its cursor addressed, and how the screen is cleared, and so forth.

As you reply, it tests your answers by moving the cursor into a little box of asterisks that appears in different places around the screen. Somebody at Southdata has put a lot of thought into making the essentially boring business of software installation as interactive as possible.

That done, you are ready to build your first form. Like DataStar the CForms program is used to create a data-entry form on the screen that can, if you like, be used to check that you are entering the right sort of data. You can make the form insist, for example, that certain fields should be numeric only, and that other fields be automatically checked against a list of valid entries before they are accepted.

The forms idea is a graphic representation of the way most database-management systems keep track of data. They store fields in records and string the records together into files. Consider the blank form in figure 1.

The dots represent fields, and a completed box is a single record. A file will consist of an indefinite number of such records. A typical database-management system operates with separate main files for each database. If you start a second database — on 19th-century novelists perhaps — the system will create another main file and another raft of little index files.

Suppose that in setting out the form of the novelists database you did not realise you were going to be interested in their birth dates. Once the thing is under way and bulging with information on Dickens and the Brontes it is no good trying to

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press the Birthdate field of the Name and Address database into service.

Superfile handles things differently, with one big database covered by a single index file. There are 250 tags, you can give them whatever names you like, and the forms you create with CForms may use the tag names to identify its fields, quite different tag names, or no tags at all.

Imagine you are filling in the form in figure 1. As you do this for a series of names and addresses the database-manager establishes a set of internal pointers for each record. Pointers are values that connect fields to tags, and tags to records. The system now has to index these pointers against the fields, so that when you are interrogating the database you only have to throw it the contents of a field to get back a record.

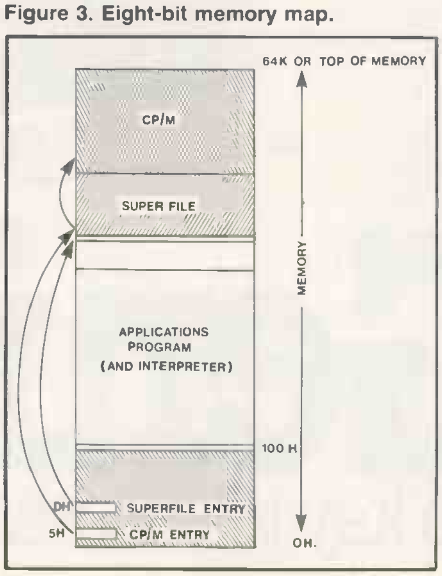
Up to this point Superfile follows the conventional wisdom. But instead of indexing all the characters in the field — Jenkins in the example above — SuperFile condenses the name on the basis of the first few consonants. The index then records the whereabouts of a field identified as something like JNK, although the internal representation is in an even more compressed binary form.

When you come to look up Jenkins the index will return the locations of all the First Name fields that match the compressed representation. This technique makes it possible to index every field and keep one big database for all the records.

There is a spin-off, too: being able to pull out a family of similar names means that even if you are not sure of the spelling you stand a good chance of identifying a field.

Normally SuperFile intervenes and does a second rapid selection to sort out the Jenkinses from the Jankers, Johnkers and Johannkovitzkies before returning the exact record. You can use the symbol @ to switch off the secondary selection

Figure 3. Eight-bit memory map.



and select from all the look-alikes the index throws up.

Southdata calls this the Fuzzy Matching search mode. There is a numerical search mode on similar lines — although using quite different techniques internally — that enables you to look for numbers lying within specified ranges.

Another major departure from traditional micro database management is the way Superfile allows you to search for any string contained in a field. Suppose you have the bright idea of adding a field called Action to your Name and Address file. Actually Names and Addresses is just a selection of tags from the big database, but you tend to think of it as a separate file because Forms filters out the other tags you do not want to look at.

Action contains plans, promises and aspirations involving each of your acquaintances. It will be full of fields like "Promised to phone her about lunch". An ambiguous string search, called by entering

lunch

will pull out all the people with whom future lunches are planned. Equally, you could find all the people you are meant to be phoning by entering

phone

Complicated code

The code that makes all this possible is complicated stuff, though the user is doubly shielded from its internal workings. It is hidden first by the elegant DBM module with its operating-system calls, and secondly by the well-designed Forms and CForms, which allow you to use the database system almost as if it were an intelligent word processor. The Forms/CForms programs can also be made to do arithmetic — calculating prices, say, from data in the database, and working out the total.

I found Superfile very impressive. Those coming fresh to micros will, I suspect, simply take it for granted, ignorant of the contortions that older database-management systems demanded of the user. With them in mind, I had better spell out one or two minor irritations lurking in this early version of the DBM/CForms/Forms package:

- DBM is written in Z-80 machine code. The package will not run on an 8080 or 8085 processor. Rair Black Box owners are out of luck.
- Forms and CForms are written in C, with a view to future transference to 16-bit machines. The word-processing package I use is also a C product, and suffers from the same snags: on an eight-bit processor the code is bulky compared to properly optimised machine code. The disadvantage in the case of CForms and Forms is that with DBM added to the operating system there is no room left for them in our 56K Vector Graphic. The Superfile suite of programs needs at least that, and we had to borrow a Xerox 820 to run it.
- The database can only be scanned forwards. To look at the record you have just passed you have to go back to the menu and start again. Superfile works fast enough to make this less of a nuisance than it might be.
- The present version of Forms has only a limited editing facility. To alter any record you must rewrite at least one whole field. Confusingly the old field remains on the screen while you write in the new line, tempting you to think you can perform a partial edit on the field by overwriting some of the characters.

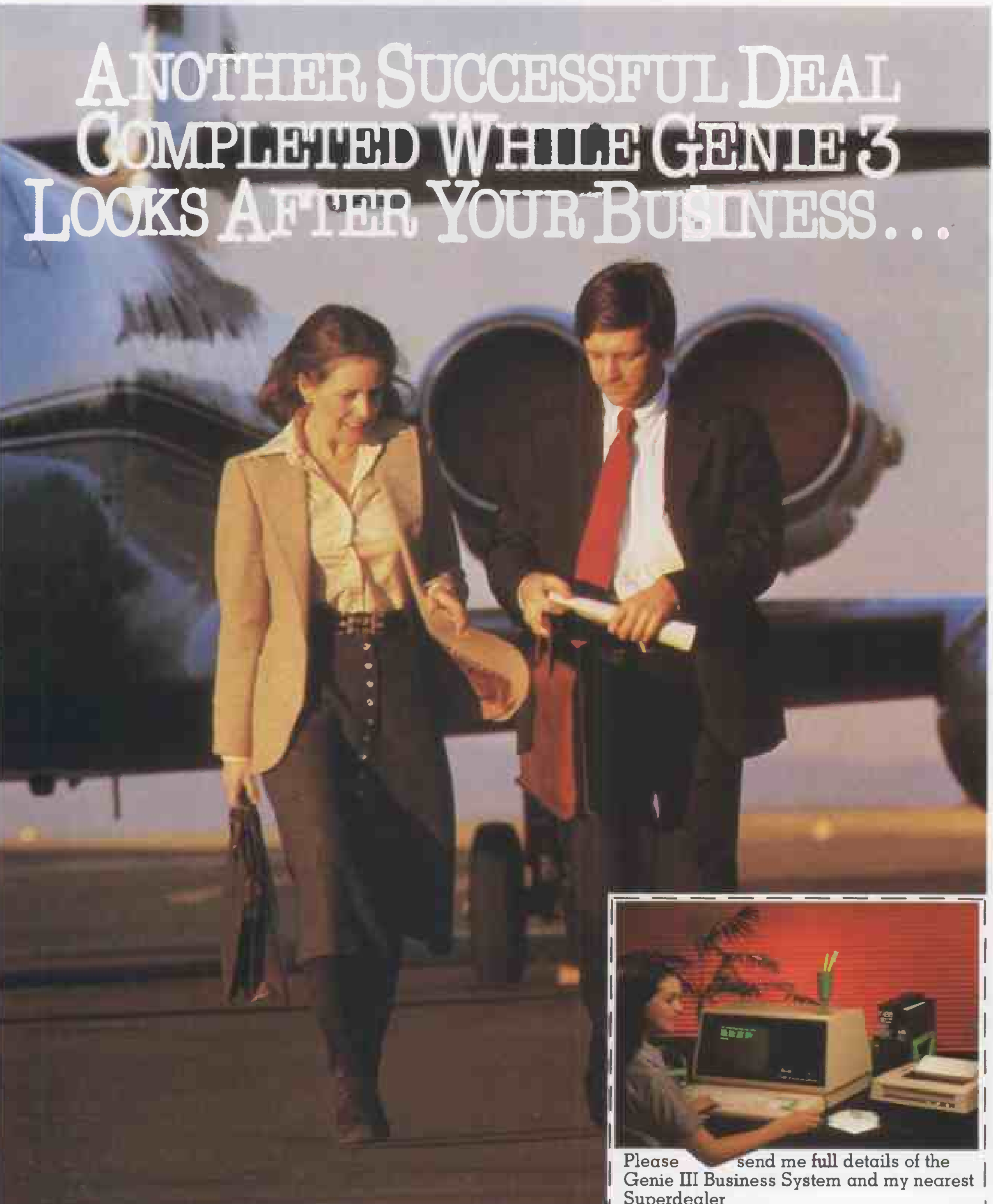
Of course Superfile is still not a true relational database; the records exist as fixed relationships inside the system. But the ability to search on any combination of fields, and even on the partial contents of fields, gives the system a flexibility that extends well beyond the simple card-index concept.

Relational searches can be done, the manual suggests, by using the data from one record as a criterion for finding another. It is clear that to do this the Forms/CForms interface to DBM would have to be replaced by a specially written high-level language program. The package goes half-way to meet you on this point by providing a Microsoft Basic routine called DBMSkel.BAS, a skeleton program that organises the business of calling DBM from within the Basic interpreter.

arithmetic capabilities of Superfile, the otherwise lucid documentation is a little obscure around the subject of creating formulae to calculate fields from other fields. Setting up simple totals is easy, but deriving figures from other calculated fields — as you might if your form calculated VAT-add prices, and then totalled those prices — seems to present problems. Forms is marked as Version 0.1; presumably later versions will cope with this.

Conclusions

- **Superfile is a welcome release from the straitjacket of older micro data handlers. For example, you are free to add new fields as your database grows.**
- **Forms and CForms are easy to use, but take up a great deal of space. Forms could use a few more editing facilities; at the moment the only way of correcting a line is the destructive backspace.**
- **The handling is very "natural" and direct, with little of the user-frustration that often accompanies ingenious software. The inability to search backwards as well as forwards through the database is an irritating shortcoming.**
- **The Superfile package is a remarkable example of what can be done on an eight-bit processor; 16-bit machines are full of promise, but Superfile does it now, on the Z-80.**
- **Southdata Limited is at 10 Barley Mow Passage, London W4. Telephone: 01-994 6477.**



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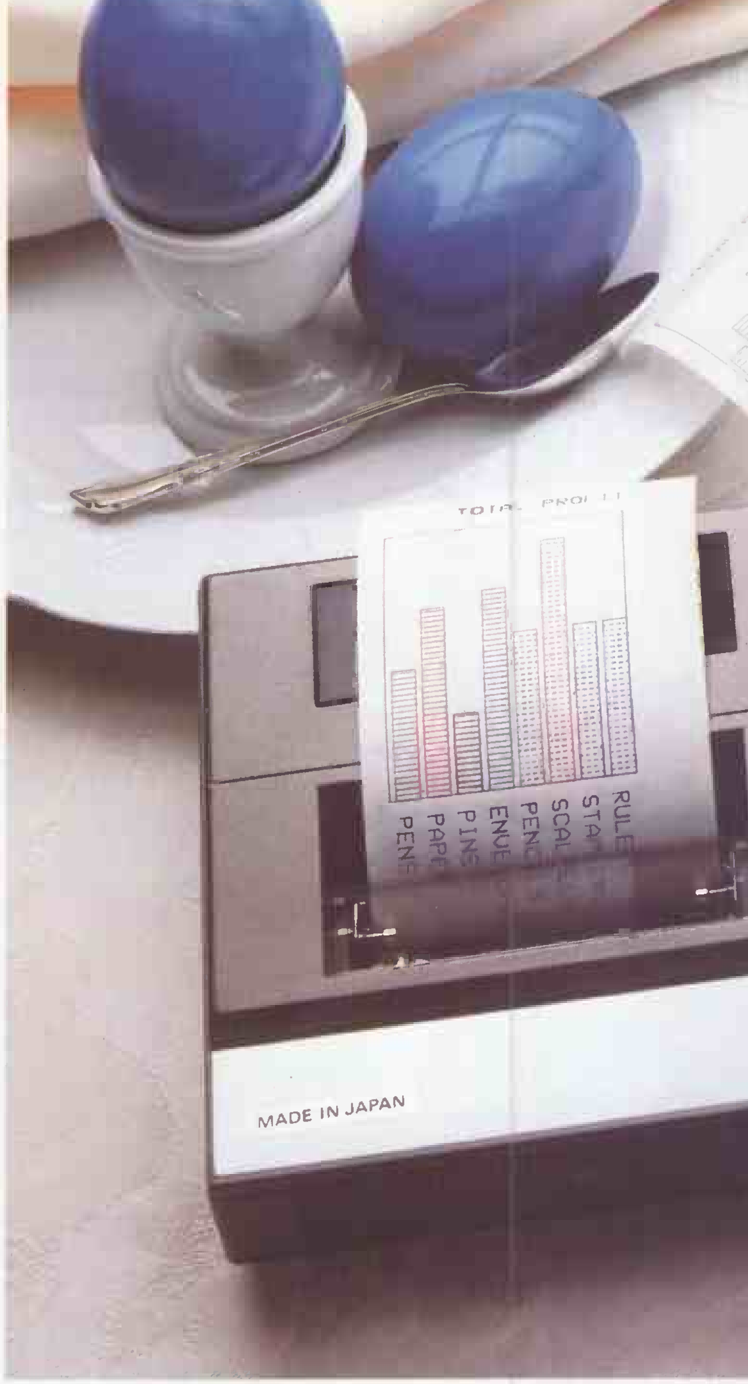

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ROLE PLAY was originally tried out in industrial and managerial training, but it is now widely used in foreign-language learning. Activities range from participation in everyday situations in which learners play themselves to participation in specific dramatisations in a setting in which the learner plays a definite role and is assigned definite ideas and attitudes.

The main aims of these activities are:
- to provide the learner with a rehearsal for real life,
- to provide intensive oral practice in a relatively free and creative manner,
- to provide an opportunity to develop and test communicative competence.

In Town Planning a group of up to six take on the roles of individuals in a town, planning the siting of a new factory. They take into account the increased traffic flow by deciding on zebra crossings and overpass and underpass locations, and by creating one-way systems.

Role assignation

A map of the town is displayed, followed by reasons for the need for a factory in the town. Roles are assigned to a car driver, a bus driver, the factory owner, an allotment tenant, the librarian, and a shopkeeper — see lines 490-1000. Each player has conflicting wishes and needs, and each has the task of ensuring that their own views are adequately represented, and that if compromises are made, as they have to be, they are made with sufficient recompense.

There is, of course, no way of pleasing everyone all the time, and so there is no fixed result in this role play. Different groups will reach different conclusions, none of which will be perfectly satisfactory to all participants. In the process, however, the language of persuasion, negotiation, argument and compromise will be well practised, and inappropriate utterances will meet with real-life responses. In many respects the program could be useful outside the language class, particularly in areas such as social or local studies.

The program itself contains a sub-game called Shopping, which is a timed activity giving familiarity with the town plan. The Rems clearly label this game where it surfaces in the various routines of the main program, and it can be left out if desired.

The map of the town is produced using Animate, a drawing utility from Molimerx, and is held in machine code and called as in line 2000. The printout of this map, done on a Line-Printer VII, has doubled up on all horizontal graphics to give an idea of what it looks like on the screen, but users of the program can easily generate their own maps, perhaps in other, more imaginative ways.

A flashing hash sign CHR$(95) begins at the east end of Manor Drive, representing a vehicle which can be driven along any of the roads. One-way streets, overpasses, underpasses and zebra crossings can be inserted on all east-west streets. The vehicle will not pass over a one-way street sign.

Active screen locations are 15423 to 16383, and Peek and Poke references to these are in order to insert and delete standard ASCII symbols. The lines from 2000 to 2130 are included in the listing only as a help to the development of the town plan. Line 2000 calls up the plan, 2010 to 2080 print out each line and 2090 to 2130 repeat the graphics of each line in order to extend the printout vertically.

Principal variables
- S holds 43 — asterisk in shopping game
- SC shopping score; maximum 10, timed for 1 minute
- A number of town planners
- C number of shoppers
- P cursor position
- Q holds 95 — hash sign vehicle representation
- S used to store value of P in town planning
- T used to store location of P when movement takes place
- U number of road signs inserted on the plan
- Y(I) holds the locations of U
- V(I) holds the values of U
- I and I$ are used throughout as transitory variables

Animate routine

The Basic program was written for a 16K Video Genie, and uses about 6,155 bytes. The Animate plan routine appears to use up most of the rest of 16K memory, so all Rems and lines 2000 onward should be omitted. To insert road features the @ sign is pressed, or Return to go back to the display of roles. Arrow keys control the cursor movement, and the cursor will not cross kerbs.

So why use a computer instead of cards or toy cars? First, the micro offers a tidier medium — there are no cards or items to be lost or displayed, and exact states of play can be recalled later on if the activity has to be interrupted.

Town planning and shopping aid language learning

Role playing is now widely used in foreign-language learning. It promotes day-to-day conversation rather than mastery of complex grammatical translations. Chris Harrison looks at how a town-planning simulation can promote an understanding of the language of persuasion, negotiation, argument and compromise. The computer is now rapidly taking its place alongside the teacher as informant and helper.

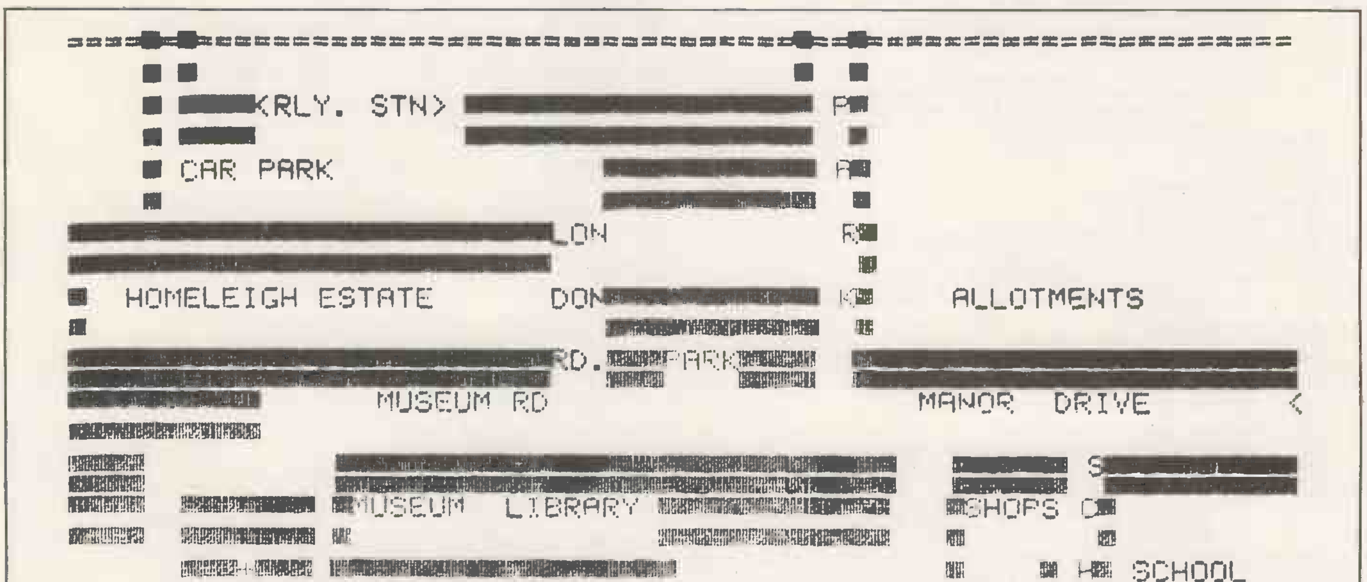
The computer can be seen as informant and helper, where cards and boards give a far more inanimate impression. Less time is spent on setting the activity up before action can take place and, perhaps most importantly, the computer is impartial, hiding little from the players, giving them a confidence impossible in most board games.

The computer helps learning in several ways, varying from activities which the computer controls completely, to activities in which the students appear to have complete control over what happens. Examples of the former might be reading passages presented on the screen at a predetermined speed.

Just down the scale, with the machine still controlling the dialogue, are multiple-choice questions, much used in maths, geography and history programs, as well as many of the more commercial reading comprehension suites and language-learning packages. These activities are no less controlled when they are dressed up with fancy graphics and musical interludes. All the Yes/No games are located here.

Next in line is the kind of program which contains data of its own, but also manipulates data provided by the student. Examples of this kind are my plurals program, available from the TRS-80 Educational Library, my Cloze in

(continued on next page)



(continued from previous page)
Practical Computing, June 1982, Chris Jones's ZX-81 language-learning programs and several others. For language learning, these are the most satisfactory kinds of program to write, for a skeleton is imposed, which is fleshed out by the student and animated by the program.

The Luehrmann program Animals, modified imaginatively by John Higgins, exemplifies the kind of program in which the student actually teaches the computer to ask questions of the student in order to add to the computer's "knowledge". Students are often awestuck by this program, and a strong desire to know "how it's done" provides excellent motivation for the production of acceptable English. At the far end of the scale is the kind of program which, within certain clearly defined bounds, allows the student complete creative freedom — drawing, art and pattern-making clearly fit in here.

For many decades language teaching was done by using a grammatical model, and the learner's progress was monitored through a combination of translation and complex grammatical transformations. Ability to use the language to achieve some sort of useful meaningful communication often seemed irrelevant to teachers.

However, it does not take an academic argument to show the point of learning French, Maori or Estonian is not to become an expert in knotty grammatical problems, but to be able to perform something in the language in question. Can the learners communicate their needs and thoughts effectively? Can they argue appropriately? Can they tell a joke? Can they understand the language they are exposed to and use it with reasonable ease?

Several new techniques have been developed over the last 10 years or so to ensure this. The silent way, community language learning, role play and several others demand a very high degree of participation in which the learning aid — blackboard, tape recorder, teacher, textbook, chart, computer — plays only a helping role. Note the place of the teacher and the computer as learning aids, informants and helpers. Such humanistic and student-centred techniques are the subject of intense research and discussion today, and it is interesting to see how rapidly the microcomputer is taking its place alongside the more traditional aids.

Background reading

K Morrow and K Johnson, *Communicate*, Centre for Applied Linguistics, University of Reading (1976)

Humanistic approaches: an empirical view ELT documents 113, The British Council (1982)

M. Finocchiaro, "Role Playing in the Language Classroom" *Glottodidactica* 11, 25-31 (1978)

Communication games in a language programme (film or video cassette). The British Council (1979)

A full bubliography *Using drama, roleplay, games and songs in foreign language teaching* may be obtained from the Language Teaching Library, 20 Carlton House Terrace, London SW1Y 5AR.


```
5       REM TOWN PLANNING role play by Chris Harrison 1982
             incorporating SHOPPING, a game for young
             children
6       REM The map of the town was generated using 'ANIMATE'
            a machine code drawing utility. The Basic program
            uses about 6155 bytes, but the 'ANIMATE' routines
            add greatly to this.
7       REM You will need to omit all REM statements and
            possibly lines 2000 onward to fit everything
            into 16K. The routine after 2000 prints the
            screen to printer.
8       REM much use has been made of the line feed
            (down arrow) facility in this listing.
            It may be necessary to use it frequently
            for roles and instructions, but not
            elsewhere.
9       REM Set flags. P is cursor position; S="*";
            W is counter used only in shopping expedition;
            SC is shopping score (10 for each "*" collected);
            A=number of town planners playing; Q=hash sign
10 P=15807:S=43:W=0:SC=0:A=0:Q=95
19      REM menu
20 GOSUB 380
29      REM if shopping game
30 IF A=1 THEN GOSUB 1140
40 IF A=1 THEN GOSUB 310
49      REM routine fed from 1020 allowing review of roles
50 CLS:PRINT:PRINT:INPUT "DO YOU WANT TO SEE YOUR ROLES AGAIN";Y$
60 IF Y$="Y" OR Y$="YES" THEN GOSUB610
69      REM next routine only for shopping game, and puts
             'shopping' items in dispersed locations for
             collection
80 IF A=2 THEN 120
90 I$=""
100 POKE15770,42:POKE15505,42:POKE15970,42:POKE16253,42:
    POKE15617,42:POKE15885,42:POKE16196,42:POKE15917,42:
    POKE15584,42:POKE15941,42
119     REM Position cursor at end of Manor Drive
120 POKEP,S
130 IF A=2 THEN 160
139     REM elementary scoring routine for 'shopping'
140 W=W+1:IF  W>400 THEN  280
150 PRINT@1017,SC;
159 .   REM 'T' flag keeps size of previous 'P' to avoid
             cursor going off screen. Next routine scans
             direction keys. S holds previous contents of
             P from 250
160 T=P:G=PEEK(14400):IF NOT  G AND PEEK(P)<129 THEN POKEP,S
170 IF GAND16THEN P=P+64:IFPEEK(P)>129 THENP=P-64
180 IF  GAND8 THEN P=P-64:IFPEEK(P)>129 THEN P=P+64
190 IF GAND 32 AND PEEK(P)<>62  THEN P=P-1:
    IF PEEK(P)>129 THEN  P=P+1
200 IF GAND64 AND PEEK(P)<>60  THEN P=P+1:
    IF PEEK(P)>129  THEN P=P-1
210 IF  PEEK(P)=42 THEN SC=SC+100:POKEP,S
219     REM scans to see if <CR> or '@' is pressed for
            review of roles or instructions for inserting
            one way streets, overpasses or zebra crossings.
220 I$=INKEY$:IF I$=CHR$(13) THEN GOTO 50ELSE IF I$="@"
    THEN GOSUB 1030
239     REM 15423 is left of second row; 16383 is bottom
            left corner.
240 IF P<15423 THEN  P=T ELSE IF P>16383 THEN  P=T
249     REM see what's in P and remember it in S
250 S=PEEK(P)
260 POKEP,Q
270 GOTO130
279     REM lines 280-300 for shopping game only for
            display of final score
280 CLS:PRINT@400,"YOUR SCORE: ";SC
290 FOR I=1TO2500:NEXT
300 GOTO10
309     REM routine calls up machine code map generated
        through 'Animation' utility.
310 POKEP,Q:POKE 17126,A:POKE17127,A
320 X=USR(0)
329     REM 'U'=number of items inserted; 'Y(I)' holds
            their locations, and 'V(I)' their values.
            Data is picked up at lines 1080-1120.
330 FORI=1 TO U:POKEY(I),V(I):NEXT I
340 IF A=1 THEN 360
350 I$=INKEY$:IF  I$="" THEN 350ELSE 80
360 FOR I=1  TO 3000:NEXT
370 A=0:RETURN
380 CLS
389     REM the following lines are instructional and
            need no explanation
390 PRINT@1,"IN TOWN TODAY      BY CHRIS HARRISON 1982"
400 PRINT@256,"HALLO. THERE IS A CHOICE OF GAMES HERE

YOU CAN EITHER GO ROUND TOWN DOING SOME SHOPPING

OR YOU CAN USE THE BOARD TO DO SOME TOWN PLANNING."
410 PRINT:PRINT:INPUT"
WHICH GAME DO YOU WANT TO PLAY (1 OR 2)";A
420 IF A<1 OR A>2 THEN CLS:GOTO410
430 IF  A=1 RETURN
440 PRINT:PRINT:INPUT "HOW MANY PLAYERS ARE YOU (MAX. 6)";C
450 IF C<1 OR C>6 THEN  440
460 C=INT(C)
470  GOTO  490
480 STOP
490 CLS:PRINT@64,"SO YOU WANT TO DO SOME TOWN PLANNING!"
500 PRINT"
YOU WILL NOW SEE A  PLAN OF THE TOWN, WITH AREAS THAT
ARE SCHEDULED FOR DEVELOPMENT MARKED IN WHITE."
510 PRINT"RIGHT. I WILL GIVE EACH OF YOU ";C;" A ROLE TO PLAY."
520 PRINT:INPUT"NOW PRESS 'RETURN'";Z:CLS
530 ZZ$="1":GOSUB 310
540 CLS:PRINT"YOUR TOWN HAS VERY HIGH UNEMPLOYMENT, BUT HAS
ATTRACTED FUNDS FOR THE BUILDING OF A FACTORY
WHICH WILL EMPLOY OVER 200 PEOPLE."
550 PRINT"UNFORTUNATELY, IT WILL BE A SMELLY FACTORY, AND
THE WIND USUALLY BLOWS FROM THE SOUTH WEST."
560 PRINT:PRINT"AS YOU MAKE YOUR PLANS,
YOU CAN ADD ZEBRA CROSSINGS,
PEDESTRIAN BRIDGES AND UNDERPASSES IF YOU LIKE, SINCE
THE FACTORY WILL UNDOUBTEDLY CREATE VERY MUCH EXTRA TRAFFIC."
570 PRINT"      TO MAKE ONE OF THESE, PRESS  '@'"
580 PRINT"IF  AT ANY TIME YOU WANT TO SEE YOUR ROLE AGAIN
PRESS 'RETURN'"
590 PRINT:PRINT:PRINT"PRESS THE SPACE BAR WHEN
YOU ARE READY FOR YOUR ROLES"
600 IF INKEY$=""THEN600
610 CLS
620 PRINT@15,"PLAYER 1 :  CAR DRIVER":PRINT:PRINT
630 PRINT"YOUR NORMAL ROUTES ARE FROM HOMELEIGH ESTATE TO
SCHOOL AND SHOPS. IT IS BECOMING MORE DIFFICULT TO
CROSS THE TRAFFIC TO GET INTO MUSEUM ROAD. AND  IT
OFTEN TAKES YOU 15 MINUTES TO REACH THE CAR PARK."
640 PRINT:PRINT"YOU PREFER OVER OR UNDERPASSES
TO ZEBRA CROSSINGS ON SAFETY GROUNDS.
YOU WANT THE FACTORY TRAFFIC KEPT
OUT OF THE CENTRE OF TOWN."
650 PRINT:PRINT"             NOW PRESS THE SPACE BAR"
660 IF INKEY$="" 6290
670 IF C<2 THEN GOTO 50
680 CLS:PRINT@15,"PLAYER 2 :  BUS DRIVER"
690 PRINT:PRINT"THE PRESENT SYSTEM OF TRAFFIC
JAMS HAS BROUGHT YOU
MUCH OVERTIME WHICH YOU ARE UNWILLING TO LOSE."
700 PRINT"YOU BELIEVE THAT ZEBRA CROSSINGS SLOW DOWN TRAFFIC,
COST LITTLE, CAN EASILY BE MOVED, AND CONTRIBUTE TO
ROAD SAFETY."
```

(continued on page 83)

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PC9

Choose logically.

LOGITEK

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(continued from page 80)

```
710 PRINT:PRINT"IF SCHOOL LANE BECAME A MAIN TRAFFIC
ROUTE YOU FEAR
THAT YOUR FAVOURITE TEA BREAK TERMINUS OUTSIDE THE SCHOOL
WOULD BE LOST."
720 PRINT:PRINT"YOU WOULD PREFER A FACTORY IN THE S.E.
 OR IN THE NORTH."
730 PRINT:PRINT"          NOW PRESS THE SPACE BAR"
740 IF INKEY$="" THEN 740
750 IF C<3 THEN GOTO 50ELSE CLS
760 PRINT@15,"PLAYER 3  :  FACTORY OWNER
770 PRINT:PRINT"YOU WANT THE FACTORY NEAR THE RAILWAY
STATION, AND ARE
WILLING TO FIX EXPENSIVE POLLUTION FILTERS IF YOU
GET THIS SITE. IF A  BY-PASS ROAD IS BUILT YOU WILL NOT
BUILD YOUR FACTORY IN THIS TOWN."
780 PRINT:PRINT"YOU INSIST ON SAFE ROADS FOR YOUR
WORKERS WHO WILL COME TO WORK ON FOOT OR BY BICYCLE."
790 PRINT:PRINT"          NOW PRESS THE SPACE BAR"
800 IF INKEY$="" THEN 800
810 IF  C<4 THEN GOTO50ELSE  CLS
820 PRINT@15,"PLAYER 4  :  ALLOTMENT TENANT"
830 PRINT:PRINT"YOUR JOY IN LIFE IS YOUR  ALLOTMENT,
AND ALL YOU ASK
 IS QUIET, FRESH AIR AND ACCESS. YOU  FEEL VERY STRONGLY
ABOUT TRAFFIC AND ANY KIND OF POLLUTION."
840 PRINT:PRINT"YOU ALWAYS TRAVEL BY BICYCLE
AND TAKE AN ACTIVE PART
IN THE SCHOOL SPORTING  PROGRAMME.
YOU LIVE IN HOMELEIGH ESTATE."
850 PRINT:PRINT"          NOW PRESS THE SPACE BAR"
860 IF INKEY$="" THEN 860
870  IF C<5 THEN  GOTO50ELSE CLS
880 PRINT@15,"PLAYER 5  :  LIBRARIAN"
890 PRINT:PRINT"YOU  LIKE YOUR LIBRARY IN THE MIDDLE
OF THE TOWNBUT YOU HATE THE TRAFFIC PASSING NEAR BY."
900 PRINT"YOU WOULD LIKE GREEN LANE MADE INTO A BY PASS,
EVEN IF THIS MEANT A ZEBRA CROSSING
OR A BRIDGE TO THE SCHOOL."
910 PRINT:PRINT"YOU WANT SUITABLE PEDESTRIAN
ACCESS FROM THE CAR PARK AND FROM HOMELEIGH ESTATE."
920 PRINT:PRINT"YOU ARE VERY MUCH IN FAVOUR OF THE
FACTORY, BUT INSIST THAT IT BE SITED WELL AWAY FROM THE
LIBRARY IN CASE THE POLLUTION SPOILED YOUR TREASURES."
930 PRINT:PRINT"          NOW PRESS THE SPACE BAR"
940 IF INKEY$=""  THEN 940
950 IF C<6 THEN GOTO 50ELSE CLS
960 PRINT@15,"PLAYER 6  :  SHOPKEEPER"
970 PRINT:PRINT"THE GROWTH OF HEAVY TRAFFIC
HAS REDUCED YOUR CUSTOMERS IN THE MIDDLE OF TOWN.
YOU URGENTLY NEED THE TRAFFIC RE-ROUTED,
SO THAT THE CENTRE"
980 PRINT"OF TOWN ATTRACTS MORE PEOPLE."
990 PRINT:PRINT"YOU THEREFORE FAVOUR A FACTORY
IN THE SOUTH-EAST BECAUSE YOU ARE WORRIED
THAT A FACTORY ELSEWHERE WILL TAKE
EVEN MORE CUSTOMERS AWAY."
1000 PRINT:PRINT"          NOW PRESS THE SPACE BAR"
1010 IF INKEY$="" THEN 1010
1020 GOTO50
1029   REM insertion of road features routine
1030 CLS
1040 U=U+1:Y(U)=P
1050 PRINT@64,"WHAT DO YOU WANT TO INSERT HERE?"
1060 PRINT"
1. ZEBRA CROSSING   = ";CHR$(95)"
2. OVERPASS         = ";CHR$(41);CHR$(40)"
3. ONE WAY STREET   = ";CHR$(60);" OR ";CHR$(62)
1070 PRINT"4. DELETE OBSTACLE  = ";CHR$(42);"
5. LEAVE PLAN ALONE = PRESS SPACE BAR"
1080 B$=INKEY$:IF  B$="" THEN 1080
1090 IF B$=CHR$(42) THEN B$=CHR$(128)
1100 IF  B$=CHR$(35)  THEN B$=CHR$(95)
1110 S=ASC(B$)
1120 V(U)=S
1130 GOTO310
1139   REM shopping game title and instructions in
         double size print
1140 CLS:PRINTCHR$(23)
1150 PRINT@12,"S H O P P I N G"
1160 PRINT"
I SHALL NOW SHOW YOU A MAP
USE THE ARROW KEYS TO GO"
1170 PRINT"AROUND THE TOWN DOING YOUR
SHOPPING AND DELIVERING MESSAGES
BY GOING OVER THE STARS."
1180 PRINT"AFTER A MINUTE THE GAME WILL STOP.
YOUR SCORE IS AT THE BOTTOM RIGHT HAND CORNER."
1190 PRINT:PRINT"WHEN YOU ARE READY TO PLAY"
1200 PRINT"PRESS 'NEWLINE'"
1210 I$=INKEY$:IF I$="" THEN 1210
1220 CLS:RETURN
1230 STOP
1999   REM this routine was used only to print out
       the screen, and is not part of the program.
2000 X=USR(0)
2010 FORX=15360TO16359STEP64
2020 FORY=0TO63
2030 Z=PEEK(X+Y):IFZ>128ORZ<33THEN2070
2040 IFZ=32ORZ=128THENLPRINTCHR$(30);CHR$(32);:GOTO2080
2050 Z$=CHR$(PEEK(X+Y))
2060 LPRINTCHR$(30);Z$;:GOTO2080
2070 FORI=1TO6:LPRINTCHR$(18);CHR$(191);:NEXTI
2080 NEXTY:LPRINT
2089   REM for the Line Printer VII you need to print
       graphics horizontals twice to avoid a very
       fore-shortened printout
2090 FORV=Y-64TOY-1
2100 Z=PEEK(X+V):IFZ>128THEN2110ELSELPRINTCHR$(30);
     CHR$(32);:GOTO2120
2110 FORI=1TO6:LPRINTCHR$(18);CHR$(191);:NEXTI
2120 NEXTV
2130 LPRINT:NEXTX
```

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from the professionals

smal-LDOS™

LDOS is an advanced and sophisticated disk operating system for the TRS-80 Models I and III, the original Video Genie, the Genie I and Genie II. It comprises some 113K of code. It was over a year in development and cost in excess of ¼ million dollars to write. It contains an advanced Disk Basic Interpreter enhancement, a complete Job Control Language compiler and many other features.

Obviously it is also complex. This is why it is accompanied by some four hundred pages of manual. It is not the best system for beginners.

On the other hand, LDOS contains so many important features that if a person is just starting out with disks he should be aware of them and, if you like, raised in the right habits. Presently available lower cost disk operating systems are all "first generation" and are primitive. Indeed, they tend to train a person in the wrong direction.

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CONV	PDUBL	REPAIR
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LBASIC		

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Secrets of coding

The art of breaking codes and ciphers, referred to as cryptanalysis, is based on some well-defined mathematical techniques, explained by Muriel Gilligan

CODES AND CIPHERS are usually associated with the clandestine operations of government and military organisations which want to communicate in a secret manner and yet read the secret communications of their competitors.

A message written in open English that anyone can read is said to be in clear or plain text. A prescribed set of instructions called a cipher can convert this into an apparently unreadable form known as the cryptogram. Although there are numerous ciphers, they are all based on only two principles which can be illustrated by enciphering the simple text

THE CAT SAT ON THE MAT

by both methods:

EHT TAC TAS NO EHT TAM
UIF DBU TBU PO UIF NBU

It is obvious that each word of plain text has been written backwards.

In the second example each letter of the original plain text has been substituted by the corresponding next letter of the alphabet. The letter T has been replaced by U, H by I, and so on. This is called a substitution cipher.

Studying the characteristics of simple ciphers reveals their weaknesses, which can then be used to develop methods of breaking the cipher and developing better ones. In general,

- In a transposition cipher the original letters of the message are retained.
- The cipher retains the original word lengths, and hence two-letter cryptogram words actually stand for two-letter words in the plain text.
- In the substitution cipher the word "THE" which is enciphered as "UIF" is seen to be repeated in both texts, hence common words and common letters will appear repeatedly in the cryptogram.
- In the original text every word contains a vowel; and if Y is regarded as a vowel you could go further and say that every word in the English language must contain at least one vowel.

These principles can be used when attempting to solve a cryptogram, for example,

CPUI ZPV BOE J TIBMM HP UP UIF HBNF PO XFEOFTEBZ

The first problem is to decide whether it is a transposition or substitution cipher. If the frequency of occurrence of the letters in the cryptogram is roughly the same as the frequency distribution of letters in normal English text, then it is likely to be a transposition cipher. You can construct a frequency table for the letters of the cryptogram by counting the number of times that each letter occurs. This can easily be programmed for a computer, but for this simple example writing out the alphabet in a horizontal line will suffice.

Work through the cryptogram letter by letter, placing a tick or tally-mark under the letter for each time that letter occurs in the cryptogram. This yields

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

The letters can then be sorted according to the number of times which they occur:

P(5), B(4), F(4), U(3), I(3), E(3), O(3), Z(2), T(2), M(2), H(2), C(1), V(1), N(1)

A similar exercise carried out on a piece of normal English such as a novel or newspaper article usually puts letters in the order

E,T,A,O,N,I,R,S,H, . . .

This is obviously quite different from the order found from the cryptogram, so it is likely that it was coded from a substitution cipher. Furthermore, the letters P,B,F,U,I,E,O in the cipher probably correspond to E,T,A,O,N,I,R,S,H in the plain text.

The next problem is to find out what substitutions are involved. Since J occurs in the cryptogram as a single-letter word it must stand for either A or I in the plain text. Similarly the two-letter words HP, UP and PO must each stand for plain text words like AM, AN, AS, AT, BE, BY, etc. All three words contain the cryptic letter P, and this reduces the possible substitutions to those that can read something like

HP, UP, PO = AT, IT, TO

P appears frequently, which suggests that it is likely to stand for a vowel rather than a consonant and that H, U and O are consonants. The plain text must therefore be in the form

HP, UP, PO = (blank) vowel, (blank) vowel, (vowel) blank

Most forms can be eliminated except

HP, UP, PO = –O, –O, O–

which can be developed to

HP, UP = DO, SO; NO, GO; TO, GO; SO, GO; GO, TO; etc.

PO = OF or OR or ON

One of the three-letter words is probably something common like THE, AND, YOU, HIM or HER. The group HP UP UIF could be TO GO AND or DO TO THE, and you can try the particular substitutions in the cryptogram in turn until you find what could be consistent plain text. The version GO TO THE with H=G, P=O, U=T, I=H and F=E yields

.OTH .O. ... . .H.. GO TO THE G..E O. .E..E....

(continued on next page)

plain:	A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
cipher:	. . . . F . . H I . . . . P . . . . U . . . .

Figure 1.

(continued from previous page)

If you also write out the assumed cipher key in the form of figure 1.

The assumed substitutions are merely the plain text letters moved one place. You could try this idea immediately but, from CPUI you can guess the plain text BOTH, which, when you remember that J corresponds to A or I and PO corresponds to ON or OF will lead you to BOTH YOU AND I, as the text. Further work soon reveals the whole text as

BOTH YOU AND I SHALL GO TO THE GAME ON WEDNESDAY.

This type of cipher is called a direct standard alphabet. Julius Caesar was reputed to have used it with a shift of three, a version which is now called the Caesar Cipher. Since the letters of the alphabet can only be shifted 25 places before becoming a normal alphabet again. This type of cipher will yield only 25 cipher alphabets.

For such a small number of possibilities it is quite easy to program a computer to try each cipher alphabet in turn until plain text appears. This technique can be used with pencil and paper by selecting a group of letters from the cryptogram and running down the alphabet as in table 1.

Table 1.

Text	Shift
CPUI	as a cipher
DQVJ	one place
ERWK	two places
....	......
YLQE	22 places
ZMRF	23 places
ANSG	24 places
BOTH	25 places
CPUI	26 places

This technique is called completing the plain complement. Running down the alphabet will break any shifted normal alphabets in only a few minutes, so a cipher that is not susceptible to this technique is desirable. One way of forming an alternative cipher is to use an inverse alphabet, with the cipher alphabet written backwards. This can also be shifted, so you now have an extra 26 possible ciphers. In the simplest form of such ciphers the substitute for A is Z. In effect, the back half of the cipher key is merely the front half back to front. The encipherer need only write out the alphabet as follows

A B C D E F G H I J K L M

Z Y X W V U T S R Q P O N

It then becomes possible to decipher or encipher any letter by changing it to the letter with which it is paired. If you find two letters which are each other's substitutions, then one of these reciprocal alphabets is probably involved. Therein lies the weakness of such ciphers.

A mathematical examination of the 51 ciphers developed so far shows that ciphers can be put on a formal basis which can in turn be exploited with more complicated ciphers. Each letter of the alphabet can be allocated the number corresponding to its position in the normal alphabet

$$A=1,\ B=2,\ \ldots,\ Z=26$$

The mathematical technique known as modular arithmetic is capable of reducing all integer numbers down to one and only one of the set of 26 chosen for the cipher. When any number is divided by 26, the remainder must be between zero and 25. The remainder represents the original number. For example,

$$32=26+6$$

The number 32 is said to be congruent to the number 6, modulo 26. This is written as

$$32 \equiv 6 \pmod{26}$$

The general form for any integers a, b, is that

$$a \equiv b \pmod{26}$$

If

$$a - b = k(26)$$

where k is any integer.

Since $26 \equiv 0 \pmod{26}$, the set of numbers 1 to 26 forms a complete set of residues for arithmetic modulo 26 and you can carry out the operations of addition, subtraction, multiplication and division using such arithmetic.

The infinite set of integer numbers is associated with an infinite number of cycles of the normal alphabet as follows:

...X	Y	Z	A	B...
...−2	−1	0	1	2...
...X	Y	Z	A	B...
...24	25	26	27	28...
...X	Y	Z	A	B...
...50	51	52	53	54...

It is possible to reduce negative numbers to the set 1, 2, . . . , 26. For example, for the value of −3: suppose

$$-a < 0$$

hence

$$a > 0$$

therefore

$$a = k(26) + b$$

where

$0 \leq b \leq 25$ or rather $1 \leq b \leq 26$

$a - 26 = k(26) - (26 - b)$

$a = (k+1)(26) - (26 - b)$

$-a = -(k+1)(26) + (26 - b)$

hence

$$-a \equiv 26 - b \pmod{26}$$

where

$$a \equiv b \pmod{26}$$

applying this to

$-a = -3$

$$-3 \equiv 26 - 3 = 23 \pmod{26}$$

hence −3 and 23 represent the same letter, namely W.

The two types of substitution ciphers can be formally expressed as equations which can be used to encipher the plain text. This can be applied to the Caesar cipher.

Plain: A B C D E F
1 2 3 4 ...

Let P = the number associated with the plain text

Let C = the number associated with the cipher text

Let S = the number of places shifted

then for the Caesar cipher there is a shift of three places forward, so S = 3 and the cipher instructions can be formerly stated as

$$C = P + S$$

To encipher the plain text AND:

- A implies P=1, hence C=1+3=4 and the cipher letter is D
- N implies P=14, hence C=14+3=17 and the cipher letter is Q
- D implies P=4, hence C=4+3=7 and the cipher letter is G

so the cipher for AND is DQG.

These ideas can be developed to deal with more complicated ciphers. If you suspect that you are faced with a direct standard alphabet cipher you only need the substitution letter for one plain text letter to be able to solve the equation C=P+S.

Another application concerns the transformation for a shifted inverse alphabet which can be represented as

$$C = (1 - P) + S \pmod{26}$$

or

$$(1 - C) + S = P \pmod{26}$$

This can be interpreted as meaning that the inversion of the cipher text with a positive shift will produce plain text.

In the case of an inverse alphabet with shift you can use the technique of running down the alphabet, provided that you invert the cipher text first. Consider the following cipher,

Plain: A B C D E F G H I J K . . .
Cipher: W V U T S R Q P O N M . . .

Enciphering plain text THE gives the cryptic form DPS. Now use the following inversion scheme to invert DPS

A B C D E F G H I J K L M N
Z Y X W V U T S R Q P O N M

This gives WKH to which we now apply the technique of running down the alphabet,

W K H
X L I
Y M J
. . .
R F C
S G D
T H E

Identifying weaknesses, helps to produce better ciphers. In this case it is obvious that the cipher would be improved by omitting the word spaces or by disguising the word spaces in some way. Often the cryptogram is split up into groups of five-letter blocks. Using this technique on the cipher used in the previous example gives

CPUIZ PVBOE JTIBM MHPUP
UIFHB NFPOX FEOFT EBZAB

The cryptogram has to be made up to 40 letters for convenience by adding two arbitrary letters AB, known as dummy letters or nulls. The more difficult ciphers are nearly always presented in group of five letters. The cryptogram could have been presented with artificial word lengths, which would not bother the person with the cipher key but could cause the cryptanalyst to waste time.

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Seasonal adjust… of time-series

In the real world, the analysis of statistical data is bedevilled with problems undreamed of by textbook authors. This program by Guy Judge helps you see the wood for the trees.

ECONOMIC VARIABLES whose values are monitored over time exhibit marked seasonal patterns. Unemployment, for example, tends to rise in the first and third quarters of the year and to fall below its trend value in the second and fourth quarters. Official statistics such as those appearing in *Economic Trends*, published monthly by HMSO, are usually seasonally adjusted so that regular seasonal changes are not confused with long-run trends.

Business firms too may find it helpful to seasonally adjust sales figures if the values show a noticeable seasonal pattern. Beer sales, for example, show seasonal increases in the summer months, while sales of other alcoholic drinks generally rise above trend values in December.

These Basic programs written for the ZX-81 and Pet micros produce seasonally adjusted values for quarterly data covering between three and 15 years, that is 12 to 60 quarters. The ZX-81 program requires a 16K RAM pack, and a printer version is also available to give a hard-copy output. No Poke or Peek instructions are used, so the program should be readily transportable to other machines. The Pet version is given as an illustration.

The program assumes an additive decomposition model and estimates the trend using a four-quarterly moving average. The actual value observed in any time period A(I) is assumed to be given

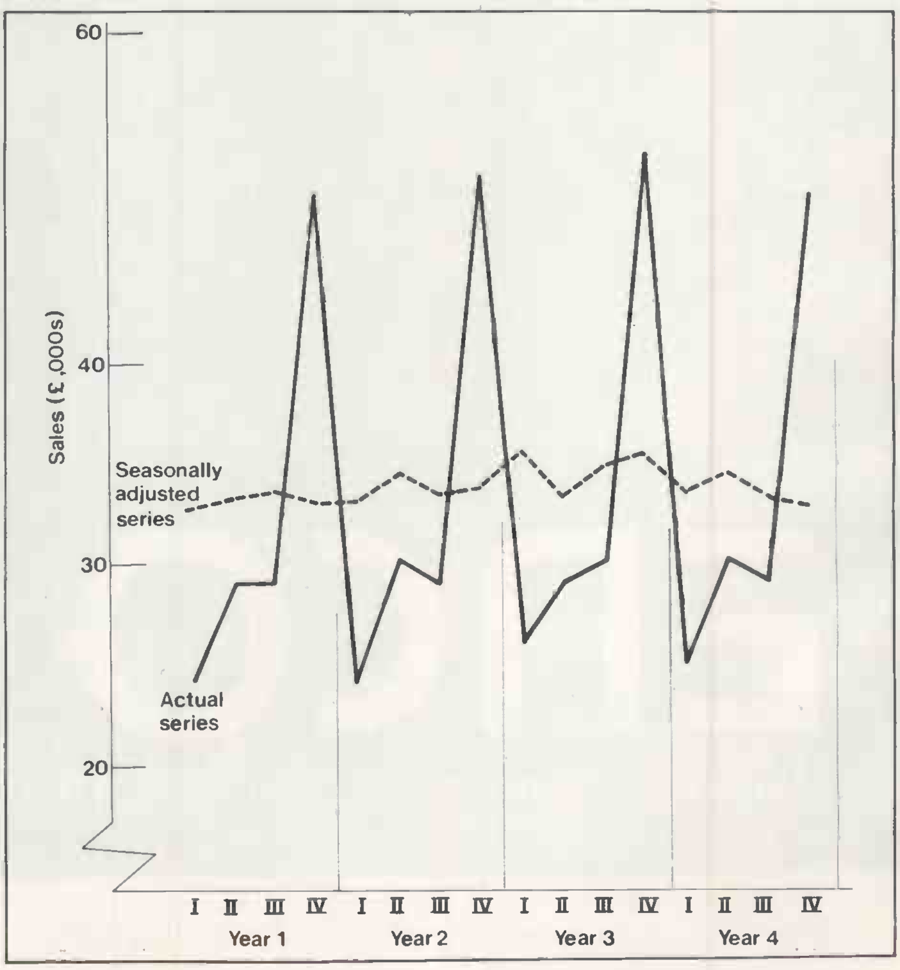

Table 1. Example data: fictitious sales figures in £,000s for wine and spirits.

Year	Quarter	Sales
1	1	24
	2	29
	3	29
	4	50
2	1	24
	2	30
	3	29
	4	51
3	1	26
	2	29
	3	30
	4	52
4	1	25
	2	30
	3	29
	4	50

This series shows a marked seasonal pattern. The program estimates a seasonal increase in sales of £17.25 thousand above trend in quarter 4, with a drop of about £8.8 thousand below trend in quarter 1 and about £4 thousand below trend in quarters 2 and 3.

```
******************************
*                            *
*        TIME SERIES         *
*      (ZX-81  VERSION)      *
*                            *
******************************

ADDITIVE DECOMPOSITION MODEL
FOUR PERIOD MOVING AVERAGE TREND

MINIMUM OF 12, MAXIMUM OF 60
OBSERVATIONS
HOW MANY OBSERVATIONS?
16
INPUT DATA SERIES
24
29
29
50
24
30
29
51
26
29
30
52
25
30
29
50
          MOVING     DETRENDED
          AVERAGE    SERIES

3         33         -4
4         33.125     16.875
5         33.25      -9.25
6         33.375     -3.375
7         33.75      -4.75
8         33.875     17.125
9         33.875     -7.875
10        34.125     -5.125
11        34.125     -4.125
12        34.125     17.875
13        34.125     -9.125
14        33.75      -3.75

PERIOD    ACTUAL   SEASONALLY
                   ADJUSTED

1           24     32.791667
2           29     33.125
3           29     33.333333
4           50     32.75
5           24     32.791667
6           30     34.125
7           29     33.333333
8           51     33.75
9           26     34.791667
10          29     33.125
11          30     34.333333
12          52     34.75
13          25     33.791667
14          30     34.125
15          29     33.333333
16          50     32.75

SEASONAL COMPONENTS

S1=-8.7916667
S2=-4.125
S3=-4.3333333
S4=17.25
S1+S2+S3+S4=0

RESIDUAL COMPONENTS
3           0.33333333
4           -0.375
5           -0.45833333
6           0.75
7           -0.41666667
8           -0.125
9           0.91666667
10          -1
11          0.20833333
12          0.625
13          -0.33333333
14          0.375

END OF PROGRAM
```

by the sum of a trend component T(I) and a seasonal component S(I), plus a residual R(I) to allow for any irregular random influences:

$$A(I) = T(I) + S(I) + R(I)$$

The series is decomposed into the three elements with T(I) first estimated by a four-quarterly centred moving average.

By averaging the first four observations, where there is one value from each quarter, seasonal and random influences should tend to balance out. Dropping the first quarter for year 1 but including the first quarter for year 2 again provides one representative from each quarter, and by averaging should eliminate everything but the trend value.

ment
data

Moving through the data set obtaining an average of each block four values provides a way of estimating the trend. Unfortunately, the moving averages found in this way would not correspond with any of the original time periods. For example, the first moving average would fall halfway between quarters 2 and 3.

The moving averages can be "centred" if neighbouring pairs are themselves averaged so that the resulting values can be aligned with the original time periods. Thus, for the example data, set the first two moving-average values

$$\tfrac{1}{4}(24 + 29 + 29 + 50)$$

plus

$$\tfrac{1}{4}(29 + 29 + 50 + 24)$$

Summed and divided by 2, this gives a moving average of 33 centred on year 1 of quarter 3.

As this example illustrates, it is possible to proceed directly to the centred moving average for period 1 by taking

(A (I−2) + 2* A(I−1) + 2* A(I) + 2* A(I+1) + A(I+2))/8

as in line 390 of the program. The detrended series D(I) is then found by subtracting T(I) from A(I):

$$D(I) = S(I) + R(I)$$

By taking all first-quarter values of S(I) and averaging them, it should be possible to eliminate all the random effects to end up with a single estimate of the first-quarter seasonal effect. However, the sum of the season effects must be zero, that is,

$$S(1) + S(2) + S(3) + S(4) = 0$$

A correction to ensure this is made in lines 680 to 720.

(continued on page 91)

ZX-81 program.

```
   1 REM TIMESERIESPRINT
  10 LPRINT "*******************
**********"
  20 LPRINT "*
         *"
  30 LPRINT "*          TIME SERIE
S        *"
  40 LPRINT "*        (ZX-81  VERS
ION)     *"
  50 LPRINT "*
         *"
  60 LPRINT "*******************
**********"
  70 LPRINT
  80 LPRINT "ADDITIVE DECOMPOSIT
ION MODEL"
  90 LPRINT "FOUR PERIOD MOVING 
AVERAGE TREND"
 100 LPRINT
 110 REM **ALLOCATE SPACE FOR AR
RAYS**
 120 REM **M=MAXIMUM NUMBER OF A
RRAYS**
 130 LET M=60
 140 DIM A(M)
 150 DIM T(M)
 160 DIM D(M)
 170 DIM S(M)
 180 DIM R(M)
 190 REM **DATA INPUT SECTION OF
 PROGRAM**
 200 LPRINT "MINIMUM OF 12, MAXI
MUM OF 60     OBSERVATIONS"
 210 LPRINT "HOW MANY OBSERVATIO
NS?"
 220 INPUT N
 225 LPRINT N
 230 IF N<12 THEN LPRINT "TOO FE
W OBSERVATIONS"
 240 IF N>M THEN LPRINT "TOO MAN
Y OBSERVATIONS"
 250 IF N<12 THEN GOTO 200
 260 IF N>M THEN GOTO 200
 270 LPRINT "INPUT DATA SERIES"
 275 FOR I=1 TO N
 280 INPUT A(I)
 282 LPRINT A(I)
 285 NEXT I
 300 REM **COMPUTE MOVING AVERAG
EAND DETRENDED SERIES**
 350 LPRINT TAB 6;"MOVING";TAB 1
5;"DETRENDED"
 360 LPRINT TAB 6;"AVERAGE";TAB 
15;"SERIES"
 370 LPRINT
 380 FOR I=3 TO N-2
 390 LET T(I)=(A(I-2)+2*A(I-1)+2
*A(I)+2*A(I+1)+A(I+2))/8
 400 LET D(I)=A(I)-T(I)
 410 LPRINT I;TAB 6;T(I);TAB 15;
D(I)
 420 NEXT I
 430 LPRINT
 500 REM **NOW COMPUTE SEASONAL 
COMPONENTS**
 510 LET P1=0
 520 LET P2=0
 530 LET P3=0
 540 LET P4=0
 550 LET Q=0
 560 FOR I=3 TO N-5 STEP 4
 570 LET P3=P3+D(I)
 580 NEXT I
 590 FOR I=4 TO N-4 STEP 4
 600 LET P4=P4+D(I)
 610 NEXT I
 620 FOR I=5 TO N-3 STEP 4
 630 LET P1=P1+D(I)
 640 NEXT I
 650 FOR I=6 TO N-2 STEP 4
 660 LET P2=P2+D(I)
 670 NEXT I
```

(listing continued on page 91)

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● Circle No. 170

(continued from page 89)

The residuals are also provided: if their pattern is noticeably non-random, this would point to an inadequacy in the modelling. It is also possible to highlight periods where unusually large irregular effects occurred. A series of negative residuals followed by a series of positive residuals may point towards the need for a multiplicative model allowing seasonal effects to interact proportionately on the trend.

$$A(I) = T(I) * S(I) * R(I)$$

In this situation the logarithms would be additively separable so without rewriting the entire program, lines could be inserted to convert values into logarithms after input, coupled with lines to reconvert values back from logarithms before output. Other embellishments to the program could be a subroutine for plotting both actual and seasonally adjusted values against time to give a visual interpretation of the results.

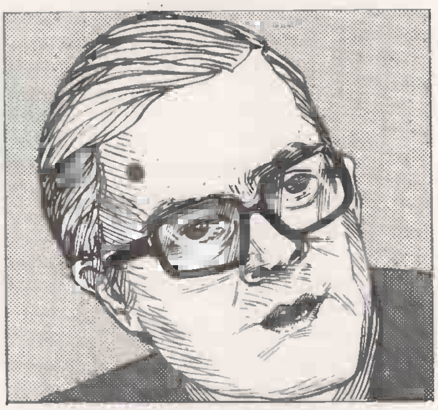
(listing continued from page 89)

```
 680 LET Q=(P1+P2+P3+P4)/4
 690 LET P1=P1-Q
 700 LET P2=P2-Q
 710 LET P3=P3-Q
 720 LET P4=P4-Q
 730 FOR I=3 TO N-1 STEP 4
 740 LET S(I)=4*P3/(N-4)
 750 NEXT I
 760 FOR I=4 TO N STEP 4
 770 LET S(I)=4*P4/(N-4)
 780 NEXT I
 790 FOR I=1 TO N-3 STEP 4
 800 LET S(I)=4*P1/(N-4)
 805 NEXT I
 810 FOR I=2 TO N-2 STEP 4
 820 LET S(I)=4*P2/(N-4)
 830 NEXT I
 840 REM **COMPUTE RESIDUALS**
 850 FOR I=3 TO N-2
 860 LET R(I)=D(I)-S(I)
 870 NEXT I
 880 PRINT "TYPE C TO CONTINUE"
 890 INPUT Q$
 900 IF Q$="C" THEN GOTO 910
 910 CLS
1000 REM **TABULATED RESULTS**
1010 PRINT "PERIOD";TAB 8;"ACTUA
L";TAB 15;"SEASONALLY"
1020 PRINT TAB 15;"ADJUSTED"
1030 PRINT
1040 FOR I=1 TO N
1050 PRINT I;TAB 8;A(I);TAB 15;A
(I)-S(I)
1060 NEXT I
1070 PRINT
1080 PRINT "TYPE C FOR CHECK STA
TISTICS, E FOR END OF RUN"
1090 INPUT Q$
1100 IF Q$="E" THEN GOTO 1270
1110 REM **CHECK STATISTICS**
1120 CLS
1130 PRINT "SEASONAL COMPONENTS"
1140 PRINT
1150 PRINT "S1=";S(1)
1160 PRINT "S2=";S(2)
1170 PRINT "S3=";S(3)
1180 PRINT "S4=";S(4)
1190 PRINT "S1+S2+S3+S4=";S(1)+S
(2)+S(3)+S(4)
1200 PRINT
1205 PRINT "TYPE C TO CONTINUE"
1206 INPUT Q$
1207 IF Q$="C" THEN GOTO 1210
1210 PRINT "RESIDUAL COMPONENTS"
1220 FOR I=3 TO N-2
1230 PRINT I;TAB 8;R(I)
1240 NEXT I
1250 FOR D=1 TO 500
1260 NEXT D
1270 PRINT "END OF PROGRAM"
```

Pet program.

```
1 OPEN4,4
2 CMD4
3 LIST
4 PRINT#4
5 CLOSE#4
6 REM TIMESERIES
10 PRINT "**************************************************"
20 PRINT "*                                                *"
30 PRINT "*         TIME SERIES PROGRAM                    *"
40 PRINT "*          (PET VERSION)                         *"
50 PRINT "**************************************************"
60 PRINT
70 PRINT
80 PRINT "ADDITIVE DECOMPOSITION MODEL "
90 PRINT "FOUR PERIOD MOVING AVERAGE TREND"
100 PRINT
110 REM***ALLOCATE SPACE FOR ARRAYS"
120 REM***M=MAXIMUM NUMBER OF OBSERVATIONS***
130 M=60
140 DIM A(M)
150 DIM T(M)
160 DIM D(M)
170 DIM S(M)
180 DIM R(M)
190 REM*** DATA INPUT SECTION OF PROGRAM ***
200 PRINT "MINIMUM OF 12._MAXIMUM OF 60 OBSERVATIONS"
210 PRINT "HOW MANY OBSERVATIONS"
220 INPUT N
230 IF N < 12 THEN PRINT "TOO FEW OBSERVATIONS"
240 IF N > M THEN PRINT "TOO MANY OBSERVATIONS"
250 IF N < 12 THEN GOTO 200
260 IF N > M THEN GOTO 200
270 PRINT "INPUT DATA SERIES"
275 FOR I=1 TO N
280 INPUT A(I)
285 NEXT I
290 PRINT
300 REM*** COMPUTE MOVING AVERAGE AND DETRENDED SERIES ***
310 PRINT "TYPE C TO CONTINUE"
320 INPUT Q$
330 IF Q$="C" THEN GOTO 340
340 PRINT"□";
350 PRINT TAB(10);"MOVING";TAB(20);"DETRENDED"
360 PRINTTAB(10);"AVERAGE";TAB(20);"SERIES"
370 PRINT
380 FOR I=3 TO N-2
390 LET T(I)=(A(I-2)+2*A(I-1)+2*A(I)+2*A(I+1)+A(I+2))/8
400 LET D(I)=A(I)-T(I)
410 PRINT I;TAB(10);T(I);TAB(20);D(I)
420 NEXT I
430 PRINT
500 REM***NOW COMPUTE SEASONAL COMPONENTS***
510 LET P1=0
520 LET P2=0
530 LET P3=0
540 LET P4=0
550 LET Q=0
560 FOR I=3 TO N-5 STEP 4
570 LET P3=P3 +D(I)
580 NEXT I
590 FOR I =4 TO N-4 STEP 4
600 LET P4=P4+D(I)
610 NEXT I
620 FOR I=5 TO N-3 STEP 4
630 LET P1=P1+D(I)
640 NEXT I
650 FOR I=6 TO N-2 STEP 4
660 LET P2=P2+D(I)
670 NEXT I
680 LET Q=(P1+P2+P3+P4)/4
690 LET P1=P1-Q
700 LET P2=P2-Q
710 LET P3=P3-Q
720 LET P4=P4-Q
730 FOR I=3 TO N-1 STEP 4
740 LET S(I)=4*P3/(N-4)
750 NEXT I
760 FOR I=4 TO N STEP 4
770 LET S(I)=4*P4/(N-4)
780 NEXT I
790 FOR I=1 TO N-3 STEP 4
800 LET S(I)=4*P1/(N-4)
805 NEXT I
810 FOR I=2 TO N-2 STEP 4
820 LET S(I)=4*P2/(N-4)
830 NEXT I
840 REM***COMPUTE RESIDUALS***
850 FOR I=3 TO N-2
860 LET R(I)=D(I)-S(I)
870 NEXT I
880 PRINT "TYPE C TO CONTINUE"
890 INPUT Q$
900 IF Q$="C" THEN GOTO 910
910 PRINT"□";
1000 REM***TABULATED RESULTS***
1010 PRINT"PERIOD";TAB(10);"ACTUAL";TAB(20);"SEASONALLY"
1020 PRINT TAB(20);"ADJUSTED"
1030 PRINT
1040 FOR I=1 TO N
1050 PRINT I; TAB(10);A(I);TAB(20);A(I)-S(I)
1060 NEXT I
1070 PRINT
1080 PRINT"TYPE C FOR CHECK STATISTICS, E FOR END OF RUN"
1090 INPUT Q$
1100 IF Q$="E" THEN GOTO 1270
1110 REM*** CHECK STATISTICS ***
1120 PRINT"□";
1130 PRINT "SEASONAL COMPONENTS"
1140 PRINT
1150 PRINT "S1=";S(1)
1160 PRINT "S2=";S(2)
1170 PRINT"S3=";S(3)
1180 PRINT"S4=";S(4)
1190 PRINT "S1+S2+S3+S4=";S(1)+S(2)+S(3)+S(4)
1200 PRINT
1205 PRINT"TYPE C TO CONTINUE"
1206 INPUT Q$
1207 IF Q$="C" THEN GOTO 1210
1210 PRINT "RESIDUAL COMPONENTS"
1220 FOR I=3 TO N-2
1230 PRINT I;TAB(10);R(I)
1240 NEXT I
1250 FOR DELAY=1 TO 500
1260 NEXT DELAY
1270 PRINT "END OF PROGRAM"
1280 END
```

On the face of IT



In the year of Information Technology, privacy of personal data should be Kenneth Baker's chief concern.

by Boris Allen

INFORMATION TECHNOLOGY, IT, has fired many with a touching enthusiasm — unrealistic, but touching. Supposedly the world will be a very different place with the inevitable changes that technology will bring.

The brave new world assumes enormous changes in people and society. Most commentators who have questioned this inevitable change have concentrated on aspects such as employment, and are only too easily classed as modern Luddites. It can be argued that these changes will not easily occur; single-minded advocates have ignored elementary social and interactional aspects.

British governments successively support the need of the state to interfere in the public's private affairs. The opposition, expresses token worries about the depredations of the agents of the state, be it Customs and Excise, Inland Revenue, the police, or other more secretive agencies. However, as soon as the opposition becomes the government attitudes change. Surely, therefore, the need for individuals to protect themselves against such depredations in key areas of privacy must be seen to be highly rational.

The report *Information Technology* considered this to be an important question, saying: "Power from the use of information, which can now be provided by IT, is great and there is clearly potential for abuse." It felt that justifiable fears of abuse were a major reason for people's resistance to new ways of collecting and handling data, by both government and the private sector.

The minister of state concerned with IT, Kenneth Baker, told the Commons that the new TV services proposed in the Cable Systems report would "change the fabric of society". Baker amplified on this familiar statement by saying that soon doctors may conduct surgeries with patients via television. Yet patients still want to see the doctor in the flesh, and in privacy. Doctors could not hold their surgeries by television for complaints of a physical nature. How, for example, does a doctor examine over the television — "Press yourself here, and tell me if it hurts"?

Baker's enthusiasm to make his own job easier, and his wish to convince MPs of the benefits of IT, would seem to explain his other example: MPs could deal similarly with constitutents' complaints by TV link from their offices in Westminster instead of personal interviews. One fear is that an MP who was never in his constituency, would become a remote figure, untouched by the real world outside Westminster. To deal with one's constituents at arm's length is probably a recipe for losing the next election. People will not accept such impositions, even though technologists might see no reason against them.

Data protection is another area in which no government of the 1970s can take any credit. One of the recommendations of *Information Technology* was that the government should bring forward proposals for data-protection legislation without delay.

A recently published White Paper on data protection gives the Government's proposals for legislation. It gives two main reasons for legislation: the threat to privacy posed by the rapid growth in the use of computers, which is important to the public, and to help U.K. companies who have operations in countries with data-protection legislation.

The central feature of the proposed legislation requires all users of automatic data systems, relating to identifiable individuals, to register. Most applicants are expected to be registered without question, but the Registrar will have power to make enquiries, require modifications, and in extreme cases refuse registration or de-register.

The legislation will not apply to data that must be safeguarded for the purposes of "national security", an ill-defined term with worrying precedents. Exemptions will include some data needed by the police and other security agencies: but registered data users who make information available to the authorities will not be required to register disclosures.

Breach of the data requirement principles is to be a civil offence, and will ensure that data subjects who have suffered damage due to a breach of the requirements governing data use can secure compensation. According to the proposals "It is not envisaged that the Registrar will have any role to play in relation to civil proceedings, which will be the responsibility of the individual who alleges he has suffered damage."

So, yet again, the state has not taken seriously the public's right to privacy. In the state sector, allegations of injustice caused by maladministration of data systems can be referred to the appropriate Commissioner for Administration, or Ombudsman. Unfortunately there are a growing number of local authorities who ignore the Commissioner's recommendations.

The Court of Appeal recently confirmed an order which allows the police to freeze a bank account of an accused person, until their trial. In a supposedly more cashless society, the safest place to keep one's money, if in fear of the police or the Inland Revenue, is in money, not a bank account. Indeed the growing unofficial economy conducts many of its transactions in cash.

Privacy is very difficult to assure in a society very dependent on communication devices, the so-called "wired society" of Mr Baker. Computerised data banks can intrude on your freedom — it is not against the law — far more easily than you can on theirs. Furthermore, the government proposals go on to say "In the public sector costs and manpower will have to be contained within existing planned totals, even if this means deferring application of the legislation in some areas."

In a wired society, it is not stretching the technological imagination too far to suggest that while you are watching them on your console, they might be watching you. Until all governments take the problem of privacy seriously, the prospect of a wired society is low. Mr Baker may want to talk to his constituents at long range by television, but a wired society requires the whole-hearted acceptance of a communications terminal in the home, paid for by the householder, and needs to have privacy at the top of its list.

Privacy is not at the top of any implementers list, or that of the government, because the implementers will benefit from intrusions into our privacy, as will the state, whatever party is in power.

References

Information Technology, a report by the Advisory Council for Applied Research and Development, HMSO (1980).

Data Protection, The Government's proposals for legislation, HMSO (1982).

Cable Systems, a report by the Information Technology Advisory Panel, HMSO (1982).

New ZX81 Software from Sinclair.

A whole new range of software for the Sinclair ZX81 Personal Computer is now available – direct from Sinclair. Produced by ICL and Psion, these really excellent cassettes cover games, education, and business/household management.

Some of the more elaborate programs can only be run on a ZX81 augmented by the ZX 16K RAM pack. (The description of each cassette makes it clear what hardware is required.) The RAM pack provides 16-times more memory in one complete module, and simply plugs into the rear of a ZX81. And the price has just been dramatically reduced to only £29.95.

The Sinclair ZX Printer offer full alphanumerics and highly-sophisticated graphics. A special feature is COPY which prints out exactly what is on the whole TV screen without the need for further instructions. So now you can print out your results for a permanent record. The ZX Printer plugs into the rear of your ZX81, and you can connect a RAM pack as well.

Games

Cassette G1: Super Programs 1 (ICL)
Hardware required – ZX81.
Price – £4.95.
Programs – Invasion from Jupiter. Skittles. Magic Square. Doodle. Kim. Liquid Capacity.
Description – Five games programs plus easy conversion between pints/gallons and litres.

Cassette G2: Super Programs 2 (ICL)
Hardware required – ZX81.
Price – £4.95.
Programs – Rings around Saturn. Secret Code. Mindboggling. Silhouette. Memory Test. Metric conversion.
Description – Five games plus easy conversion between inches/feet/yards and centimetres/metres.

Cassette G3: Super Programs 3 (ICL)
Hardware required – ZX81.
Price – £4.95.
Programs – Train Race. Challenge. Secret Message. Mind that Meteor. Character Doodle. Currency Conversion.
Description – Fives games plus currency conversion at will – for example, dollars to pounds.

Cassette G4: Super Programs 4 (ICL)
Hardware required – ZX81.
Price – £4.95.
Programs – Down Under. Submarines. Doodling with Graphics. The Invisible Invader. Reaction. Petrol.
Description – Five games plus easy conversion between miles per gallon and European fuel consumption figures.

Cassette G5: Super Programs 5 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £4.95.
Programs – Martian Knock Out. Graffiti. Find the Mate. Labyrinth. Drop a Brick. Continental.
Description – Five games plus easy conversion between English and continental dress sizes.

Cassette G6: Super Programs 6 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £4.95.
Programs – Galactic Invasion, Journey into Danger. Create. Nine Hole Golf. Solitaire. Daylight Robbery.
Description – Six games making full use of the ZX81's moving graphics capability.

Cassette G7: Super Programs 7 (ICL)
Hardware required – ZX81.
Price: – £4.95.
Programs – Racetrack. Chase. NIM. Tower of Hanoi. Docking the Spaceship. Golf.
Description – Six games including the fascinating Tower of Hanoi problem.

Cassette G8: Super Programs 8 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £4.95.
Programs – Star Trail (plus blank tape on side 2).
Description – Can you, as Captain Church of the UK spaceship Endeavour, rid the galaxy of the Klingon menace?

Cassette G9: Biorhythms (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – What are Biorhythms? Your Biohythms.
Description – When will you be at your peak (and trough) physically, emotionally, and intellectually?

Cassette G10: Backgammon (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £5.95.
Programs – Backgammon. Dice.
Description – A great program, using fast and efficient machine code, with graphics board, rolling dice, and doubling dice. The dice program can be used for any dice game.

Cassette G11: Chess (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Chess, Chess Clock.
Description – Fast, efficient machine code, a graphic display of the board and pieces, plus six levels of ability, combine to make this one of the best chess programs available. The Chess Clock program can be used at any time.

Cassette G12: Fantasy Games (Psion)
Hardware required – ZX81 (or ZX80 with 8K BASIC ROM) + 16K RAM.
Price – £4.75.
Programs – Perilous Swamp. Sorcerer's Island.
Description – Perilous Swamp: rescue a beautiful princess from the evil wizard. Sorcerer's Island: you're marooned. To escape, you'll probably need the help of the Grand Sorcerer.

Cassette G13: Space Raiders and Bomber (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £3.95.
Programs – Space Raiders. Bomber.
Description – Space Raiders is the ZX81 version of the popular pub game. Bomber: destroy a city before you hit a sky-scraper.

Cassette G14: Flight Simulation (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £5.95.
Program – Flight Simulation (plus blank tape on side 2).
Description – Simulates a highly manoeuvrable light aircraft with full controls, instrumentation, a view through the cockpit window, and navigational aids. Happy landings!

Education

Cassette E1: Fun to Learn series – English Literature 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Novelists. Authors.
Description – Who wrote 'Robinson Crusoe'? Which novelist do you associate with Father Brown?

Cassette E2: Fun to Learn series – English Literature 2 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Poets, Playwrights. Modern Authors.
Description – Who wrote 'Song of the Shirt'? Which playwright also played cricket for England?

Cassette E3: Fun to Learn series – Geography 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Towns in England and Wales. Countries and Capitals of Europe.
Description – The computer shows you a map and a list of towns. You locate the towns correctly. Or the computer challenges you to name a pinpointed location.

Cassette E4: Fun to Learn series – History 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Events in British History. British Monarchs.
Description – From 1066 to 1981, find out when important events occurred. Recognise monarchs in an identity parade.

Cassette E5: Fun to Learn series – Mathematics 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Addition/Subtraction. Multiplication/Division.
Description – Questions and answers on basic mathematics at different levels of difficulty.

Cassette E6: Fun to Learn series – Music 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Composers. Musicians.
Description – Which instrument does James Galway play? Who composed 'Peter Grimes'?

Cassette E7: Fun to Learn series – Inventions 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Inventions before 1850. Inventions since 1850.
Description – Who invented television? What was the 'dangerous Lucifer'?

Cassette E8: Fun to Learn series – Spelling 1 (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £6.95.
Programs – Series A1-A15. Series B1-B15.
Description – Listen to the word spoken on your tape recorder, then spell it out on your ZX81. 300 words in total suitable for 6-11 year olds.

● Circle No. 172

Business/household

Cassette B1: The Collector's Pack (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £9.95.
Program – Collector's Pack, plus blank tape or side 2 for program/data storage.
Description – This comprehensive program should allow collectors (of stamps, coins etc.) to hold up to 400 records of up to 6 different items on one cassette. Keep your records up to date and sorted into order.

Cassette B2: The Club Record Controller (ICL)
Hardware required – ZX81 + 16K RAM.
Price – £9.95.
Program – Club Record Controller plus blank tape on side 2 for program/data storage.
Description – Enables clubs to hold records of up to 100 members on one cassette. Allows for names, addresses, 'phone numbers plus five lots of additional information – eg type of membership.

Cassette B3: VU-CALC (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £7.95.
Program – VU-CALC.
Description – Turns your ZX81 into an immensely powerful analysis chart. VU-CALC constructs, generates and calculates large tables for applications such as financial analysis, budget sheets, and projections. Complete with full instructions.

Cassette B4: VU-FILE (Psion)
Hardware required – ZX81 + 16K RAM.
Price – £7.95.
Programs – VU-FILE. Examples.
Description – A general-purpose information storage and retrieval program with emphasis on user-friendliness and visual display. Use it to catalogue your collection, maintain records or club memberships, keep track of your accounts, or as a telephone directory.

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Simply use the FREEPOST order form below and either enclose a cheque or give us your credit card number. Credit card holders can order by phone – simply call Camberley (0276) 66104 or 21282 during office hours. Either way, please allow up to 28 days for delivery, and there's a 14-day money-back option, of course.

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Tel: Camberley (0276) 66104 & 21282.

To: Sinclair Research, FREEPOST, Camberley, Surrey, GU15 3BR.
Please send me the items I have indicated below.

Qty	Cassette	Code	Item price	Total
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	G2: Super Programs 2	31	£4.95	
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	ZX Printer	27	£59.95	
	Post & packing – *only* if ordering hardware		£2.95	

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The jigsaw is completed

THE BASIC implementation of an independent program unit or procedure may be useful in the form of a subroutine. Yet Basic does not have a true subroutining capability, due in part to the requirements of line numbering. The line numbers in a subroutine must start after the highest numbered line in the main program, and this is very difficult to ensure unless the Basic system has a renumbering facility.

A further difficulty in Basic is that subroutines cannot have parameters, so you cannot write a Basic equivalent of

call solve (a,b,c)

in which a, b and c are variables which are local to the procedure called Solve. Instead, you have to write something like this:

```
 100  A = 10 : B = 5 : C = 1
 110  GOSUB 1000
 120  PRINT X
 :
1000  REM – SUBROUTINE 'SOLVE'
1010  X = (–B + SQR (B*B –4*A*C))/(2*A)
1020  RETURN
```

The values of A, B, C and X are "global"; that is, they have the same meanings and values throughout the program. Though there are a few dialects of Basic which permit local variables to be used and also enable subroutines to be called by label — for example, the Acorn Atom — this is a very rare, if desirable feature. For the majority of microcomputer users it is essential to use subroutines carefully.

One ploy is to use variable names that are meaningful inside each subroutine.

For example, if your micro permits two-letter plus one-digit variable names, you could use variables AA1 to AA9 for subroutine 1, AB1 to AB9 for subroutine 2 and so on. Never use these variable names in a main program and never use variable names from one subroutine inside another. If you do this, you will avoid most of the programming pitfalls in subroutines. If you can renumber subroutines as well then most of your problems are over.

As a convention, whenever you wish to use a subroutine within a PDL description, will write something like:

call proc (list of variables)

where "proc" is the name of a subroutine or procedure, and the list of variables is that required for input or output purposes. It will always be implemented as a Gosub when you do your PDL to Basic conversion.

Each of the five PDL constructs described in last month's article can be simulated in Basic or any other target language. The simple sequence, of course, translates directly.

The alternative clause is more troublesome, being capable of two implementations. In the sequence in figure 1, x is processed if t is equal to 10. There are two ways to translate this into Basic. Some people prefer the negative-logic approach of version 2 on the grounds that x appears before y. My preference is for version 1 because it maintans the logical test — in this case, equality.

Some dialects of Basic permit you to write:

IF (true/false expression) THEN (statement or line number) ELSE (statement or line number)

which makes for an easier translation. If the actions can be expressed in single statements a direct translation may be possible.

The choice clause translates more easily by use of the statement:

ON expression GO TO 1st line number, 2nd line number . . . nth line number

If subroutines are used, a better translation is:

ON expression GOSUB 1st line number, 2nd line number . . . nth line number

which automatically returns control to the next line after the On when returning from the subroutine. Variants of these statements may have to be used, such as:

GO TO (line number list) OF expression
GOSUB (line number list) OF expression

Some examples are shown in figure 2. The first version permits some form of "exception routine" to deal with N having other than the expected value. The second approach is similar, but no Gotos are required except after the Gosub, otherwise subroutine 1 will be entered illegally. It has greater modularity by allowing the independent development and maintenance of subroutines.

Repetition is achieved with an If statement; the terminating condition is a test

PDL	Basic Version 1	Basic Version 2
if t = 10	100 IF T = THEN 130	100 IF T <> 10 THEN 130
then x	110 statement y	110 statement x
else y	120 GO TO 140	120 GO TO 140
end if	130 statement x	130 statement y
	140 REM	140 REM

Figure 1.

PDL	Basic (using ON . . . GO TO)	Basic (using ON . . . GOSUB)
case of	100 ON N GO TO 300 400, 500	100 ON N GOSUB 1000, 2000, 3000
case 1	110 exception routine	....
case 2	300	....
	399 GO TO 6000	1000 REM-SUBROUTINE 1
	500	....
end case	....	2000 REM-SUBROUTINE 2
	6000 REM	....
		3000 REM-SUBROUTINE 3
		....

Figure 2.

PDL	Basic
do (b) until (a) end do	300 statement b
	....
	310 IF X = THEN 330
	320 GO TO 300
	330 REM

Figure 3.

PDL	Basic
WHILE A DO B END DO	100 IF X = 10 THEN 120
	110 GO TO 150
	120 statement b
	....
	140 GO TO 100
	150 REM

Figure 4.

In the final article of his series Graham Beech shows how structured elements are built up into a complete Basic program.

of equality between X and 10 in the Basic example in figure 3. As for the If-Then clause, the Until could also be formulated with negative logic — in this case, X <> 10.

Iteration also requires an If statement — see figure 4. Where appropriate, the For-Next construction can be used for repetition or iteration: surprisingly, it may be either of these, dependent on the software designer. Most microcomputer Basics, including Microsoft, implement For-Next as repetition.

A simple example program illustrates the use of PDL and implementation into Basic. Here is a goal statement relating to an investment problem:

Given:
- a capital sum (principal);
- annual rate of interest, expressed as a fraction;
- interest added monthly, quarterly or annually;
- all interest is reinvested;

calculate the amount at the end of n years.

The outline design might be:
- Input all data from the keyboard.
- If interest is added quarterly or monthly divide the rate by 4, or 12, and multiply the investment period by 4 or 12.
- For each relevant investment period, compute the nett amount:
  Amount←Amount × (1+rate)
- print the final amount.

In this simple case, you can now go straight to the detailed coding level — see figure 4 — there are no strong arguments for dividing the program into procedures. The program has a header of the form Program name, and a terminator, end name. Comments are enclosed by double slashes, //.

The next task is to translate this design into Basic. The dialect supplied on the Tandy TRS-80 has been chosen; its only machine-specific feature is the Input statement, which can include a prompting statement. Machines that do not have this feature require an extra Print.

The first section of the program — lines 100 to 200 — is a simple sequence, followed by If statement. The Goto statements are a consequence of the PDL-to-Basic translation process, not a violation of Goto avoidance.

The heart of the program is the iteration loop in lines 220 to 290. The final section consists of just two lines.

This program works, but it does not check for user foolishness such as a negative initial principal, or a value of S other than 2 or 3. In fact it assumes that any value other than 2 or 3 is 1.

```
Program Investment
print What is the principal, interest rate, investment term?
input Prin, rate, time
print "which scheme"; input s
//input and print have their usual meanings; s is 1, 2 or 3
depending on yearly, quarterly or monthly addition of interest//
if s = 2 then rate←  rate/4; time←4 x time end if
if s = 3 then rate← rate/12; time←12 x time end if
   Amt     ←    Prin
   Periods ←  1
while
   Periods < time
   do
      Amt← Amt x (1 + rate)
      Periods ← Periods + 1
   end do
print "You will have"; Amt
end Investment
```

Figure 5.

```
100   INPUT "PRINCIPAL, INTEREST, TERM"; P,R,T
110   INPUT "SCHEME? (1 + YRLY; 2 = QRTLY; 3 = MTHLY)"; S
120   IF S = 2 THEN 140
130   GO TO 170
140   LET R = R/4
150   LET T = T*4
160   GO TO 210
170   IF S = 3 THEN 190
180   GO TO 210
190   LET R = R/12
200   LET T = T*12
210   REM - TO BE CONTINUED

220   LET A = P
230   LET N = 1
240   REM - START OF LOOP
250   IF N < = T THEN 270
260   GO TO 300
270   LET A = A * (1 + R)
280   LET N = N + 1
290   GO TO 250
300   REM - ENTER FINAL SECTION

310   PRINT "YOU WILL HAVE"; A; "POUNDS"
320   END
```

Figure 6.

These are errors in the original design, but it is a simple matter to include suitable checks. For example,

```
do
print enter a positive value
input Prin
until Prin > 0
end do
```

locks the user into a loop until he enters an acceptable value.

There is never a unique way of designing a program. You may wish to redesign the program using:
- a case statement to select the interest rate;
- a For-Next loop.

As a second example, consider a computer-dating bureau which asks the following questions of its clients:
- Name
- Sex (M or F)
- Height (inches)
- Age (in years)

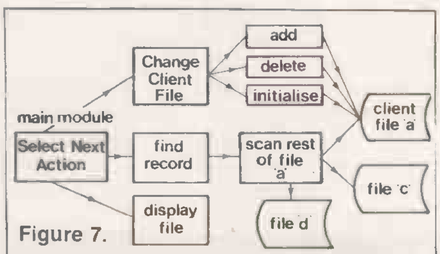

Figure 7.

- Given the list: 1) music; 2) sport; 3) travel; 4) theatre; 5) pets, choose one number for your main interest
- From the same list, choose a number for your main dislike.

This information will be written as a "record" of the form

(Name), (M or F), (Height), (age), (Like), (Dislike)

For example:

JOHN, M, 72, 22, 1, 2

represents a 6ft-high 22-year-old music-loving, sport-hating male.

The bureau has a list of many such records numbered from 1 upwards. In matching prospective partners, they are anxious to match.
1. M with F — without exception.
2. ages within 2 years, if possible.
3. heights within 6 inches, if possible.

They wish to ensure that the main interest of one does not happen to be the dislike of the other.

The task is to design a program for the bureau who happen to have a microcomputer — in this case, a Tandy TRS-80 — with disc drives. A suitable goal could be:
- Given the client data records, and a selected client, list prospective partners that satisfy all three criteria, followed by those that fail to satisfy criteria 2 and/or 3.

An outline design then follows:

(continued on next page)

Listing 1. Computer-dating program.

```
100 REM- MAIN PROGRAM
102 REM- SET UP SPACE FOR STRINGS
105 CLEAR 5000
107 CLS
120 INPUT"1: FILE SECTION. 2: MATCH. 3: DISPLAY. 4: STOP.";X
130 ON X GOSUB1000,2000,1800
140 IF X=4 THEN 160
150 GOTO 120
160 PRINT"END OF PROGRAM"
170 END
1000 REM- FILE CONTROL MODULE
1002 CLS
1004 INPUT"DO YOU WANT TO INITIALISE (& CLEAR) THE FILES";A$
1006 IF A$="YES" GOTO 1010
1008 GOTO 1020
1010 OPEN"O",1,"FILA/TXT"
1011 OPEN"O",2,"FILB/TXT"
1012 OPEN"O",3,"FILC/TXT"
1013 OPEN"O",4,"FILD/TXT"
1015 CLOSE
1017 PRINT:PRINT
1020 INPUT"1: ADD TO FILE. 2:DELETE. 3: RETURN ";X9
1040 ON X9 GOSUB 1100,1500
1050 IF X9=3 THEN 1070
1060 GOTO 1020
1070 RETURN
1100 REM- ADD TO FILE
1105 CLS
1110 OPEN"I",1,"FILA/TXT"
1111 OPEN"O",2,"FILB/TXT"
1120 IF NOT(EOF(1)) THEN 1125
1122 GOTO 1130
1125 INPUT #1,A$,B$,H9,A9,L9,D9:PRINT #2,A$;",";B$;",";H9;A9;L9;D9
1127 GOTO 1120
1130 REM-FILE NOW COPIED
1140 INPUT"NAME ";A$:INPUT"  SEX";B$:INPUT"HEIGHT (INCHES)";H9
1150 INPUT"AGE (YRS)";A9:INPUT"LIKE (1-6)";L9:INPUT"DISLIKE (1-6)";D9
1160 PRINT #2,A$;",";B$;",";H9;A9;L9;D9
1170 PRINT:INPUT"ANY MORE ";R$
```

(continued from previous page)

1. Store the records in sequential file, on disc.
2. Find a particular record and copy into temporary storage.
3. Select from the remaining records:
   (a) those that match all three criteria,
   (b) those that fail on criteria 2 or 3,
   (c) store the contents of (a) and (b) in sequential output files.
4. Display the contents of either output file.

Stage 1 must be improved slightly to permit file manipulation:

(a) set up a new file,
(b) add new records,
(c) delete old records.

Stage 2 also requires decomposition:

(a) request a client name,
(b) scan the client file for the record associated with the chosen name,
(c) either copy the record into temporary storage, or report that no valid record exists.

The problem is now assuming a modular character; in fact, functions 1 and 2 are quite independent of each other. Figure 7 shows the main communications paths.

There is little chance of data corruption, since communication is enabled between the modules by selecting from options. In contrast, a bottom-up programmer may have started by requesting a client name, then adding "special" statements to indicate that file updating was required instead.

The simplest implementation is to design the records of the file thus:

(Name), (M or F), (Height), (Age), (Like), (Dislike)

Since the files are to be sequential, new records are added at the end of a file but unwanted records must, somehow, be deleted to make room for new ones. The design is oriented to disc storage but, being sequential, cassette tape could be used, though with slower access speed. Random-access files would be much faster but their implementation is very machine-specific.

The main module repeatedly calls one of three procedures until the user types a "4" to stop the program — see figure 8. It would be incorrect to include initialisation of, for example, the files. To do so would add unnecessary connections to this module.

The filecon module is used to add to, delete from, or list the file of clients. It also initialises the files on the first time the program is used, effectively emptying them and preparing them to receive new data. File handling is the least standardised aspect of Basic, so the file-related statements are left deliberately vague.

Some terminology is introduced for convenience:

pointer — the presently addressed record in a sequential file is located by a "pointer" variable. It is incremented to the next record position whenever a record is read from or output to a sequential file.

open — a disc file must be opened to either receive data, or output, or to supply data to the program, input.

close — disc files must be closed before being reopened.

end-of-file — files have a marker, similar to the pointer which locates the end of a file. If you test for this marker, before attempting to read a record, you avoid falling off the end of the file.

The file-control module is shown in figure 9. In some implementations of Basic, the user can add extra records to the end of a sequential file. But in most cases, the action of opening such a file to receive output resets the record pointer to the beginning of the file, thereby effectively erasing its contents.

A more general solution is to use a work file Filb, make the additions or deletions to that, and then copy Filb to Fila, as in the procedures in figure 10.

(listing continued on page 101)

```
1180 IF R$="NO" THEN 1200
1190 GOTO 1140
1200 REM- NOW COPY BACK
1205 CLOSE
1210 OPEN"I",2,"FILB/TXT"
1211 OPEN"O",1,"FILA/TXT"
1220 IF NOT(EOF(2)) THEN 1240
1230 GOTO 1300
1240 INPUT #2,A$,B$,H9,A9,L9,D9: PRINT #1,A$;",";B$;",";H9;A9;L9;D9
1250 GOTO 1220
1300 CLOSE
1310 RETURN
1500 REM- DELETE RECORD
1505 CLS
1507 LET F9=0
1510 OPEN"I",1,"FILA/TXT"
1520 OPEN"O",2,"FILB/TXT"
1530 INPUT"CLIENT NAME ";C$
1540 IF NOT(EOF(1)) THEN 1560
1550 GOTO 1590
1560 INPUT #1,A$,B$,H9,A9,L9,D9
1570 IF A$<>C$ THEN PRINT #2,A$;",";B$;",";H9;A9;L9;D9 ELSE LET F9=1
1580 GOTO 1540
1590 PRINT: PRINT"END OF FILE"
1600 IF F9<>1 THEN PRINT"RECORD NOT FOUND" ELSE PRINT"RECORD DELETED"
1610 REM- NOW COPY B BACK TO A:
1612 CLOSE
1615 OPEN"I",2,"FILB/TXT"
1616 OPEN"O",1,"FILA/TXT"
1620 IF NOT(EOF(2)) THEN 1640
1630 GOTO 1680
1640 INPUT #2,A$,B$,H9,A9,L9,D9: PRINT #1,A$;",";B$;",";H9;A9;L9;D9
1660 GOTO 1620
1680 CLOSE
1690 RETURN
1800 REM-LIST FILE
1801 INPUT"WHICH FILE";F$
1802 IF INSTR(F$,"FIL")<>0 AND INSTR(F$,"TXT")<>0 THEN 1804
1803 PRINT"BAD FILE NAME": GOTO 1801
1804 OPEN"I",1,F$
1805 PRINT"NAME";TAB(21)"SEX";TAB(26)"HT";TAB(36)"AGE";TAB(46)"LIKE";TAB(56)"DISLIKE"
```

Before writing the match procedure, you can write display so that it will list any of the sequential files — see figure 11. Next, the match procedure calls two procedures — one to select a record, another to compare that record against all of the others — see figure 12. The select procedure accepts "client-name" and returns "copy", consisting of the chosen records — see figure 13.

Finally, match "copy" against all of the other records and output the best matches to File, the second-best to Fild. Since male-male and female-female matches are excluded, you do not have to worry about matching "copy" with itself. This procedure uses abs meaning "absolute difference", which is widely available — see figure 14.

(continued on page 101)

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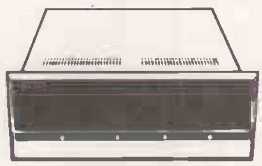

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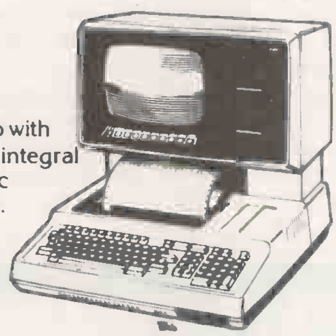

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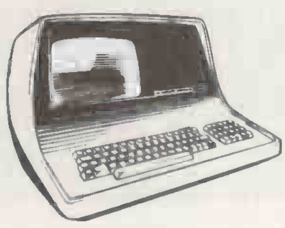

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(listing continued from page 99)

```
1820 IF NOT(EOF(1)) THEN 1830
1825 GOTO 1860
1830 INPUT #1,A$,B$,H9,A9,L9,D9
1840 PRINT A$;TAB(22)B$;TAB(25)H9;TAB(36)A9;TAB(48)L9;TAB(58)D9
1850 GOTO 1820
1860 PRINT: PRINT"**END OF FILE**"
1865 CLOSE
1870 RETURN
2000 REM-MATCH
2010 CLS
2020 INPUT"NAME";N$
2030 GOSUB 2200
2040 IF C$<>"" THEN GOSUB 2500 ELSE PRINT"NOT IN LIST"
2050 RETURN
2200 REM-SELECT
2210 OPEN"I",1,"FILA/TXT"
2220 LET C$=""
2230 IF NOT(EOF(1)) AND C$="" THEN 2250
2240 GOTO 2300
2250 INPUT #1,A$,B$,H9,A9,L9,D9
2260 IF N$=A$ THEN 2280
2270 GOTO 2290
2280 C$=A$:D$=B$:H1=H9:A1=A9:L1=L9:D1=D9
2290 GOTO 2230
2300 CLOSE
2310 RETURN
2500 REM-COMPARE
2510 OPEN"I",1,"FILA/TXT"
2520 OPEN"O",3,"FILC/TXT":OPEN"O",4,"FILD/TXT"
2530 IF NOT(EOF(1)) THEN 2550
2540 GOTO 2620
2550 INPUT #1,A$,B$,H9,A9,L9,D9
2560 IF B$<>D$ THEN 2580
2570 GOTO 2610
2580 IF L1<>D9 AND L9<>D1 THEN 2600
2590 GOTO 2610
2600 IF ABS(H1-H9)>6 OR ABS(A1-A9)>2 THEN P9=4 ELSE P9=3
2605 PRINT#P9,A$;",";B$;",";H9,A9,L9,D9
2610 GOTO 2530
2620 CLOSE
2630 RETURN
```

(continued from page 99)

The Basic listing of the program — listing 1 — is written in TRS-80 Basic, though only small changes will be required for other machines. Opening a file for output does not erase a file unless you print something — even if it is only bank record — to that file; hence the rather odd coding at the beginning of filecon, starting at line 1000.

Effortless Basic

File peculiarities aside, this program was coded effortlessly into Basic. It is not intended to be a sophisticated or user-proof program — for example, no error checking is included — but it does illustrate the main advantage of structured design for a program of moderate complexity.

Most of the effort is expended at the design stage — the Basic programming is straightforward. Indeed, this shifts the emphasis away from attempts to standardise the language, in favour of standardising the design procedure.

```
Program main-module
  do
    print type a number from 1-4; input number
      case of
         1:  call filecon //file control module//
         2:  call match //find client record//
         3:  call display //list the matching clients//
      end case
    until number = 4
  end do
end main module
```

Figure 8.

```
procedure filecon
  print "initialise the files?" //if 'YES' set the record
  pointers of "fila", "filb", "filc" and "fild" to the
  beginning in each case//
  do
    input   1, 2, 3 or 4
            1:  call add
            2:  call delete
            3:  call list

    until 4 //is typed//
  end do
end filecon
```

Figure 9.

```
procedure add
  //open "fila" to supply input, "filb" to receive output.
  Copy "fila" to "filb", leaving the latter in the output
  state//
do
  input new record; output new record to "filb"
  until no more additions
end do
  //Copy "filb" to "fila".  Close the files//
end add

procedure delete
  //open "fila" for input, "filb" for output//
del - flag ← 0;
  input client-name
    while not at the end of "fila"
      do
         read record//from "fila"//
         if (record-name) <> (client-name) then output
         record//to "fila"// else del-flag ← 1 end if
      end do
if del-flag <> 1 then print "record not found" else
  print "record deleted" end if
//copy "filb" to "fila".  Close the files//
end delete
```

Figure 10.

```
procedure display
  input filename //eg. "fila"//
  //open the file for input//
  while not at the end of the file
    do
      read record; print record
    end do
  //Close the file//
end display
```

Figure 11.

```
procedure match
  input client-name
  call select //to find record. 'Select' assigns 'blank' to
  the string 'copy' if it cannot find the record//
  if copy <> 'blank' then
     call compare else print "not in list"
end match
```

Figure 12.

```
procedure select
  //open "fila" for input//
  copy    'blank'
while not at end of file and copy = 'blank'
  do
       read record
         if record-name = client name
            then copy   record
         end if
  end do
  //Close "fila"//
end select
```

Figure 13.

```
procedure compare
  //open "fila" for input; "filc" and "fild" for output//
while not at end of "fila"//
  do
     read record//from "fila"//
       //1 and 2 refer to records being compared//
       if sex 1 <> sex 2 then
         if (like 1 <> dislike 2 and like 2 <> dislike 1) then
           if (abs (height 1 - height 2) > 6 or
              (abs (agel - age2) > 2) then
              output record to "fild" else
              output record to "filc"
           end if
         end if
       end if
     end do
  //close files//
end compare
```

Figure 14.

Fatal listing — Goto hyperspace

by Edward Teague

Melanie Fossett was absorbed in the morning paper when her concentration was broken by a lump of marmalade splattering on to the final paragraph of the article. She looked up sharply at her husband, whose gesticulations with a marmalade-laden knife had caused the news black-out.

"For God's sake Norman! Stop wittering on about your blasted computer". Melanie raged at her husband who ignored her every word. With a heavy sigh she slapped her sticky newspaper on the table and screamed at him, "Norman, I swear I'll kill you if you don't do something about that computer — morning, noon and night you are at it — you don't listen to a word I say".

With tears brimming in her eyes, Melanie Fossett slammed out of the room, flung on her coat and stormed out of the house. Norman Fossett was aware but unmoved by his wife's tantrum and noisy exit.

The Pet that had been introduced to the drawing office of Fothergill & Bickerstaff, the engineering firm where Norman worked as a sales representative, was provided to assist draughtsmen in routine structural calculations but had initially proved to be a major lunchtime attraction for everybody in the company for games of Space Invaders.

Norman had started to haunt Tottenham Court Road and spend hours searching out new and ever more obscure programming guides. Many a night was spent explaining to his wife the need to buy a personal computer, the comparative merits of the Z-80 and 6502 processors, and whether it was worth buying two disc drives to enable fast copying

Melanie was not prepared for the change that overcame her partner after he finally decided which computer to purchase. Months spent in discussion with wild-eyed men along Tottenham Court Road and nights sitting up in bed reading the seeming endless flood of punditry which had brought a decision.

One Saturday afternoon he bore home proudly a Genie computer with a single disc drive and printer. Three-o-clock the following morning found him still pecking away at the keyboard, trying to remove a system bug.

In the morning Melanie awoke at eight to hear a noise that sounded like a whining buzz-saw. She sat up with a start to find the bed empty. Rushing downstairs she found Norman crouched over a small box which was spewing paper. With the demonic gleam characteristic of the computer freak and the religious zealot alike, Norman looked up at her. "Just look at this darling, the first program. Isn't it fantastic"?

Melanie's eye bitterly surveyed the wreckage of the dining room. Norman had already been up for an hour and had his sleek new compact Genie computer with disc drive setting on the immaculately polished table. The screaming printer occupied the coffee table, which cables were strung across the room and magazines and piles of listing paper were strewn across the chairs. A neglected cup of coffee was congealing on top of the piano.

"Are you going to clear this mess up"? she shrieked.

'What mess darling"? Norman looked around helplessly, ineffectually trying to tidy the pile of magazines.

Like most people, Norman and Melanie Fossett had, as Lord Chesterfield remarked, married to find happiness and found that they had had to make do with contentment. Now Norman had found his happiness; Melanie's discontent was just about to start.

Norman's absorption with his computer became absolute. Every minute of his time and, increasingly, some of Fothergill & Bickerstaff's, was spent in contemplation of the sleek Genie monitor on lengthy and much sribbled-on program listings. Their joint bank account bore testimony to Norman's lavish expenditure.

Melanie would call him for meals and he would not hear, appointments at the dentist were forgotten, and Norman's hair, once spruce and neat, became lank and long.

Norman and Melanie had met at Windsor. Both children of the Flower Power era, they had been arrested in the police swoop on the Jazz & Blues festival and shared the same police van.

The ersatz mysticism of that period never left Norman and he had become fascinated with magic squares, those mathematical curiosities, matrices of whole numbers that showed certain strange regularities in the pattern of their numbers. He now became obsessed with writing a program to produce and print out magic squares. Using the elegant formula provided in Lancelot Hogben's *Mathematics for the Million*, he eventually succeeded. By entering the size of the matrix and the total that he wished each column and diagonal to be, he could generate the requisite magic square. It was a party trick that brought him admiration only from his fellow freaks.

Further research led him to Claude Bragdon, whose ideas on projective geometry he had first read about in an obscure American book first published in 1923. His quest for knowledge about four-dimensional geometry led him to read Howard Hinton's *Fourth Dimension*, and eventually the famous article in the American Journal of Mathematics by W I Stringham *Regular Figures in n-dimensional space*". Here he came to the breaking point: his sleek and thoroughly reliable Genie failed him. As does every other computer user, he soon discovered the limits of his machine.

Resorting to the Tottenham Court Road again, he saw what he wanted. It was love at first sight. One view of the sleek lines of the new Sharp MZ-80B sold it to him. Instantly smitten, he stroked the sensitive keyboard and opened the carefully dampened cassette deck. "Like to see the moving graphics sir"? asked the hovering salesman.

As soon as Norman arrived home with the new computer, Melanie knew exactly what had happened to their joint account. This time Norman had to listen. Finally Melanie cooled down, though not without a parting shot. She announced that she would be taking a couple of days off to stay with Cassandra, a fierce feminist friend from Melanie's university days. Cassandra lived up in Cheshire working at Jodrell Bank as an astrophysicist and dividing her time between looking for quasars and agitating for free creches.

It was with a cheery smile that he saw her off on the train to Crewe; cheer that vanished on his return home. His latest program listing, his most ambitious to date and involving the complete inversion of a sphere, was no where to be found. His printer had broken down and he could not print out another. There was nothing for it but to sit down and struggle with a screen display of the program listing all weekend.

(continued on next page)

continued from previous page

The insistent bell of the telephone interrupted him and he went to answer it in the hall.

"Hello Norman, it's me Melanie, can you pick me up from the station at seven"?

"Certainly, darling".

"Everything OK, programming coming along"?

Norman was taken aback at this unprecedented interest, "Yes . . . er, fine dear. Funny thing, though, I don't seem to be able to find my latest listing."

"Oh yes, I'm sorry, I picked up some printout paper as a bookmark."

"Thank the Lord for that, I couldn't imagine where it was. OK, see you at seven".

Norman was relieved to see how relaxed and happy Melanie was; the journey back from the station was free of the manic feminism with which Cassandra usually stuffed her. He was also relieved to see that Melanie had his listing. Within minutes Norman was again engrossed in the program. With the printed listing he could at last make headway. He swiftly entered the lines of code. Finally everything seemed to be right, so he decided to run the program. He typed in Run and the sceen flashed

The final solution
Copyright N Fossett
This program not to be copied for any purpose

The screen cleared and a prompt asked for the number of faces on the sphere he wished to invert. He tapped in 666, a number he liked to use because the first magic square he constructed had been based on a total of 666 for the columns and diagonals. Unknown to him it was also an exact reproduction of an antique Hebrew magic square.

The screen flashed a prompt, asking him for the size of incremental steps he wanted in units. He chose the lowest, which was one. The program should now run but to his surprise the screen now displayed

Do you wish to enter hyperspace?
Answer Y/N.

Norman gazed at the screen in disbelief. Where had this line come from? It was not an instruction he could recall. Frantically he scrabbled through his listing, then in faint pencil he saw a line written in for the display he was looking at, with a Goto command to which he turned. Further lines of code, not immediately intelligible to him, were there. Curious to find out what happened, he tapped the Y key with his left index finger and hit carriage return with his right little finger.

Immediately the screen display showed a sphere which he recognised as being constructed with 666 faces. It slowly started to rotate as the faces inverted, and from the centre a growing dark area spread to the circumference. The circumference appeared to gather speed as the dark central mass grew bigger and darker. Faster and faster the circle flew.

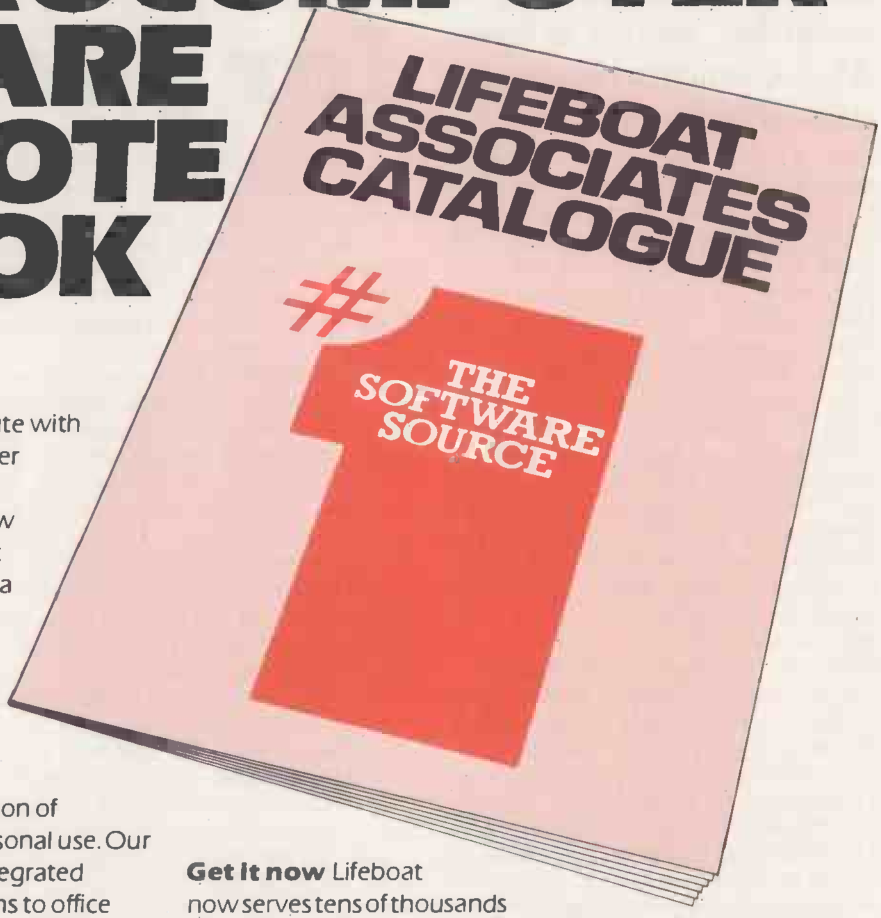
Sweat broke out on Norman's face: the black central spot was becoming a void before his eyes. He sat transfixed as the phosphorescent green circle revolved and grew and the frightening black space appeared to grow over the screen and eventually over the computer. In fascinated horror Norman stood up and shrieked, "Melanie, Melanie come quickly, the computer . . ."

He stretched out his hand in disbelief at the computer, and felt the force tug his fingers, growing, irresistible, engulfing.

His final piercing shriek was quickly extinguished, but loud and long enough to wake Melanie, who was drowsing by the fire. She opened the door to the dining room. The polished dining table reflected the wall lights. Where the computer had previously stood was a clean, bare table. She walked over to it and picked up the listing, smiling as she noted Norman's handwriting where he had headed it "The final solutiun". Spelling had never been his strong point.

Switching off the light, she felt in her pocket for the car keys. Damn! Norman had had them. She would have to walk down to the police station to report him missing. But first she had better just phone Cassandra.

WHEN IT COMES TO MICROCOMPUTER SOFTWARE WE WROTE THE BOOK



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● Circle No. 179

If mention of handshaking protocols, serial buses and IEE-488 ports fills you with confusion, help is at hand. Alan Clements reports on data-transmission lines.

All together or for parallel and

IN ORDER to go from my home to work I must travel along a number of roads provided by courtesy of the local authorities. I would, of course, prefer a single, direct path between my home and work, along which only I am allowed to travel. Unfortunately, my own private road would be immensely costly, not to mention inefficient, but it would be fast.

A similar situation exists in digital systems. While it would be nice to connect each module, or functional part of the system, directly to every other module with which it communicates, it is not economically possible. Consequently a digital system of any complexity has a set of highways along which information moves from point to point. These highways are called buses — from the Latin word *omnibus* which means "for all" — and are normally labelled by the nature of the information they carry, such as data or address. Figure 1 illustrates how buses move information from one part of a microprocessor to another.

Returning to the analogy of the roads, it is necessary to devise a set of rules to be obeyed by all road users if an orderly flow of traffic is to be achieved. Such a set of rules is called a protocol and, in the case of road traffic, is enshrined in the highway code. Parallel buses move simultaneously a number of bits, often eight or 16, over parallel lines using one line per bit. Serial buses, more commonly called data links, move all data along one line a bit at a time.

There are two fundamental approaches to the transfer of information on buses: open-loop or synchronous, and closed-loop or asynchronous protocols. With an open-loop protocol data is transmitted from a source to its destination without any further communication between destination and source. When the source transmits the data it assumes that the destination has received the data after a suitable time has elapsed. The postal system normally operates this way: you pop a letter in a letter-box and assume that it will be delivered.

A closed-loop protocol operates in a more conservative mode. Information is transmitted from the source to the destination, but the source does not proceed to its next task until the destination has confirmed the receipt of the data. This mode requires two-way communication. Closed-loop protocols are similar to letters sent "advice of delivery": the recipient signs a slip of paper on receiving the letter, and the slip is returned to the sender confirming the safe delivery. The popular eight-bit microprocessors use open-loop protocols, while some of the more sophisticated 16-bit microprocessors rely on closed-loop protocols.

The simplest parallel bus designed to move m bits of data at a time would consist of m lines plus a ground return. It has no additional control lines — see figure 2. The timing diagram illustrates a time sequence of events.

By convention digital signals are represented by horizontal lines at a logical 0 to 1 level. In figure 2 the data on the bus is represented by two parallel lines because it is not the data itself that matters but the point at which the data changes. The shaded portion of the timing diagram represents data which is in the process of changing and is therefore invalid. Between the shaded regions the data is constant and stable.

The device which puts data on a bus is called a transmitter or a talker. The device taking data from a bus is called a receiver or a listener. Sometimes the transmitter is called a source and the receiver a sink. Unless otherwise stated, the term data means information being moved along a bus, rather than its narrower use where it often refers to the contents of an address location.

The primitive bus of figure 2 presents the receiver with a problem. How does it know when to sample the data on the bus? If both receiver and transmitter had perfect clocks they could arrange for the receiver to sample the data at the right time, but in practice it is difficult to do this reliably over a long time span.

Identical characters

Another solution would be to let the receiver look for changes in the data on the bus. When the receiver detects a change of state on one or more of the m lines of the bus, all it has to do is wait a short time for the data to settle and then it can sample the data. This scheme is analogous to that used by asynchronous serial data buses where a start bit denotes the beginning of a stream of 10 or more bits. A particular difficulty with this arrangement is that two identical characters cannot be transmitted consecutively as none of the lines changes state between the characters.

The open-loop bus protocol encountered most frequently uses a single control line to synchronise the receiver with the transmitter. The line may be called "data available", and when asserted by the transmitter it tells the receiver that data is now available for it to read.

Note the use of the word "asserted". All lines must be in an electrically low or high state, and one of these states must be chosen as the level which causes the action to take place, but for the purposes of description it does not matter what the actual level is. A line is asserted when it is set at the level which causes its named action to be carried out.

A typical microprocessor with a synchronous data bus is the 6809, whose timing diagram is given in figure 3. The 6809 has a 16-bit address bus which it uses to provide memory and peripherals with the location of the memory, into which data is being written, or from which data is being read. The eight-bit data bus is bidirectional and moves data to the CPU

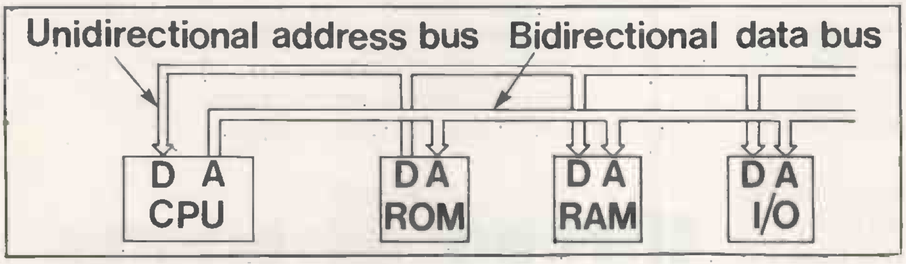
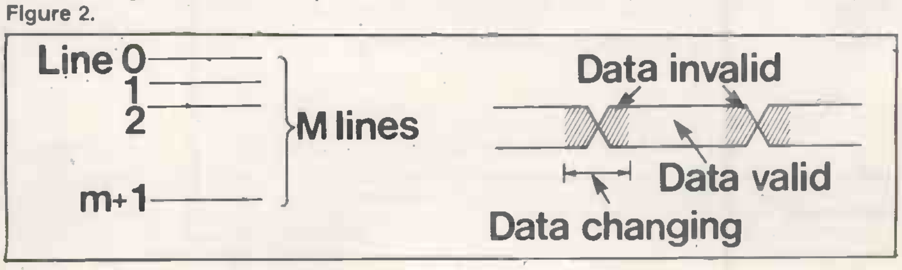


Figure 1.

Figure 2.


one at a time: protocols serial data ports

in a read cycle and from the CPU in a write cycle.

The R/$\overline{W}$ read/$\overline{write}$ line from the CPU indicates to the memory the nature of the data transfer. When it is in a logical 1 state a read cycle is taking place. The line used to control the bus is the E (enable) line, and is a system clock. The Q line is a clock identical to the E clock, but lagging the E clock by one-quarter of a cycle; Q stands for quadrature. It is not strictly necessary for data transfer.

The timing diagram in figure 3 corresponds to a read cycle when R/$\overline{W}$ = 1. At the start of the cycle when E is low the CPU is busy calculating the value of the address of the memory location to be examined. Up to point C the contents of the address bus are invalid and may not be used, hence the shading. After point C which occurs t_{AD} seconds after the start of a cycle the address is valid until point D, t_{AH}, the address hold time, after the end of the cycle.

The memory assumes that the address is valid when E is high and, as R/$\overline{W}$ = 1, puts its data on the data bus. At the end of the cycle signified by the falling edge of

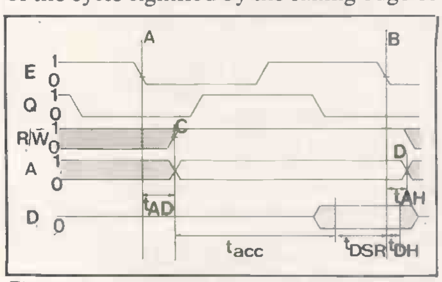


Figure 3.

the E clock, the CPU reads the contents of the data bus.

The protocol of the 6809 requires that the data be valid at least t_{DSR} seconds, the data set-up time, before the end of a cycle, and that the data remains stable for at least t_{OR}, the data hold time, after the end of a cycle. It is entirely up to the designer of the system to ensure that these criteria are satisfied and that the memory component is capable of working at the speed demanded by the CPU.

The CPU blindly reads the data bus at the end of a read cycle. If the memory has failed or is not there because an erroneous address has been generated, the CPU does nothing about it. Fortunately, such failures are rare and the majority of microprocessors work quite happily with a synchronous bus. However, they are of less use when dealing with memory or peripheral components having widely differing access times, or where the system must have a very high level of reliability or integrity.

Information transfer using a closed-loop protocol requires that the receiver should confirm the receipt of data to the transmitter. This interaction between transmitter and receiver is usually called handshaking, though some people call it an interlocked transfer. In general, there are two types of handshake procedure: the two-wire handshake and the three-wire handshake.

Two-wire handshake

In a two-wire handshake two control lines, data available, DAV, and data accepted, DAC, facilitate an orderly flow of information from transmitter to receiver. Figure 4 illustrates the operation of the two-wire handshake. When the transmitter has data ready it puts it on the data bus and asserts DAV. When the receiver sees that DAV has been asserted it reads the data and asserts DAC.

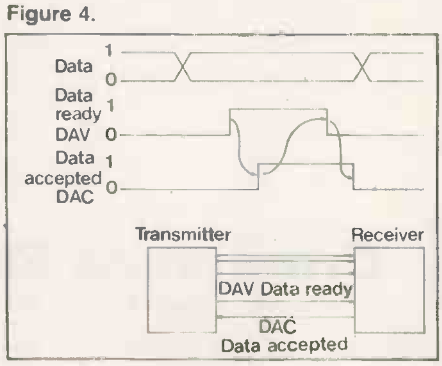
The transmitter now sees that the receiver has confirmed its receipt of data so the transmitter can de-assert DAV, its job having been done. In turn the receiver de-asserts DAC and the exchange of information is complete.

A potentially fatal problem can arise with handshaking protocols. Suppose the transmitter asserts data available and the receiver is not working. Does the transmitter wait for ever, hoping to see data accepted? If this were to happen the system would just hang up.

In a well-designed system a time-out mechanism is used to avoid hang-ups. When the transmitter first asserts DAV a timer is started. If a certain period, the time out, elapses without DAC being asserted, the data transfer is aborted and some form of error-handling procedure invoked.

Suppose in a large computer system someone runs a program which produces a paper-tape output. As the paper-tape

Figure 4.



punch is not frequently used it might not be plugged in. When the program tries to send data to the tape punch it receives no acknowledgement, and times out. This results in a call to the operating system which prints a message on the operator's console, suspends this task, and runs another.

The 68000 16-bit microprocessor uses a two-wire handshake to transfer data between itself and peripherals and memory. Figure 5 illustrates the operation of the 68000 in a read cycle. At the end of state S_O the 68000 puts out an address on its address bus, and at the end of S_2 it asserts its address-valid strobe, $\overline{AS}$, telling the

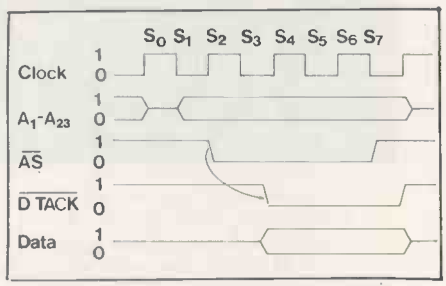


Figure 5.

memory that the address is valid and should be acted upon.

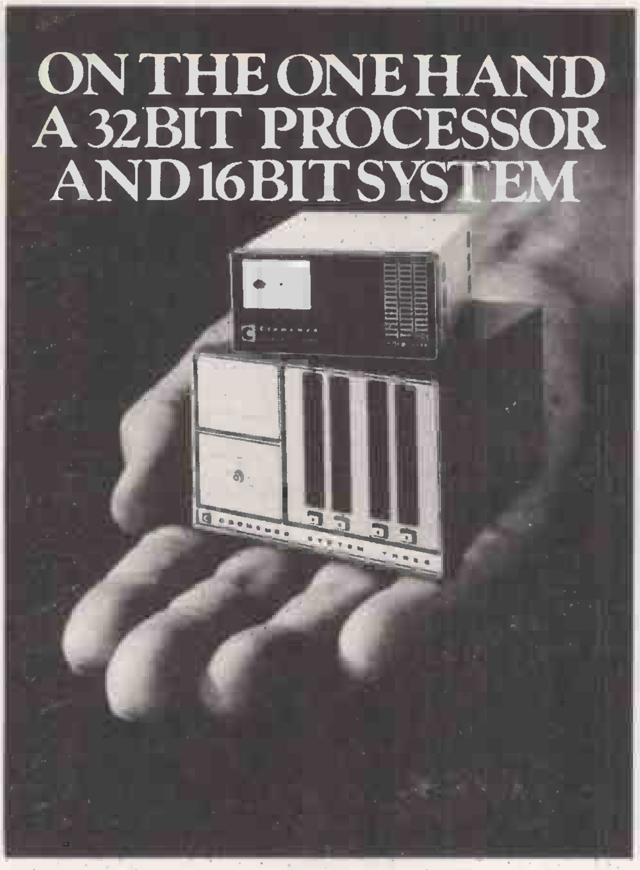
When the peripheral sees that the address strobe has been asserted, it acknowledges it by asserting $\overline{DTACK}$, data acknowledge, and puts data on the data bus. When the 6800 CPU sees $\overline{DTACK}$ it latches the data from the memory and terminates the read cycle. Should $\overline{DTACK}$ not be asserted within a reasonable time external circuitry — provided by the designer, as only he can say what constitutes a reasonable time — asserts the active-low bus error $\overline{BERR}$ input to the CPU. The CPU may then either try to run the bus cycle again or to initiate a bus error sequence, which is really a special form of interrupt.

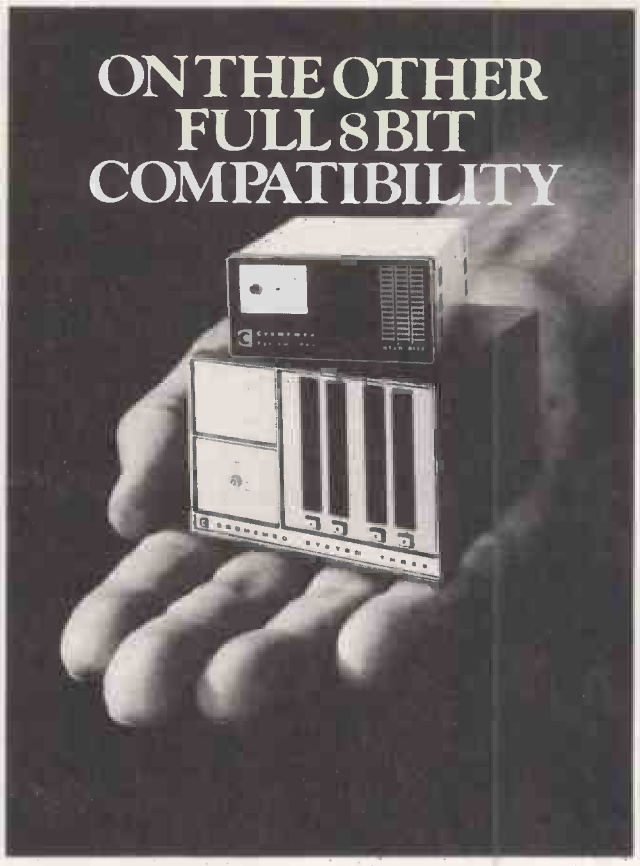
Handshaking can be taken one step further by the addition of a second control line, in addition to data available, from the receiver to transmitter. Called, ready for data, RFD, it indicates to the transmitter that the receiver or receivers are able to accept data.

The three-wire handshake is largely associated with the IEEE-488-1975 bus which is designed to transfer data between one or more computers and intelligent test and measurement equipment. Such an interlinked network of equipment forms the basis of automatic testing.

Carefully controlled power levels, for

(continued on page 111)





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(continued from page 109)
example, can be applied to a PCB under test and a number of signals injected at various points by signal generators controlled from the IEEE bus. Simultaneously a battery of programmable signal monitors could sample the signals on the PCB at a host of predetermined points. The whole process may be controlled by a computer which configures the signal sources and measuring equipment, and then receives reports from the measuring equipment via the bus. Eventually the computer can produce a go/no-go indication or even write a report on the PCB.

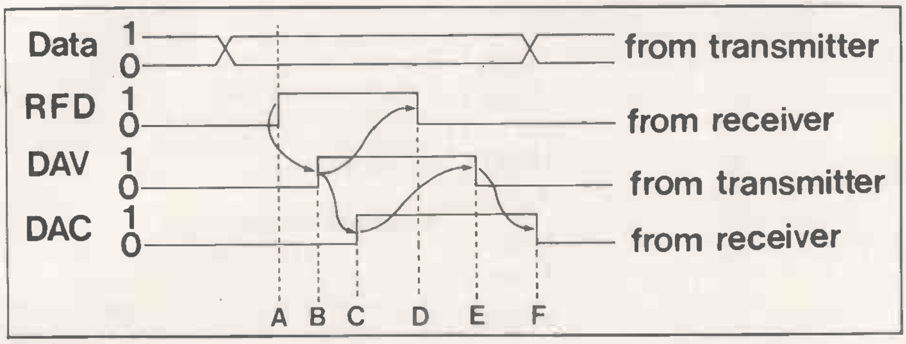


Figure 6a.

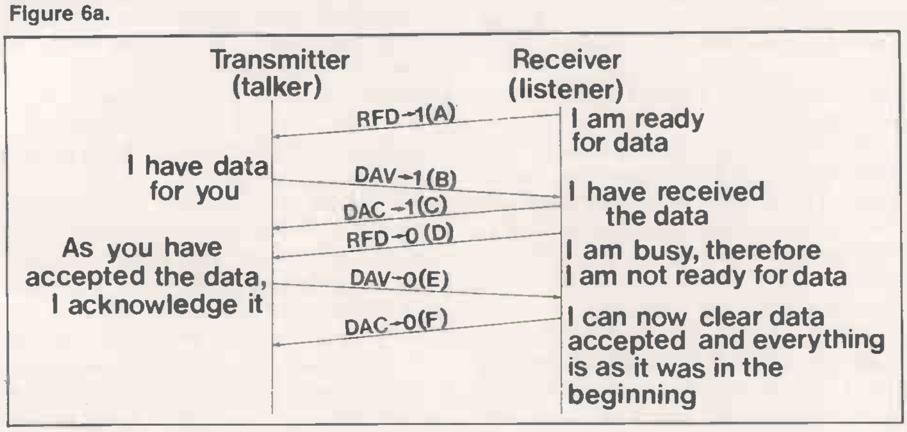


Figure 6b.

The IEEE-488-1975 is often simply called the IEEE bus, though this colloquial use is incorrect because the IEEE has laid down standards for a number of buses including the S-100 bus — sometimes also called the General Purpose Interface Bus GPIB. The IEEE bus has eight data lines plus five control lines in addition to the three lines involved in the handshaking procedure.

Figure 6a illustrates the operation of the three-wire handshake which uses a timing diagram and a message-exchange sequence. When the receiver is able to accept data it asserts ready for data, RFD, telling the transmitter to go ahead. The transmitter can now assert data available, DAV, causing the receiver to issue a data accepted, DAC, signal and to de-assert RFD as it is no longer in a ready state. When the transmitter receives confirmation of data accepted it de-asserts DAV and the receiver de-asserts DAC in turn, completing the transfer of data.

Figure 6b is another way of writing the timing diagram called a message-exchange sequence. Each action of the control lines is represented by a message between the transmitter and receiver. Read this diagram downwards from top to bottom, unlike the timing diagram which is read from left to right.

In the two-wire handshake the transmitter assumes that the receiver is always ready. The handshake itself merely confirms the acceptance of data. The three-wire handshake is used in an environment where receivers may take a little time to digest the current data and may therefore be unable to accept data for some time.

The IEEE bus allows a number of receivers to listen to one transmitter even though response times of the receivers may be widely different. The IEEE bus is designed to operate at the pace of the slowest device using it. Consequently, a transmitter on an IEEE bus does not begin to speak until it knows that the bus is free and that all listeners have indicated their readiness for data.

The operation of the three-wire handshake is complicated by the fact that it is not possible to separate the logical operation of the bus from its physical operation. If a single transmitter can speak to many receivers, it follows that each of the receivers must be able to assert ready for data. However, the transmitter does not care if one listener is ready for data and the others are not. It is the old syndrome of much rejoicing at the return of the hundredth sheep. The transmitter is interested only in the last receiver to signal that it is ready for data.

The solution to this problem is to let receivers signal when they are not ready for data. The transmitter must wait if any receiver says it is not ready for data. Once the last receiver has said that it is no longer not ready for data, they must all be ready for data. An identical argument may be applied to data accepted which, in the case of the IEEE bus, becomes not data accepted, NDAC.

A second problem is due to the electrical nature of typical bipolar-logic elements. The gates which drive the handshake lines have open-collector outputs: they can pull the line down actively to an electrical low state with the line sitting at less than 0.4V with respect to ground.

When not pulling the line down, the open-collector gate has no effect on the line, apart from a small leakage current. If none of the open-collector gates connected to the line is pulling it down the line is pulled up to a high level of greater than 2.8V by a resistor. The line normally sits at a high state and may be pulled down to a low state by any of the open-collector gates connected to it.

Electrical state	Logical state
high > 2.0V	0 = false
low < 0.8V	1 = true

Table 1.

For such buses the electrical high state is called a logical-zero or false state, and the electrical low state is called a logical-one or true state. In these circumstances the bus is said to operate with negative logic rather than the conventional positive logic where an electrical low state represents a logical-zero — see table 1.

The three lines used to control the flow of data are:

DAV, Data Valid; when true DAV indicates to the receivers that data is available on the eight data lines.

NRFD, Not Ready For Data; when true this line indicates that one or more lines are not ready to accept data.

NDAC, Not Data Accepted; when true this line indicates that one or more lines have not accepted data.

Listeners active

The timing diagram of a data transfer as an IEEE bus is given in figure 7. Suppose that the bus is initially quiet with no transmitter activity. Three active receivers are busy and consequently they have asserted NRFD, pulling it down to an electrical low condition, that is NRFD true. Not all receivers may be taking part in a conversation with the transmitter. The receiver must have been programmed as listeners are said to be active.

The diagram shows two dotted lines to the left of the rising edge of NRFD. The first dotted line represents one of the receivers becoming ready for data. This does not affect the state of the NRFD line as two other receivers are holding it down. When the third receiver de-asserts

(continued on page 112)

(continued from page 111)
NRFD the line rises to an electrically high state signifying that not ready for data is false, or the line is ready for data.

If a transmitter wishes to use the bus it samples the state of the NRFD line and, if it finds it false, puts its data on the data bus. After a delay of 2µs. to allow the data to settle, the transmitter asserts DAV by pulling it down to an electrical low state. As soon as the listeners see DAV asserted they assert NRFD by pulling it down, signifying that they are once more busy.

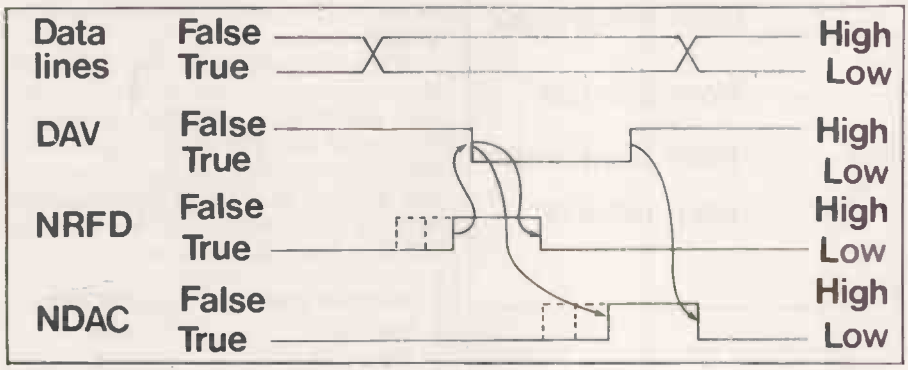


Figure 7.

Meanwhile the listeners are holding NDAC electrically low indicating that not data accepted is true. When a receiver sees DAV it reads the data from the bus and sets NDAC false. That is, if not data accepted is false then data accepted must be true.

Because all receivers must make their NDAC outputs false before the NDAC line may rise to an electrical high or false state, the transmitter does not know that data has been accepted until the slowest reader has acknowledged. The cycle is now completed by the transmitter releasing DAV followed by the receivers asserting NDAC.

Serial links

The three-wire handshake has been adopted for the IEEE bus and this bus has surfaced in at least one of the popular microprocessor systems so it seems that it will be around for some time. Several semiconductor manufacturers have produced chips to interface to this bus, either as part of a microprocessor chip set or as a stand-alone interface. However, the three-wire handshake is not necessarily the best approach to the transmission of data over a bus.

Any production to protocols for buses would be incomplete without a mention of the type of protocols used by serial buses where the transmission path or data link conveys information from transmitter to receiver a single bit at a time. In general an m-bit parallel data bus is at least m times faster than the equivalent data link — nobody uses the term bus when there is a single line. Consequently, designers choose a serial data link when economy is more important than speed.

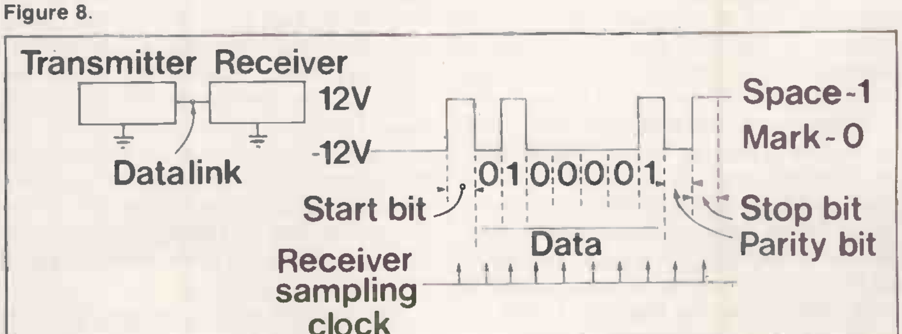
Data links may also be broadly classified into two types: asynchronous and synchronous. Asynchronous serial data links usually operate with the individual data bits formed into groups representing single characters or words. More often than not, the code chosen to represent the characters is the seven-bit ASCII code used by the majority of printers and VDUs.

The problem facing a serial data link is that data and control information may not be separated by having separate lines. The only alternative is to separate control and data by time. Figure 8 shows how this may be done.

When the line is inactive it sits at −12V representing a logical-zero or "mark" state. The popular RS-232 interface uses this convention: the older 20mA interface represents a logical-zero by a current of 20mA and a logical-one state by no current. When the transmitter wishes to transmit a seven-bit character it first raises the line to a +12V level, representing a logical-one or a space condition. This level is maintained for T seconds, where $1/T$ is the rate at which bits are transmitted.

When the receiver sees a zero-to-one transition on the line it waits $\frac{1}{2}T$ seconds and samples the line. If it sees a zero, it assumes that the transition was a false alarm and does nothing. If it still sees a logical-one it assumes that a character is about to be transmitted and triggers its local clock. This clock samples the state of the line every T′ seconds for the next 9T′ seconds. Note that T′ is not the same as T since the clock at the receiver is not synchronised with the clock at the transmitter, hence the term asynchronous transmission.

Figure 8.



The first period of T seconds is called the start bit and has the control function of telling the receiver that seven data bits are to follow immediately. These are transmitted with the least-significant bit first. In figure 8 the word is 1000010, which is 42hex and represents the ASCII character B. As long as the receiver samples each bit within its own time slot the seven data bits will be correctly assembled into the appropriate character.

The eighth bit is a parity bit chosen to make the total number of 1s in the eight bits even. Should an error occur during transmission with a 1 being turned into a 0 or vice versa, the received data will no longer have an even number of 1s, indicating an error. It is also possible to transmit words with an odd parity where the total number of 1s is odd.

Control characters

The last bit is a stop bit at the idle level which provides a breather between the current word and any following word. It is a hangover from the days when the transmitter and receiver were entirely electromechanical devices. In order to send additional control information down the line, special control characters have now been devised for this purpose, for example Carriage Return, Escape, Device Control 1, etc.

There are many possible arrangements of a synchronous serial-transmission system. Bits are sent down the line continually with no gaps between individual bits or between groups of bits. The receiver must separate the bits and group them into packages. Unlike the asynchronous format, data is not set in groups of seven bits representing a word but in much larger groups called packets or frames.

One method of extracting bit timing is to encode the data in the way illustrated in figure 9. Each of the bit periods is called a bit cell and has a duration T seconds. If a 1 is to be transmitted a low-to-high or positive transition is made at the centre of a bit cell. If a 0 is to be transmitted a high-to-low transition is made, guaranteeing that there is at least one transition per bit and the duration between consecutive transitions is either T or $\frac{1}{2}T$. It requires a relatively modest amount of circuitry to extract timing

(continued on page 114)

(continued from page 112)
information from this phase-encoded signal.

Once the bits have been separated the receiver's next task is to group them into packages or frames. As the transmitted data is pure binary data it is impossible to use special characters to control the flow of data. A clever solution to this problem relies on a technique called bit insertion or bit stuffing.

Suppose you decide to indicate the start and end of a frame of data by means of a special flag which has the unique value 01111110. Whenever the receiver sees these eight bits it knows it must be at the beginning or the end of a frame.

Now suppose that the transmitter monitors the data it is sending. If it sends the sequence 011111 it may be in for trouble. If the next bit is a 0 there is no problem, but if the next bit is a 1 followed by a 0 a flag pattern is generated.

When the transmitter sends the sequence 011111 it inserts a 0 after the fifth 1 so that 0111110X is transmitted. The X represents the bit that would have been sent after the five 1s. No matter what X is, a flag cannot now be formed. At the receiver flags are removed because they merely split the data stream into frames. If the sequence 011111 is received the next bit, which must be a zero, is stripped or deleted. A typical frame has the format shown in figure 10.

This packet of information begins with an address, allowing the transmitter to communicate with a number of different receivers over a common data link: only the receiver addressed by the transmitter responds. The control field is used to control the flow of information. It can contain a poll bit which when set causes the receiver to get in touch with the transmitter, software handshaking.

Included in the control field are sequence counts which number the frames flowing along the link; one number for data flowing in each direction. If any frames are lost in transit a receiver notices that the next frame is not in sequence and can therefore ask for a retransmission.

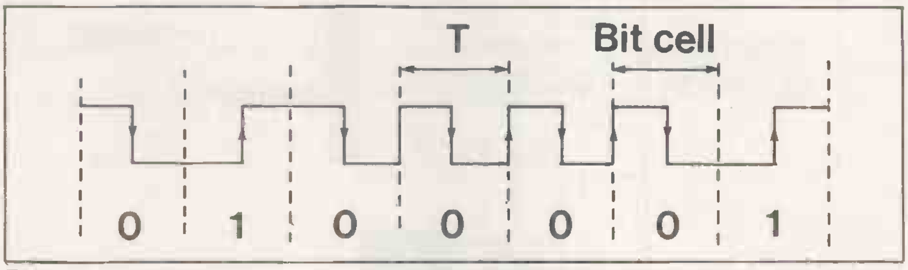


Figure 9.

Flag	Address	Control	Data	CRC	Flag

Figure 10.

Slow but sure

The data itself transmitted in the data field is in pure binary form. After the data comes a 16-bit cyclic redundancy code, CRC, obtained by dividing the preceding binary values by a polynomial and recording the remainder. At the receiver the same process is performed and if the locally generated CRC is different to the received CRC an error is assumed to have occurred. This method of error detection is very powerful.

A serial data link seems crude by comparison with the parallel data link with its special control lines, but the serial link may ultimately prove to be the most popular and enduring arrangement. While a serial link is slower, very high-speed transmission is normally required only within the CPU itself. Moreover, modern serial links such as Ethernet operate at up to 10,000,000 bits per second, and the use of fibre optic links could lead to a 10-fold improvement in performance.

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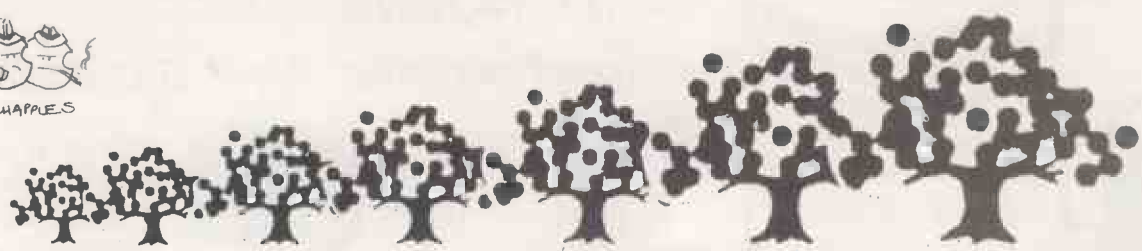

................and still growing!

● Circle No. 183

Martin Hayman examines the progress made in the field of automated medicine, and finds one system which has raised the rate of correct diagnosis to over 90 percent.

Medical diagnosis

ONE OF THE HUMAN tasks which the computer was predicted to take over, back in the days when computers were mysterious and their potential apparently limitless, was that of doctoring. The cybernetic future, as seen from the broad and speculative viewpoint of the mid-1950s, would include automated medicine.

Indeed, as recently as this year, Clive Sinclair has suggested in these pages that one of the most vital roles for the home — as opposed to professional — computer would be as a home medical diagnostic resource, to some extent replacing doctors themselves.

The idea of a machine which will support people, in sickness or in health, has clearly taken a powerful hold on the collective imagination, and is still, despite the demythologising effect of the microcomputer, current among today's enthusiasts. Almost half of the fiction manuscripts which arrive at *Practical Computing* bear directly or indirectly on the theme of the ultra-intelligent machine though, sad to report, the prognosis of the majority, is gloomy. Usually the UIM has learned its human-derived rules too well and is busy defeating its makers at their own game.

It would surprise the futurologists, or optimists, of the 1950s to discover how wide of the mark many of their predictions were, particularly with respect to computers in medicine. The author of the psychological quiz program Eliza must be astonished to the extent that a tongue-in-cheek program has ended up as a standard, a rallying-point for the proponents of automation in medicine. Anyone who has ever used it would realise immediately that such a simulation of intelligence, no matter how extensive, would be untrustworthy if relied on as the sole means of deducing a patient's mental health. After all, that falls under human relations, does it not?

Professional paranoia

Much work has been done on diagnostic computing but surprisingly little has been achieved. This is not mere professional paranoia — one can imagine all sorts of frights the patient as well as the doctor might take when confronted with automated medicine.

But what does impede practical progress is the inability of most medical practitioners — clinicians, to use the precise term — to concert their minds in such a way as to make their methodology comprehensible to the computer. And frankly, they jolly well do not see why they should devote a great deal of time and energy translating serviceable human methods of working into computer methods.

Put this way, the case seems unanswerable. But there is no cause for complacency about the soundness of clinicians' existing methods — as Dr Tim de Dombal soon discovered when he started researching diagnostic decision-making. De Dombal found that many doctors, especially junior doctors, were not very good at collecting information from patients: "They ask a large number of irrelevant questions; they fail to ask questions that are relevant; they fail to record the data in a way that is easy to follow; they ignore obvious clues in the information available; or they obtain masses of relatively useless biochemical data, using less than five percent of it."

Information theory

De Dombal has not been alone in working towards some kind of application of what he describes as "information theory" which would help the clinician to be more rigorous and more effective. Several groups in the United States, as well as at the Royal College of Physicians in London, were working in the late 1960s and early 1970s to formulate useful applications of information science to medicine.

Given the observable haphazardness of the decision-making process among doctors, it may seem surprising that so many patients admitted to hospital do get well. Strip away the veneer of mystique which overlays any profession and you will find cock-ups comparable to those which you know happen every day in your own.

From the early days of his study at the Department of Surgery in Leeds Hospital, De Dombal cites evidence of doctors' all-too-human fallibility: "To our surprise, no universally accepted definition of an 'acute abdomen' exists, although when interviewed, a group of 19 surgeons all claimed to know what the term meant. The same depressing picture emerged when individual symptoms were considered: regarding the term dyspepsia, we found 20 different definitions in the literature, all different and some mutually incompatible. Data concerning the spectrum of diseases that present as 'acute abdominal pain' were fragmentary, data on the geographic stability of diseases and symptom patterns were non-existent, and clinicians' estimates of these values were often astonishingly vague."

To someone with a bad bellyache, who is wondering about whether to go to hospital, this news must seem about as cheery as the offer of a prussic acid pill. Better to call the witch-doctor in to wave a few magic sticks over you.

The results of this sort of imprecision are bad. De Dombal reports that in his own speciality, abdomens, there was a huge variation in diagnosis of the single most common cause of acute pain requiring hospital admission — appendicitis. Some places had a rate of 30 to 40 percent of patients whose appendix burst before removal; in others, up to 80 percent had a perfectly healthy appendix removed. The former is obviously dangerous, while the latter wasteful and expensive. There was clearly a role here for applying information science — whether or not one went on to use information technology.

The first move towards improving decision making was to sharpen definitions in such a way as to make signs and symptoms clear-cut — so that they would be accepted, if necessary, as data by a computer. De Dombal observes that "whatever one feels about the use of computers in medicine per se, the clarification of terminology and thought which computer use forces upon the surgeon is beneficial.

De Dombal started from the realistic viewpoint that doctors probably would not want anything to do with computers. Like many other professionals who might benefit in their decision-making from better organisation of thought required by computing: "Clinicians are unwilling and ineffective users of computer terminals," he says.

Symptom database

What he did was to devise a standard set of terms describing abdominal pain on a pre-formatted sheet. The clinician examining a patient runs through this list, which is then handed on to a member of the computing team. The program, which is brief to the point of terseness, is based on the assignation of prior probability of any particular symptom, or combination of symptoms, according to a database of 600 cases whose data has already been analysed according to a mathematical model known as Bayes' theorem. Symptoms are compared point by point to arrive at a posterior probability which, in the latest version, is read out, as a bar chart.

This brief account elides a great deal of hard work and a number of different implementations. The first system in 1971-72 was run on 1K of a Wang 700C. It is now available for use on a Wang 2200, Apple or Pet, though the simplicity and brevity of the program makes it

(continued on page 120)

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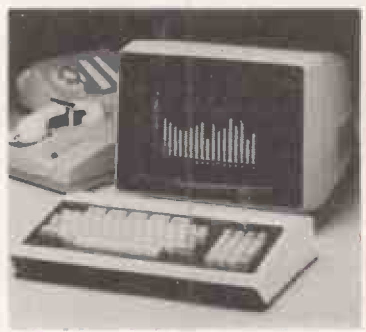

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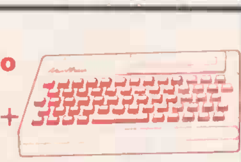

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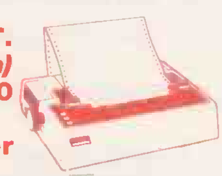

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(continued from page 117)
easily adaptable for use on almost any small micro, including possibly hand-held.

It would seem, incidentally, to be ideal for use with Sinclair's new Spectrum which has the required 32K for the current implementation and would quickly load the further 154K of overlays for rare conditions from its Microdrives. Additionally the small size, light weight and easy-clean properties of the Sinclair would seem to make it ideal for hospital use — not to mention, of course, the low cost.

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DATA from        : house surgeon

Patient's Reg.No : 123456
Date             : 29/06/82  at 1510 hrs.

SYMPTOMS

    MALE
    AGE20-29
    PAIN ONSET LT LOIN
    PAIN NOW LT HF
    PAIN NOW L LOIN
    OTHER AGGRAV
    NO REL FACTORS
    GETTING WORSE
    PAIN <12 HRS
    STEADY  AT FIRST
    STEADY NOW
    SEVERE
    NAUSEA
    NO VOMITING
    APPETITE OK
    NO PREV INDIGESTION
    NO JAUNDICE
    BOWELS NORMAL
    DYSURIA
    PREV SIMILAR PAIN
    NO PREV ABD SURGERY
    NOT TAKING DRUGS

EXAMINATION
```

```
CLINICIANS PREDICTION     :  APPX-DELIB ERROR
INVESTIGATIONS            :  URINE ANALYSIS
                             PLAIN X RAY
INITIAL PLAN - <A&E>      :  INVESTIGATION/REVIEW

COMPUTER PREDICTION

                         0%                  100%
     APPENDICITIS        |
     DIVERTICULAR DIS    |
     PERFORATED ULCER    |
     NON-SPECIFIC PAIN   |
     CHOLECYSTITIS       |
     BOWEL OBSTRUCTION   |
     PANCREATITIS        |
     RENAL COLIC         |
     DYSPEPSIA           |
```

In a practical experiment, the system was given the symptoms of an acute abdominal condition which is moderately common and whose symptoms, having suffered from them myself, I was easily able to describe. First I was questioned about the symptoms I was suffering on the basis of the pre-formatted questionnaire. Once completed, the data from the form we keyed into the Pet — obviously, no examination took place, which is why that entry is blank. The Pet then displays the top four lines of the second printout. This requires input by the clinician.

One of the fundamental principles of the programs construction — as its title makes clear — is that the system is in no way to be used as a substitute for diagnosis. It is merely a diagnostic aid. In order to arrive at the computer's analysis, the clinician is obliged to fill in both his own prediction, the investigations he proposes to make, and his proposed plan of action. Only then will the computer divulge its analysis. This is absolutely vital — not only in order to assure responsible working practice, but also to put on record the fact that the human diagnosis is the final one.

Error of judgement

As may be seen, the clinician's prediction — a deliberate error — was that the symptoms I described amounted to a case of appendicitis. But the computer correctly assigns an almost 100 percent probability to renal colic. The computer — unlike the junior houseman who finally admitted me, having written "suspected pethedine addict" on my notes is not prejudiced by any notions derived from the novels of Mr William Burroughs.

De Dombal is insistent that his system be used only as a diagnostic aid and feels that a great deal of harm was done in the 1950s by computer people who predicted that the doctor was on the way out. Their stated objective, he remembers, was "to get the computer and the patient together and hook the doctor in there somewhere", by creating a rule-based system capable of general diagnosis.

De Dombal feels this is an astonishing misunderstanding both of the role of doctors and the use of computers. Why did he start on this hard road, back in 1969? "I guess like everyone else I had the impression that computers would save me time and effort. And of course they did not."

In fact, the tendency of the work De Dombal has been doing for the past six years is to do away with the computer altogether. The useful work was that of preparing to use the computer, in the sense of reducing the terminology to a repeatable and reliable system which will be rapidly comprehensible. That work is now being made available to many doctors worldwide who are members of the

(continued on page 122)

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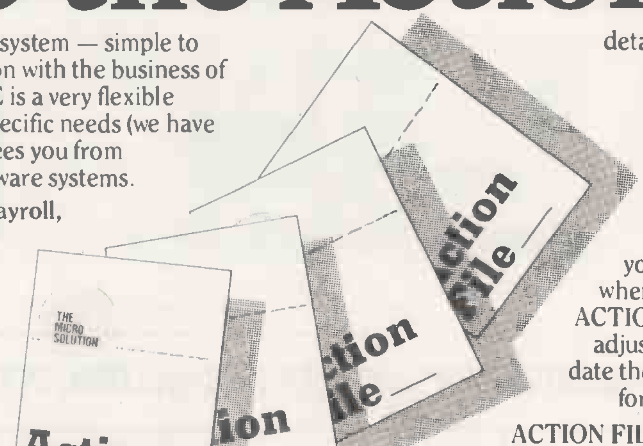

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(continued from page 120)
World Institute of Gastroenterology. Some are using the computer system as well as benefiting from the reorganisation of sympton description. Versions of the program are currently at work in various languages: French, Flemish, Dutch, Danish, Spanish, Norwegian and Thai.

"We have spent the last six years using computers to provide doctors with a consensus of world opinion which is instantly available about any one category people would put patients in. Now we have that off the computer. The computer has been used, and in a sense it has been thrown away, because it has been reduced to a simple scoring system.

"There is a difference between a computer doing diagnosis, and its having stacked into it experience from a lot of centres around the world. All our collaborators feed their experience into a centre where it's packaged and put into a computer and is then made available to a guy in the middle of the night. That doctor then makes his own decision — but he looks at the computer in the same way as an X-ray or a blood test or whatever. If one makes that aid available to him, then one would hope that his diagnostic rate would improve."

What this means in hard terms is that the doctor is going to be right more often with the computer aid than without. In his initial series of tests, back in 1971, De Dombal found that with its aid, the rate of correct diagnosis moved from 42 percent to 91 percent — more accurate even than the most senior clinicians, whose accuracy is stated to be 81 percent. A further trial showed that when the diagnostic tool was withdrawn, the diagnostic accuracy of clinicians declined.

Computerised hospitals

The long haul is beginning to pay off for De Dombal. His system is shortly to be installed in 10 hospitals in Britain, supported partly by the National Health Service but mostly by the enthusiasm of other doctors who have heard of it and want to participate. The area of application is still acute abdomen, though work has been done in other medical areas, using the same computer methodology. At Leeds there are programs in gastroenterital bleeding, acute chest pain, gastric dyspepsia and gynaecology.

De Dombal is a full-time clinician running a department himself so there are limits to what he can take on: "We have just about run out of areas to cover — not because we cannot think of anything else but because within the confines of this small group we have four areas to cover and that is a full-time job. But other people are looking at head injury, jaundice, back pain and rheumatology, so it looks as though there are other areas which are amenable to this approach.

"By and large this sort of methodolgy is useful where there is a well-defined end point. You know you are right if you take out an appendix and it is black and within 12 hours the patient gets better. That is not a matter of semantics; you know objectively you were right." He says there are four criteria in determining whether the methodology he has adopted will be useful. Firstly, the endpoint must arrive quickly — you must be able to tell, soon, whether the decision was right.

"Secondly, you must know whether you are right or wrong on objective grounds — as in the removal of an obviously infected appendix. Thirdly, that there be a relatively small number of common diseases. Bayesian analysis becomes unwieldy when there are more than about a dozen common causes among which the computer must decide. Fourthly, the diagnosis must be difficult — there is clearly no point in the computer undertaking something which human beings already do superbly well.

"Every mistake which the junior doctor might make which is corrected by the computer is one that I have made myself. I hope that I have learned from my mistakes, but it has taken me 10 years. It is all very well to say that you should learn from your mistakes but it is really a very extravagant way of learning, because each new patient does not regard himself as a new teaching module."


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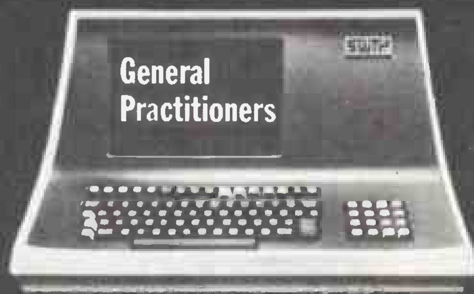

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Maze movement

Have you ever wondered how dictionary programs operate so quickly with vocabularies of tens of thousands of words stored on discs, a relatively slow medium? Graham Relf explains.

A SIMPLE TECHNIQUE was described in March's *Practical Computing*, for generating vast game structures, such as mazes, in computers with limited memory capacity. However, the technique has a draw-back when playing games in which objects have to be moved around, because the objects generated as part of the structure are fixed within it. The earlier article suggested that this drawback could be overcome and here is a method of moving the objects around.

The method makes use of hash coding, a technique which provides a means of speedily storing and retrieving entries in a large table of data or in records held in a disc file. A portion of the data to be stored, known as a key, is used to determine the address at which the data will be stored rather than storing it sequentially.

Hashing keys

As an example of a key consider a file whose records each contain a name and address. A suitable key for hashing might be formed from the first four letters of the name together with the first four letters of the town in the postal address.

When a program attempts to recall particular data, having been given a key, it computes from the key the address at which the data should be stored. It then examines that to determine whether data is in fact present instead of having to search the entire table or file.

In games programs, whenever an object is removed from any location it is recorded by its co-ordinates x, y and z, and then moved by a code number or letters. Additional information known as the status of the object and data for objects which have been deposited at locations away from where they were originally generated is also recorded. The status of Removed and Deposited is denoted by the values −1 and +1 respectively. Each record is therefore an entry in a table with the headings: Location Co-ordinates x, y and z; Object Code; Object Status.

Time consuming

The simplest way to build up this table would be to put entries into it sequentially from the start, maintaining a count of the number of entries so far. Major disadvantages occur in this scheme whenever the player moves to a new location. The whole table up to the count value has to be checked to see whether any objects have been removed from this location or dropped here. As the game proceeds and more and more objects are displaced this checking grows more time-consuming and the game soon becomes tedious.

Instead a method is needed of putting entries into the table so that the time taken to find all entries for a given location is short and also independent of both the location and the total number of

(continued on page 129)

Listing 1. Initiate table of displaced objects.

Pseudo-code:

```
L = length of table less one
Dimension  x column (L), y column (L), z column (L),
     code column (L), status column (L), pointer column (L)
For row no = 0 to L
     code column (row no) = -1        (entry is free)
     pointer column (row no) = -2     (& not in chain)
next row no
```

Basic:

```
100  L = 99
110  DIM OX(L), OY(L), OZ(L), OC(L), OS(L), OP(L)
120  FOR R = 0 TO L
130  OC(R) = -1   :  OP(R) = -2
140  NEXT R
```

Listing 2. Subroutine: Find given object at given location.

```
Inputs:  Object code, X, Y, Z, W, L, table.
Outputs: Entry row no ( = -1 if not found),
         previous row no in chain ( = -1 if none).
```

Pseudo-code:

```
Row no = W * L
Previous row no in chain = -1
Entry row no = -1
Loop indefinitely          (to follow hash chain)
     If  code column (row no) = object code
     and x column (row no) = X
     and y column (row no) = Y
     and z column (row no) = Z
     then
         Entry row no = row no
         Return             (object found)
     end if
     If  pointer column (row no) >= 0
     then
         Previous row no in chain = row no
         Row no = pointer column (row no)
     else
         Return             (end of chain, not found)
     end if
end loop
```

Basic:

```
5200  R = W * L  :  PR = -1  :  ER = -1
5210  IF  OC(R)=CD  AND  OX(R)=X  AND  OY(R)=Y  AND  OZ(R)=Z
      THEN  ER = R  :  RETURN
5220  IF  OP(R) >= 0  THEN PR = R : R = OP(R) : GO TO 5210
5230  RETURN
```

Listing 3. Subroutine: Find all objects at given location.

```
Inputs:  X, Y, Z, W, L, table.
Outputs: Dependent on actions taken at *.
```

Pseudo-code:

```
Row no = W * L
Loop indefinitely          (to follow hash chain)
     If  code column (row no) <> -1
     and x column (row no) = X
     and y column (row no) = Y
     and z column (row no) = Z
     then
         * (Act on object found)
     end if
     If  pointer column (row no) < 0
```

(listing continued on page 129)

(continued from page 127)

displaced objects. These ideals are approached by the hash coding method.

In order to work efficiently the hash-coded addresses of entries in the table must be distributed randomly across the table but must be repeatable for any given location. This property is reminiscent of the very function used in generating the game structure itself. Indeed the generating function W can, with a simple modification, be used as the hashing function. As W has to be computed for the location when the player arrives there, very little extra computation is needed to get the hash-coded address in the table for that location. W is obtained with the subroutine.

```
9000 U = 100 * SQR ( X * X + Y * Y * Z)
9010 W = U - INT (U)
9020 RETURN
```

which always returns a floating-point value in the range

$$0 <= W < 1$$

An extension of this range to span the table is now required, that is to map on to the range from 0 to L where L is the length of the table less one, or the maximum number of entries it could hold less one. This mapping is achieved simply by multiplying W by L: the hash-coded address in the table for a given location is just

$$H = W * L.$$

Avoid collision

The remaining question is whether two different locations can produce the same value for H. In general, unfortunately, they can and do. The phenomenon in which two or more keys produce the same hash code is termed a "collision", and most of the programming involved in hashing is concerned with handling collisions. There are several approaches in use for handling them but only one is described here.

The first entry in the table can be stored without fear of a collision at the hash-coded address, its home address. If another entry has the same code it obviously cannot be put in the same place. However, the entry which is there already must be marked in some way to show that there is at least one other entry for this address. A way of doing that is to put another column in the table, headed "pointer to next entry in chain", and to set up chains of entries from each home address. The new entry which has collided is tabulated in the next free, or empty, row following the collision point and the earlier entry points to this new address, thus extending a chain.

The end of a chain will have a pointer value which cannot be an address in the table; −1 will do. Figure 1 shows a hash chain of three entries in a table which so far has five entries labelled A to E, inserted in alphabetical order. The chain

(continued on next page)

(listing continued from page 127)

```
        then
            Return            (end of chain)
        end if
        Row no = pointer column (row no)
    end loop
```

Basic:

```
4100  R = W * L
4110  IF  OC(R)=-1  OR  OX(R)<>X  OR  OY(R)<>Y  OR  OZ(R)<>Z
      THEN 4170
4120  )  Statements to act on object found (e.g. report it)
....  }
4170  IF  OP(R) >= 0  THEN  R = OP(R)  :  GO TO 4110
4180  RETURN
```

Listing 4. Subroutine: Add object to table.

```
    Inputs:  Object code, object status, X, Y, Z, W, L, table.
    Outputs: Entry row no ( = -1 if not possible to add object),
             previous row no in chain ( = -1 if none), table.

NB: There are four possibilities:
    (1) The home location is free, so add there (giving previous
        row no = -1).
    (2) There is a free entry later in the chain, so add there.
    (3) There is a free entry elsewhere in the table, so use that
        and extend the chain (staying close to home if possible).
    (4) There is no room in the table (gives entry row no = -1).
```

Pseudo-code:

```
    Row no = W * L
    Entry row no = -1
    Previous row no in chain = -1
    Row no before home = row no - 1
    Row no after home = row no + 1
Loop:
    If  code column (row no) = -1
    then
        If  pointer column (row no) = -2
        then                  (case (1) or (2) )
            Pointer column (row no) = -1
        end if
        Go to  Put object
    end if
    If  pointer column (row no) <> -1
    then
        Previous row no in chain = row no
        Row no = pointer column (row no)
Go to  Loop
    end if
    End of chain = row no
    If row no < L
    then
        For row no = row no after home  to  L
            If  code column (row no) = -1
            and pointer column (row no) = -2
                          (i.e. not in another chain)
            then
                Go to  Extend chain
            end if
        next row no
    end if
    If  row no before home >= 0
    then
        For row no = 0  to  row no before home
            If  code column (row no) = -1
            and pointer column (row no) = -2
            then
                Go to  Extend chain
            end if
        next row no
    end if
    Print  'Table full'
    Return                    (object not added)
Extend chain:
    Previous row no in chain = end of chain
    Pointer column (end of chain) = row no
    Pointer column (row no) = -1
Put object:
    Code column (row no) = object code
    Status column (row no) = object status
```

(listing continued on next page)

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links entries A, C and E which all have the same hash code, that is the same home address.

A new entry may collide with any previous entry, not just with those which are at their home addresses. In such a case again simply put the new entry on the end of the chain and make the former end-of-chain entry point to it.

Empty entries

However, this second type of collision makes it necessary to exercise caution if deleting entries from the table, because the chain must always be preserved through a deleted entry unless it is at the end of a chain. It makes it necessary to distinguish between free, or empty, entries which are not on any chain and those which are free and therefore available for reuse but are nevertheless still part of a chain. In order to make such distinctions the following conventional values will be used for certain fields in an entry.

Object code = −1 means the entry is free for reuse.

Pointer = −1 means the entry is the last of a chain.

Pointer = −2 means the entry is not in any chain.

To determine whether there is an entry in the table for a given location x,y,z, it is necessary to check all entries on the chain which starts at the home address in the table for that location. Provided that the hashing function is sufficiently random to produce a good spread of codes across the table, so that collisions are minimised, this checking is much faster than scanning the whole table.

Listing 1 is a routine to set up the table of displaced objects in the initialising section of a main program. The other four listings show subroutines to manipulate the table for game purposes.

Pseudo-code

Each listing is presented in two versions. The first version of each is written in a general pseudo-code to show the detailed working of the routine and to permit adaptation to any programming system. The second version is a translation of the pseudo-code into Tandy Level II Basic to show how compact the programming can be. Some structure has been sacrificed from the pseudo-code and some conciseness from the Basic so that the relationship between the two versions of each routine may be seen more clearly.

The Basic versions have been used in an extended version of the Mammoth Maze program published in March's *Practical Computing*, running on a 16K Level II TRS-80. The method works quite effectively in such a system. The full program includes other extensions such as perspective-graphical views of locations and objects and the generation of names for the locations, all still within 10K of Basic.

	Address	Location X Y Z	Object code	Object status	Pointer to next entry in chain	Entry
	1					
Home address for	2					
entries A, C, E →	3	3 0 2	3	−1	4	A
	4	6 7 8	7	−1	6	C
Home address →	5	6 7 9	3	1	−1	B
for entry B	6	4 3 6	4	−1	−1	E
	7					
Home address →	8	4 9 8	4	1	−1	D
for entry D	9					
	*					
	*					
	*					

Figure 1. A hash chain in a table of displaced objects.

(listing continued from previous page)

```
    X column (row no) = X
    Y column (row no) = Y
    Z column (row no) = Z
    Entry row no = row no
    Return                      (object successfully added)
```

Basic:

```
5000 R = W * L : ER = -1 : PR = -1 : BH = R - 1 : AH = R + 1
5010 IF OC(R) >= 0 THEN 5040
5020 IF OP(R) = -2 THEN OP(R) = -1
5030 OC(R)=CD : OS(R)=ST : OX(R)=X : OY(R)=Y : OZ(R)=Z : ER=R :
     RETURN
5040 IF OP(R) >= 0 THEN PR=R : R=OP(R) : GO TO 5010
5050 EC=R
5060 IF  R >= L THEN 5100
5070 FOR  R = AH TO L
5080 IF OC(R) = -1 AND OP(R) = -2 THEN 5150
5090 NEXT R
5100 IF  BH < 0 THEN 5140
5110 FOR  R = 0 TO BH
5120 IF OC(R) = -1 AND OP(R) = -2 THEN 5150
5130 NEXT R
5140 PRINT 'TABLE FULL' : RETURN
5150 OP(EC) = R : OP(R) = -1 : PR = EC : GO TO 5030
```

Listing 5. Subroutine: Delete object from

Used if an object is deposited at a location (X, Y, Z) from which an identical object has been removed earlier. Depends on the subroutine 'Find object' (Listing 2) having been called first to get the required input parameters.

```
    Inputs:  Entry row no, previous row no in chain, table.
    Outputs: Table.

NB: There are four possibilities:
    (1) Entry is in home position with no chain (previous row no
        = -1, pointer column (entry row no) = -1).
    (2) Entry is in home position and there is a chain (previous
        row no = -1, pointer column (entry row no) >= 0 ).
    (3) Entry is not in home position but is at end of chain
        (previous row no >= 0, pointer column (entry row no) = -1).
    (4) Entry is not at home position nor at end of chain (previous
        row no >= 0, pointer column (entry row no ) >= 0 ).
```

Pseudo-code:

```
    If  previous row no in chain = -1
    then                        ( case (1) or (2) )
        If  pointer column (entry row no) = -1
        then                    ( case (1) only : chain link
                                  must remain in case (2) )
            Pointer column (entry row no) = -2
        end if
    else                        ( case (3) or (4) )
        If  pointer column (entry row no) = -1
        then                    (case (3) only)
            Pointer column (previous row no in chain) = -1
            Pointer column (entry row no) = -2
        end if
    end if
    Code column (entry row no) = -1     (entry now free)
    Return
```

Basic:

```
5300 IF PR >= 0 THEN 5330
5310 IF OP(R) = -1 THEN OP(R) = -2
5320 OC(R) = -1 : RETURN
5330 IF OP(R) = -1 THEN OP(PR) = -1 : OP(R) = -2
5340 OC(R) = -1 : RETURN
```

Open File

This regular section of *Practical Computing* appears in the magazine each month, incorporating Tandy Forum, Apple Pie, ZX-80/81 Line-up and the other software interchange pages.

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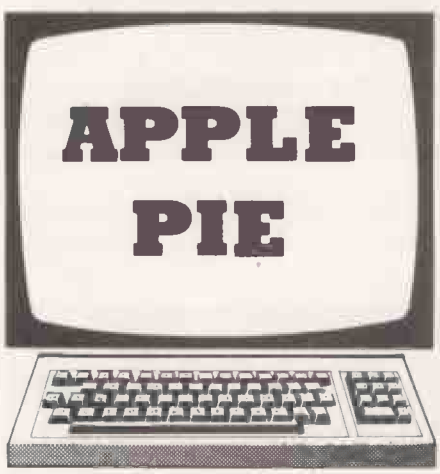
Programs should be accompanied by documentation which explains to other readers what your program does and, if possible, how it does it. It helps if documentation is typed or printed with double-line spacing — cramped or handwritten material is liable to delay and error.

Program listings should, if at all possible, be printed out. Use a new ribbon in your printer, please, so that we can print directly from a photograph of the listing and avoid typesetting errors. If all you can provide is a typed or handwritten listing, please make it clear and unambiguous; graphics characters, in particular, should be explained.

We can accept material for the Pet, Vic and Sharp MZ-80K on cassette, and material for the larger machines can be sent on IBM-format 8in. floppy discs.



Text editor-formatter

WHILE WRITING several programs in Applesoft Basic which involved coding text to appear nicely formatted on the screen. I found it awkward to keep counting the number of characters so that words didn't wrap round the screen, writes M J Parrott of Stockport, Cheshire. It occurred to me that a simple text-editing program which could take in text willy-hilly and then convert it to lines of Basic, correctly formatted for the screen, would be a most useful utility. I envisaged the utility constructing the Basic at an arbitrary starting line number, since Renumber could be used for merging it into the host program at the appropriate point.

The utility written to perform this task resides at $4000 to $4188 inclusive and is in two main parts, the first dealing with the intake of text.

A buffer is created by zeroing all bytes from $5000 to $8000 plus one page, to make sure that there will be zero bytes at the end of the text since this is how the second part of the program detects the end of the text. A character is then got from the keyboard and checked. If it is not a control character and is printable on the screen it is put into the buffer and printed on the screen. A double quote is replaced by a single quote, which is what will appear on the screen.

If the character is not a printable one it is checked to see if it is one of the two allowable control characters. If it is neither of these, the program loops back for another character. The two allowable characters are Ctrl-L, which forces a line feed, and Ctrl-E, which allows you to quit the inputting part of the program. Return is not allowed.

To use the text inputting part of the program you type in the text without worrying about line breaks — just let words wrap round the screen. If you have input enough text to fill the buffer a bell

(continued on page 135)

(continued from page 133)

sounds and the second part of the program will begin. The message Now Coding then appears briefly on the screen.

The input part of the program allows you to correct mistakes by using the Backspace key. Just go back to the error and change it. The Esc mode will work so that you can move to another part of the screen, but you cannot correct text by going to it with this mode. You must use the Backspace key.

On entering the second part of the program various pointers and flags are initialised before the coding itself begins. A pointer, Buf, is kept to the present position in the buffer, and the first character pointed to is checked to see if it is zero. If it is, the program begins the work of finishing up. If it is not zero, the program looks 40 characters ahead of the pointer in the buffer and then searches backwards looking for a blank — ASCII A0, msb high — or a Carriage Return — ASCII 8D, msb high.

When one of these is found a note is made of the position relative to the buffer pointer and a note is made of the total number of characters so far put into the Basic line. If it is more than 240 a move is made to finish that line of Basic and begin afresh. All the characters backwards from the blank or line-feed characters to the value held by Buf are transferred to lower down in memory where the Basic program is being constructed, at $801 upwards. While being transferred, the most-significant bit of each character is set low since this is how Applesoft stores its lines of text. The text in the Basic area of memory is moved by keeping a pointer to it, Bas, which corresponds to the pointer Buf.

The byte down in the Basic memory area corresponding to that first found blank or CR character is filled with a line feed value $D. The buffer and Basic pointers are then updated, and a JMP is made back to look at the first character to see if it is zero.

While bytes are being transferred from the buffer down to the Basic area of memory they are checked to see if any correspond to line-feed characters. If so, the rest of the bytes between there and the pointer are moved down, but the pointers Buf and Bas are then updated to this point rather than to the full number of characters on.

A line of Basic is completed by putting in a quote, ASCII $22, followed by a zero byte and updating the Basic pointer to the next position. The first few bytes of the line are then put in using a pointer Link. Working backwards from just before the beginning of the text a quote is inserted, then the token for Print, $BA, the line number, and finally the link address for the next line. These are obtained from the value of Bas.

The value held in Link is updated, and Bas itself is updated so that the next six bytes will be skipped. These are the bytes required at the start of the next line. A flag is then inspected to see if the end of text has been reached; if not, then the current line number held in Lin is increased by five and a JMP is made back to the start of text searching.

If the end of the text is signified, zero bytes are stored in what would have been the position of the next link address, and the end of Basic program pointers $AF and $B0 are set to just past the point. Two bytes from the top of the stack are discarded, since the final routine called does not return, the screen is cleared, and the Basic program now in memory is Run. From this point on you can do what you like with the newly constructed program: add lines to it, delete lines from it, or Save it to disc for use by Renumber.

The Basic program so constructed can have more lines of screen text than can fit on the screen. Lines such as

```
20 PRINT "PRESS SPACE BAR TO
  CONTINUE":GET T$
```

are not incorporated by the program since their format, and whether or not they will be in a subroutine, depends on several factors.

(continued on next page)

Text editor-formatter.

```
SOURCE FILE: FIRST ONE
----- NEXT OBJECT FILE NAME IS FIRST ONE.OBJO
4000:                 ORG  $4000
FC58:            CLS  EQU  $FC58
FD35:            GET  EQU  $FD35
FDED:            PRT  EQU  $FDED
FBE4:            BEL  EQU  $FBE4
FC10:            BACK EQU  $FC10
D566:            RUN  EQU  $D566
D998:            ADDON EQU $D998
0000:            BUF  EQU  $00
0002:            LIN  EQU  $02
0004:            LINK EQU  $04
00B8:            BAS  EQU  $B8
                 ********************
4000:            *
4000:            * THE FIRST ONE
4000:            *
                 ********************
4000:4C 0D 40         JMP  ORIG
4003:C7 CE C9    TEXT ASC  "GNIDOC   WON"
4006:C4 CF C3
4009:A0 D7 CF
400C:CE
400D:D8          ORIG CLD
400E:A2 80            LDX  #$80
4010:A9 50            LDA  #$50       ;BUFFER POINTERS
4012:85 01            STA  BUF+1      ;HELD IN ZERO PAGE
4014:A9 00            LDA  #$00       ;$0 & $1
4016:85 00            STA  BUF
4018:A8               TAY
4019:91 00       LOOP STA  (BUF),Y    ;ZERO THE
401B:88               DEY             ;BUFFER PLUS
401C:D0 FB            BNE  LOOP       ;ONE PAGE
401E:E6 01            INC  BUF+1
4020:E4 01            CPX  BUF+1      ;OF BUFFER
4022:B0 F5            BCS  LOOP
4024:20 58 FC         JSR  CLS        ;HOME
4027:A9 50            LDA  #$50       ;RESET BUFFER
4029:85 01            STA  BUF+1      ;POINTERS
402B:20 35 FD    BEGIN JSR GET        ;GET A CHAR.
402E:C9 9F            CMP  #$9F       ;START OF PRINTABLE
4030:90 26            BCC  CTR        ;CHARACTERS - 1
4032:C9 A2            CMP  #$A2       ;QUOTE?
4034:F0 02            BEQ  QUOTE      ;YES!
4036:D0 02            BNE  STP        ;NO!
4038:A9 A7       QUOTE LDA #$A7
403A:A0 00       STP  LDY  #$0
403C:91 00            STA  (BUF),Y    ;PUT IN BUFFER
403E:20 ED FD         JSR  PRT        ;PRINT IT
4041:E6 00            INC  BUF        ;UPDATE BUFFER POINTER
4043:D0 E6            BNE  BEGIN
4045:E6 01            INC  BUF+1
4047:E4 01            CPX  BUF+1      ;AT END OF
4049:F0 02            BEQ  BELL
404B:B0 DE            BCS  BEGIN      ;BUFFER?
404D:20 E4 FB    BELL JSR  BEL
4050:20 E4 FB         JSR  BEL
4053:20 E4 FB         JSR  BEL
4056:B0 2D            BCS  END1       ;EXIT EDITOR
4058:C9 88       CTR  CMP  #$88       ;BACKSPACE?
405A:D0 16            BNE  CTR1
405C:38               SEC
405D:A5 00            LDA  BUF        ;DEC BUF BY 1
405F:E9 01            SBC  #$01
4061:85 00            STA  BUF
4063:B0 02            BCS  CONT
4065:C6 01            DEC  BUF+1
4067:A9 00       CONT LDA  #$00       ;ZERO BUFFER
4069:A8               TAY
406A:91 00            STA  (BUF),Y
406C:20 10 FC         JSR  BACK
406F:4C 2B 40         JMP  BEGIN
4072:C9 8C       CTR1 CMP  #$8C       ;ASCII CTRL-L
4074:D0 05            BNE  CTR2
4076:A9 8D            LDA  #$8D       ;CAR RETURN
4078:4C 3A 40         JMP  STP        ;GO & STORE IT
407B:C9 85       CTR2 CMP  #$85       ;CTRL-E
407D:D0 AC            BNE  BEGIN
407F:A9 A0            LDA  #$A0       ;A BLANK
4081:A0 00            LDY  #$00
4083:91 00            STA  (BUF),Y    ;SO LAST CHAR BLANK
4085:20 58 FC    END1 JSR  CLS
4088:A2 09            LDX  #$9
408A:BD 03 40    NOTE LDA  TEXT,X
408D:20 ED FD         JSR  PRT
4090:CA               DEX
```

(continued from previous page)

```
4091:10 F7            BPL  NOTE
4093:20 E4 FB         JSR  BEL
                 ********************
4096:            *  SET POINTERS ETC
                 ********************
4096:A9 08            LDA  #$08
4098:85 B9            STA  BAS+1
409A:85 05            STA  LINK+1
409C:85 02            STA  LIN
409E:85 68            STA  $68         ;START OF PROG
40A0:A9 50            LDA  #$50
40A2:85 01            STA  BUF+1
40A4:A9 00            LDA  #$00
40A6:85 00            STA  BUF
40A8:8D 04 40         STA  TEXT+1      ;INIT CHAR COUNTER
40AB:8D 05 40         STA  TEXT+2      ;SET FLAG FOR NO END
40AE:85 03            STA  LIN+1
40B0:A9 07            LDA  #$07        ;START OF BASIC TEXT
40B2:85 B8            STA  BAS
40B4:A9 01            LDA  #$01
40B6:85 04            STA  LINK
40B8:85 67            STA  $67         ;START OF PROG
40BA:A9 00       START1 LDA  #$00
40BC:A8               TAY               ;IS 1ST CHAR 0?
40BD:D1 00            CMP  (BUF),Y
40BF:F0 25            BEQ  END2
40C1:A0 27            LDY  #$27        ;IE FOR 40 CHARS
40C3:B1 00       SEARCH LDA  (BUF),Y
40C5:C9 A0            CMP  #$A0        ;LOOK FOR BLANK
40C7:F0 09            BEQ  CONT2       ;OR
40C9:C9 8D            CMP  #$8D        ;LOOK FOR CR
40CB:F0 05            BEQ  CONT2
40CD:88               DEY
40CE:10 F3            BPL  SEARCH
40D0:A0 27            LDY  #$27        ;NOT FOUND
40D2:8C 03 40    CONT2  STY  TEXT        ;STORE Y
40D5:18               CLC
40D6:98               TYA
40D7:6D 04 40         ADC  TEXT+1      ;ADD IN CHAR COUNTER
40DA:B0 04            BCS  ENDIT       ;MORE THAN 255 CHARS?
40DC:C9 F0            CMP  #$F0        ;LESS THAN 240?
40DE:90 0E            BCC  CONT3       ;IF SO, CONTINUE
40E0:20 1A 41    ENDIT  JSR  LINE
40E3:4C BA 40         JMP  START1
40E6:A9 01       END2   LDA  #$01        ;SET FLAG FOR END
40E8:8D 05 40         STA  TEXT+2      ;OF PROGRAM
40EB:4C 1A 41         JMP  LINE        ;FINISH THE LINE
40EE:8D 04 40    CONT3  STA  TEXT+1      ;STORE CHAR COUNT
40F1:A9 0D            LDA  #$D         ;PUT CR IN BASIC
40F3:91 B8            STA  (BAS),Y
40F5:88               DEY
40F6:B1 00       LOOP2  LDA  (BUF),Y     ;GET A CHAR
40F8:C9 8E            CMP  #$8E        ;IS IT > CR?
40FA:B0 03            BCS  PUTIT       ;IF SO CONTINUE
40FC:8C 03 40         STY  TEXT        ;IF NOT FORCE RESET
                                        OF BUF,BAS
40FF:49 80       PUTIT  EOR  #$80        ;STRIP OFF MSB
4101:91 B8            STA  (BAS),Y     ;PUT IN BASIC
4103:88               DEY
4104:10 F0            BPL  LOOP2
4106:AC 03 40         LDY  TEXT        ;GET OLD Y VALUE
4109:C8               INY
410A:98               TYA               ;UPDATE BUFFER
410B:18               CLC               ;POINTER
410C:65 00            ADC  BUF
410E:85 00            STA  BUF
4110:90 02            BCC  CONT4
4112:E6 01            INC  BUF+1
4114:20 98 D9    CONT4  JSR  ADDON       ;UPDATE BAS
4117:4C BA 40         JMP  START1
                 ********************
411A:            *  LINE
                 ********************
411A:38          LINE   SEC               ;IF HERE END
411B:A5 B8            LDA  BAS         ;LINE WITH
411D:E9 01            SBC  #$01
411F:85 B8            STA  BAS
4121:B0 02            BCS  CONT7
4123:C6 B9            DEC  BAS+1
4125:A9 22       CONT7  LDA  #$22        ;A QUOTE
4127:A0 00            LDY  #$00
4129:8C 04 40         STY  TEXT+1      ;RESET CHAR COUNTER
412C:91 B8            STA  (BAS),Y     ;PUT IN FINAL "
412E:98               TYA               ;ZERO A
412F:C8               INY
4130:91 B8            STA  (BAS),Y     ;EOL TOKEN
4132:C8               INY               ;FOR NEXT LOCATION
4133:20 98 D9         JSR  ADDON       ;UPDATE BAS
4136:A0 05            LDY  #$05
4138:A9 22            LDA  #$22        ;A QUOTE
413A:91 04            STA  (LINK),Y
413C:88               DEY
413D:A9 BA            LDA  #$BA        ;? TOKEN
413F:91 04            STA  (LINK),Y
4141:88               DEY
4142:A5 03            LDA  LIN+1       ;HIBYTE OF LINE NO
4144:91 04            STA  (LINK),Y
4146:88               DEY
4147:A5 02            LDA  LIN         ;LOBYTE OF LINE NO
4149:91 04            STA  (LINK),Y
414B:88               DEY
414C:A5 B9            LDA  BAS+1       ;LINK ADDRESS
414E:91 04            STA  (LINK),Y
4150:88               DEY
4151:A5 B8            LDA  BAS
4153:91 04            STA  (LINK),Y
4155:85 04            STA  LINK        ;RESET LINKS
4157:A5 B9            LDA  BAS+1
4159:85 05            STA  LINK+1
415B:A0 06            LDY  #$06        ;WE HAVE TO SKIP
415D:20 98 D9         JSR  ADDON       ;6 BYTES
4160:A9 00            LDA  #$00        ;TEST FLAG FOR
4162:CD 05 40         CMP  TEXT+2      ;END OF PROG
4165:F0 1B            BEQ  CONT8       ;NOT SET!
4167:A8               TAY               ;ZERO Y
4168:91 04            STA  (LINK),Y    ;PUT IN ZERO
416A:C8               INY               ;BYTES FOR END
416B:91 04            STA  (LINK),Y    ;OF PROG
416D:A0 03            LDY  #$03        ; ADJUST BAS
416F:20 98 D9         JSR  ADDON       ;FOR END OF
4172:A5 B8            LDA  BAS         ;PROG POINTER
4174:85 AF            STA  $AF
4176:A5 B9            LDA  BAS+1
4178:85 B0            STA  $B0
417A:48               PHA               ; DISCARD
417B:48               PHA               ;2 WORDS FROM STACK
417C:20 58 FC         JSR  CLS
417F:4C 66 D5         JMP  RUN         ;RUN THE PROG
4182:18          CONT8  CLC               ;INC LINE NO
4183:A9 05            LDA  #$05
4185:65 02            ADC  LIN
4187:85 02            STA  LIN
4189:90 02            BCC  CONT5
418B:E6 03            INC  LIN+1
418D:60          CONT5  RTS

** SUCCESSFUL ASSEMBLY: NO ERRORS

D998 ADDON      FC10 BACK       B8 BAS        402B BEGIN
404D BELL       FBE4 BEL        00 BUF        FC58 CLS
4067 CONT       40D2 CONT2      40EE CONT3    4114 CONT4
418D CONT5      4125 CONT7      4182 CONT8    4072 CTR1
407B CTR2       4058 CTR        4085 END1     40E6 END2
40E0 ENDIT      FD35 GET        411A LINE       04 LINK
  02 LIN        4019 LOOP       40F6 LOOP2    408A NOTE
400D ORIG       FDED PRT        40FF PUTIT    4038 QUOTE
D566 RUN        40C3 SEARCH     40BA START1   403A STP
4003 TEXT

  00 BUF          02 LIN          04 LINK       B8 BAS
4003 TEXT       400D ORIG       4019 LOOP     402B BEGIN
4038 QUOTE      403A STP        404D BELL     4058 CTR
4067 CONT       4072 CTR1       407B CTR2     4085 END1
408A NOTE       40BA START1     40C3 SEARCH   40D2 CONT2
40E0 ENDIT      40E6 END2       40EE CONT3    40F6 LOOP2
40FF PUTIT      4114 CONT4      411A LINE     4125 CONT7
4182 CONT8      418D CONT5      D566 RUN      D998 ADDON
FBE4 BEL        FC10 BACK       FC58 CLS      FD35 GET
FDED PRT
```

Starburst

WHILE ATTEMPTING to draw a spiral on the screen, I forgot to change the variable of the Sin and Cos functions to radians, confesses R A Sparkes of Glasgow. The resulting starburst gave me the idea for this short program. Apple II users with colour can try replacing line 50 with a random colour for even more bizarre effects.

Starburst.

```
10   HOME
20   V=0.8 + 3 * RND(1)
30   HGR
40   POKE -16302,0
50   HCOLOR = 7
60   HPLOT 140,95
70   FOR THETA = 0 TO 500*V
     STEP V
80   R = THETA/V
90   X = 140 + R*COS(THETA)
100  Y = 95 + R*SIN(THETA)
110  IF Y>191 THEN 150
120  IF Y<0 THEN 150
130  HPLOT TO X,Y
140  NEXT THETA
150  FOR T = 1 TO 2000 :
     NEXT T
160  GOTO 10
```

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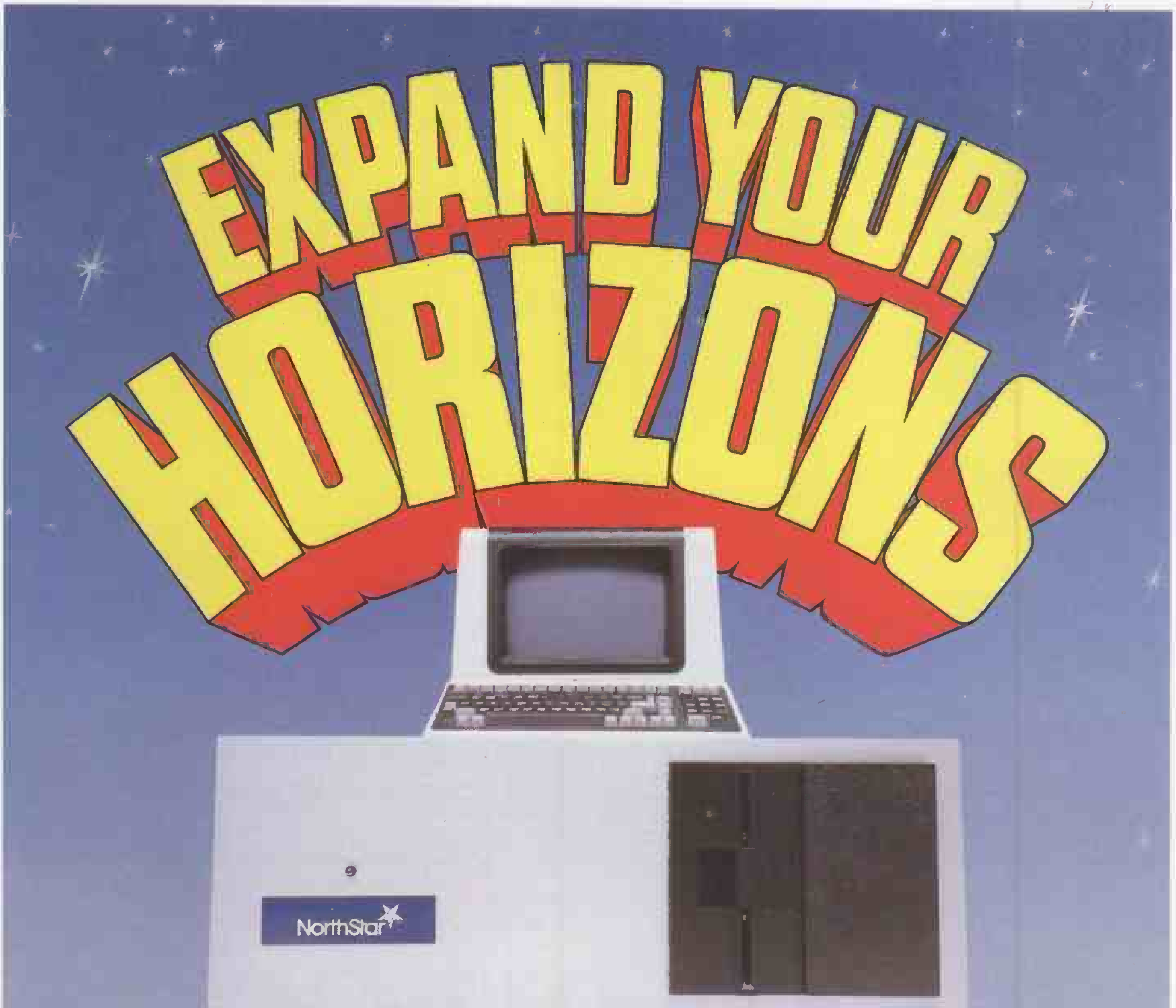
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Time into words

THIS ROUTINE takes an input in figures, and determines whether it can be interpreted as a time in the 24-hour clock system. If so, it outputs the time in words.

The input can be called from the keyboard, as in this version, or line 50040 can be changed so that the routine uses a value obtained from elsewhere, for example, from the real-time clock. The routine can be used in conjunction with a digital display in order to teach time, or it can be included as a subroutine in a real-time Adventure, issuing warnings which may sound all the more sinister for being expressed in words.

By changing the data lines, 50250 to 50280, and the four syntax lines which define Word$, 50140 to 50170, you can make the routine produce times in French or any other language.

The routine has been written on a Shapre MZ-80B in Sharp Disc Basic, but it should be easily converted to other dialects. A problem may arise if it is used as a subroutine in a longer program which also contains Data statements.

Sharp Basic allows the use of Restore with a line number. Readers without this facility will have to ensure that there are no unused Data lines earlier in the program which will be read instead of the subroutine's data.

Long variable names have been used to minimise the chance of confusion with variables used in the main program:

VOC$() — The vocabulary array
FIG$ — User's input
NUM$ — The input stripped of non-numeric characters
PAST$ — The words "past" or "to"
MIN$ — The words "minute" or "minutes"
WORD$ — The sentence finally produced
J — Counting variable
K — ASCII value of input characters
FLAG — Flag to mark if input is numeric
NUM — The input in numeric form
HOURS — The hours portion of the input
MINS — The minutes portion of the input

Time into words.

```
50000 REM TIME INTO WORDS ROUTINE
50005 REM BY JOHN HIGGINS
50010 REM Converts a time input in figures into words
50019 REM Use RESTORE in main program if it contains DATA statements
50020 RESTORE 50250:PRINTCHR$(6)
50030 DIM VOC$(30):FORJ=0TO30:READVOC$(J):NEXTJ
50040 INPUT"GIVE ME A TIME IN FIGURES:  ";FIG$
50050 NUM$="":PAST$=" PAST ":FLAG=0:MIN$=""
50059 REM Now we strip punctuation
50060 FORJ=1TOLEN(FIG$):K=ASC(FIG$)
50070 IF(K>47)*(K<58)THENNUM$=NUM$+CHR$(K):FLAG=FLAG+1
50080 FIG$=RIGHT$(FIG$,LEN(FIG$)-1):NEXTJ
50089 REM Is entry numeric?
50090 NUM=VAL(NUM$):IFFLAG<1THEN50200
50099 REM Is entry a time?
50100 IF(NUM<0)+(NUM>2400)THEN50200
50109 REM Change 24 hour to 12 hour clock
50110 NUM=NUM-(NUM<100)*1200+(NUM>1259)*1200
50119 REM Separate hours and minutes
50120 HOURS=INT(NUM/100):MINS=NUM-HOURS*100:IFMINS>59THEN50200
50129 REM Select past or to
50130 IF MINS>30THENMINS=60-MINS:HOURS=HOURS+1+(12*(HOURS=12)):PAST$=" TO "
50139 REM Select form of sentence
50140 IF MINS=0THENWORD$="IT'S "+VOC$(HOURS)+" "+VOC$(MINS):GOTO50180
50150 IFINT(MINS/5)<>MINS/5THENMIN$=" MINUTES"
50160 IF(MINS=1)+(MINS=59)THENMIN$=" MINUTE"
50170 WORD$="IT'S "+VOC$(MINS)+MIN$+PAST$+VOC$(HOURS)
50180 PRINT:PRINTWORD$;".":PRINT:GOTO50040
50200 PRINT:PRINT"THAT'S NOT A TIME.":PRINT:GOTO50040
50250 DATA  O'CLOCK,ONE,TWO,THREE,FOUR,FIVE,SIX,SEVEN,EIGHT,NINE,TEN,ELEVEN
50260 DATA TWELVE,THIRTEEN,FOURTEEN,A QUARTER,SIXTEEN,SEVENTEEN,EIGHTEEN
50270 DATA NINETEEN,TWENTY,TWENTY-ONE,TWENTY-TWO,TWENTY-THREE,TWENTY-FOUR
50280 DATA TWENTY-FIVE,TWENTY-SIX,TWENTY-SEVEN,TWENTY-EIGHT,TWENTY-NINE,HALF
```

Sharp firmware

AS A NEW MZ-80K owner I was digging through some old *Practical Computing* volumes for something interesting for my system, when I noticed a letter entitled "Sharp reproof" on page 43 of the September 1981 issue, writes George Hlimitzas of Hengelo, The Netherlands. It reflects precisely my complaints and frustrations in obtaining information about Sharp's software documentation.

Basic and monitor listings are sold at about £30 and £15 respectively, while the Basic replacement tape costs about £10. As a less expensive way to obtain what I needed I came up with a program that dumps the contents of monitor ROM with the corresponding addresses both in hex and in decimal.

Turn on the system, and after loading the Sharp Basic tape type in the Basic program. After typing Run and pressing CR, the contents of the ROM are displayed in the secreen. To dump the contents of memory locations that contain the Basic interpreter, go through the

(continued on next page)

Sharp firmware. Listing 1.

```
1    LIMIT 19999
2    GOSUB 10
3    USR(20000)
4    FOR X=20022 TO 24118
5    X1=X-20022:PRINT"(;X1; )"  ";:A=4:D=X1:GOSUB16:PRINT"
6    B=PEEK(X):A=2:D=B;GOSUB16:PRINT"    (";B;" )":NEXT:END
10   FORA1=20000TO20020:READF:POKEA1,F:NEXT:RETURN
12   DATA 197,213,229,33,0,0,17,54,78,1,0,16,237,160,234
,44,78,225,209,193,201
16   Q=D:DIMB$(A)
17   FOR I=1 TOA:Y=D/16:R=D-16*INT(Y):IF R>9 THEN R=R+7
18   B$(I)=CHR$(48+R):D=INT(Y):NEXT
19   FORI=A TO 1 STEP-1:PRINT B$(I);:NEXT:RETURN
```

Listing 2.

```
DECIMAL ADDRESS      CONTENTS(DEC)    ASSEMBLY LISTING

20000                197              PUSH BC
20001                213              PUSH DE
20002                229              PUSH HL
20003                 33              LD HL,0000
20004                  0
20005                  0
20006                 17              LODE,46
20007                 54
20008                 78
20009                  1              LD BC, 1000
20010                  0
20011                 16
20012                237              LDI
20013                160
20014                234              JP PE ,4E2C
20015                 44
20016                 78
20017                225              POP HL
20018                209              POP DE
20019                193              POP BC
20020                201              RET
```

Ball-bearing maze.

```
0 REM ** BY RICHARD COTTERILL **
10 CLR
20 DEF FNR(X)=INT(RND(1)*X)
30 GOSUB1000
40 PRINT"▣▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒";
50 FORX=1TO23:PRINT"▒                                      ▒";:NEXT
60 FORX=54208TO54247:POKEX,208:NEXT
100 ONFNR(3)GOTO120,150
110 POKE53289+FNR(38)+FNR(23)*40,72:GOTO210
120 F=53289+FNR(37)+FNR(22)*40
130 POKEF,177:POKEF+1,178:POKEF+40,181
140 POKEF+41,182:GOTO210
150 F=53289+FNR(35)+FNR(20)*40
160 POKEF,156:POKEF+1,157:POKEF+2,158
170 POKEF+3,159:POKEF+40,176:POKEF+41,240
180 POKEF+42,240:POKEF+43,179:POKEF+80,180
190 POKEF+81,240:POKEF+82,240:POKEF+83,183
200 POKEF+120,184:POKEF+121,185:POKEF+122,186:POKEF+123,187
210 B=FNR(36)+2:C=FNR(23)+1:D=B+40*C+53248
220 IFPEEK(D)<>0ORPEEK(D+1)<>0ORPEEK(D+2)<>0THEN210
230 D=0:E=0:G=0:H=0:TI$="000000":USR(62)
240 F=53248+INT(B+.5)+INT(C+.5)*40
250 IFPEEK(F)<>0THEN2000
260 POKEF,71:GETA$:IFA$="0"THENPRINT"▯▯▯"::GOSUB1140:GOTO40
270 IFA$="W"THENE=E-.25:IFE<-1THENE=-1
280 IFA$="X"THENE=E+.25:IFE>1THENE=1
290 IFA$="A"THEND=D-.25:IFD<-1THEND=-1
300 IFA$="D"THEND=D+.25:IFD>1THEND=1
310 G=G+D:H=H+E:B=B+G:C=C+H
320 IFB<1THENB=1:G=-G/4
330 IFB>38THENB=38:G=-G/4
340 IFC<1THENC=1:H=-H/4
350 IFC>23THENC=23:H=-H/4
360 POKEF,0:GOTO240
1000 PRINT"▣                T I L T"
1010 PRINT"                 ======="
1020 PRINT"▯   TRY TO ROLL THE BALL INTO THE HOLE"
1030 PRINT"▯IN THE QUICKEST TIME. THE SCREEN IS"
1040 PRINT"▯'TILTED' BY SMALL AMOUNTS BY PRESSING"
1050 PRINT"▯THE KEYS:     W"
1060 PRINT "              ↑"
1070 PRINT "            A← →D"
1080 PRINT "              ↓"
1090 PRINT "              X"
1110 PRINT"▯IF YOU ARE GOING TOO FAST, YOUR BALL MAY"
1120 PRINT"SKIP OVER THE HOLE."
1130 PRINT"▯TO QUIT THE CURRENT GAME PRESS KEY '0'."
1140 PRINT"▯▯▯▯▯▯DO YOU WANT TO PLAY (Y/N) ? ";
1150 GETA$:IFA$="Y"THENPRINT"Yes.":FORX=0TO599:NEXT:RETURN
1160 IFA$<>"N"THEN1150
1170 PRINT"No.▯▯▯▯▯▯▯▯▯▯▯▯▯▯"
1180 PRINT"▯     HAVE A NICE DAY...!▯▯▯":END
2000 PRINT"▯":IFC<12THENPRINT"▯▯▯▯▯▯▯▯▯▯▯▯▯▯"
2010 PRINT"▯▯YOU TOOK";
2020 M=VAL(MID$(TI$,3,2)):IFM>0THENPRINTM;" MINUTES";
2030 PRINTVAL(RIGHT$(TI$,2));" SECONDS."
2040 GOSUB1140:GOTO40
```

(continued from previous page)

same procedure changing the following lines of the program:

4 FORX=20022 TO 33982

5 X1=X−15414:PRINT etc, as above

12 DATA 197,213,229,33,0,18,17,54,78,1, 136,54,237,160,234,44,78,225,209,193,201

To make copies of the Basic tape turn the system off and then on again, and load Basic tape SP-5025. Replace the Basic tape with a blank tape and rewind to the beginning. Start the cassette recorder and type USR(33) in direct mode.

After Ready is displayed enter USR(36) while the record buttons are still engaged. Three minutes later, Ready is displayed. Press Stop, button and then Rewind. The Basic tape is now duplicated, and can be successfully used instead of the master tape.

The assembly language equivalent for the monitor dumping routine, Data statement 12, is shown in listing 2.

Ball-bearing maze

THIS GAME for the Sharp MZ80K improves co-ordination, is simple and can be easily converted to other machines, write Richard Cotterill of Bury St Edmunds, Suffolk. It was inspired by those gimballed wooden tables which can be tilted by two controls to roll a ball bearing around a track.

The MZ-80 has a 40-by-25 line memory-mapped VDU, and the Poke address of the top, left-hand corner is 53248. The main features of the program are:

Lines 40-60 draws a border around the edge of the screen. Any characters may be used for the border, which is 40 characters wide at the top and has 38 spaces between the left and right borders.

Lines 100-200 Poke on to the screen at a random position one of three sizes of circular "holes". Any character inside the border the ball: do not allow it to appear in a hole.

Lines 210-220 choose a random position for the ball: don't allow it to appear in a hole.

Line 230 initialises real-time clock and the ball's velocity and acceleration.

Lines 240 to 360 is the main program loop. For small angles of tilt from the horizontal, the ball's acceleration is proportional to the angle. When the ball hits the border at right-angles, it bounces off at one-quarter its original speed, that is, the coefficient of restitution is 0.25.

Lines 1000-1180 print instructions and "Do you want to play?"

Lines 2000-2040 print the time taken to finish.

The main variables are

A$ — input string
X — dummy variable
B — horizontal ball position
C — vertical ball position
D — horizontal ball acceleration
E — vertical ball acceleration
F — Poke position; also for the hole's position
G — horizontal velocity
H — vertical velocity

RML user characters

THIS PROGRAM by Roger Moffatt of Belfast for the Research Machines 380-Z or 480-Z makes use of the new level 2 graphics support routines in BasicSG2. When run it displays an eight-by-eight grid on the screen with a small x in the lower, left-hand box. If the F key is pressed, the colour of the square is inverted — from black to white, or vice versa — and the x can be moved about the grid using the following keys:

R moves the x up,
V moves the x down,
D moves the x left,
G moves the x right.

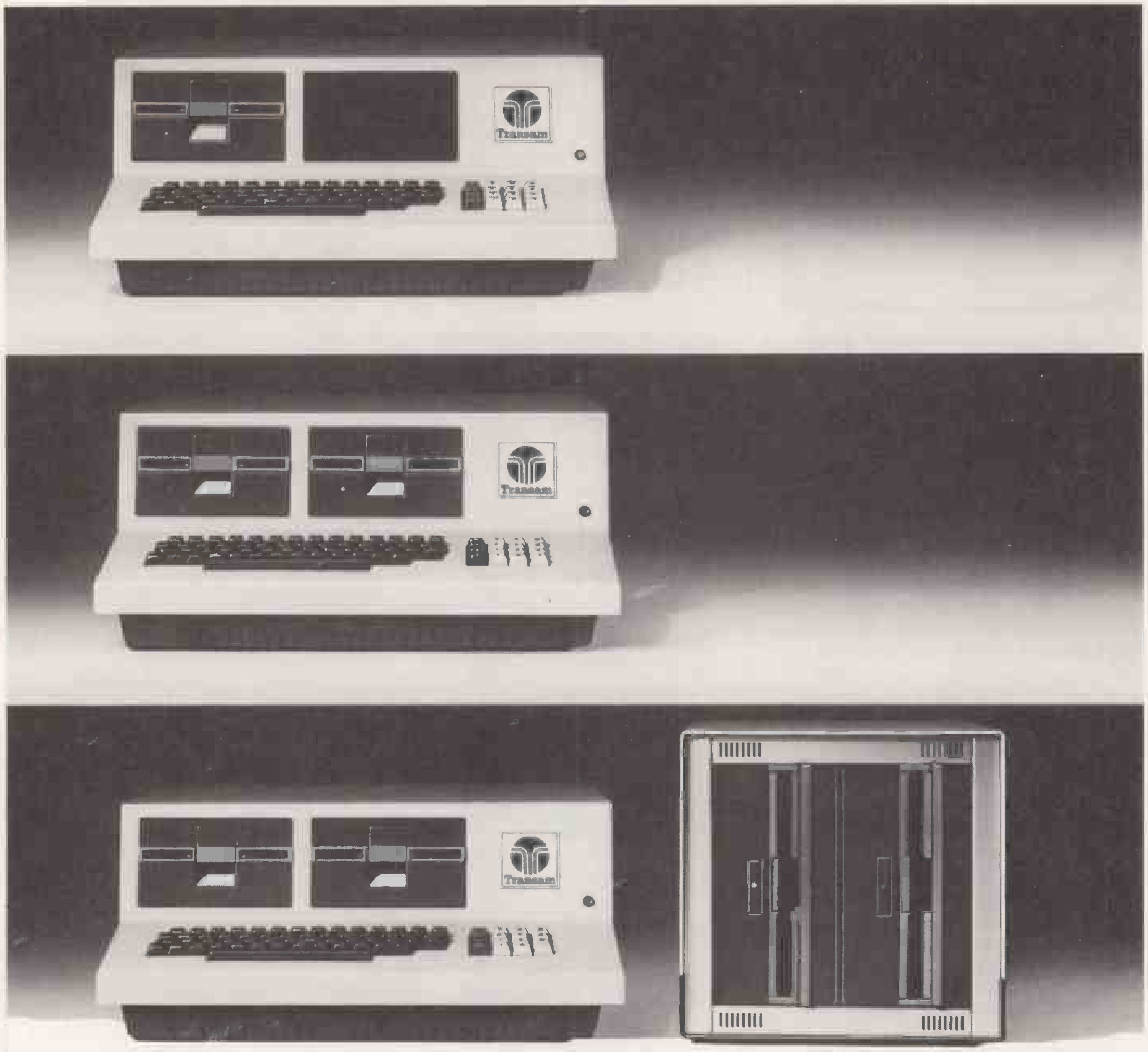
In this way a character can be formed on the grid, and when you press Return the computer produces a single user-defined character which could then be used anywhere on the screen. Any character can be created in a matter of seconds; just make a note of the numbers which the computer prints out beside the grid.

In the program the rows are numbered from the bottom 1 to 8, so to define your character use

CALL "DEFCHAR", (ASCII value of your choice), ROW 8, ROW 7, ROW 6, etc. (eg. line 460)

RML user characters.

```
10 REM ** 380Z USER DEF' CHARACTER GENERATOR
20 REM ** R.MOFFATT
30 REM ** 29 JUNE 1982
40 REM ** BASICSG2
50 PUT 12,21,17
60 ?"To move the 'x' use 'D' 'G' 'R' 'V'"
70 ?"To invert a squares colour use 'F'"
80 ?"and Press 'RETURN' to end."
90 ST$="STPLOT":L$="LINE":P$="PLOT"
100 CALL"RESOLUTION",1,4
110 CALL"OFFSET",-20,-20
120 FOR Y=0 TO 64 STEP 8
130 CALL P$,0,Y,10
140 CALL L$,64,Y
150 NEXT Y
160 FOR X=0 TO 64 STEP 8
170 CALL P$,X,0,10
180 CALL L$,X,64
190 NEXT X
200 X=0:Y=0
210 CALL"DEFCHAR",1,0,0,36,24,36,0,0,0
220 CALL"DEFCHAR",2,255,255,255,255,255,255,255,255
230 F$=CHR$(2)
240 A$=CHR$(1)
250 CALLST$,X,Y,VARADR(A$),-14
260 K=GET(10)
270 CALL ST$,X,Y,VARADR(A$),-14
280 IF K=ASC("R") THEN Y=Y+8+8*(Y=56)
290 IF K=ASC("V") THEN Y=Y-8-8*(Y=0)
300 IF K=ASC("D") THEN X=X-8-8*(X=0)
310 IF K=ASC("G") THEN X=X+8+8*(X=56)
320 IF K=ASC("F") THEN CALL ST$,X,Y,VARADR(F$),-15
330 IF K=13 THEN 350
340 GOTO 250
350 FOR Y=0 TO 56 STEP 8
360 B=0
370 FOR X=0 TO 56 STEP 8
380 CALL"RDOUT",X+4,Y+4,VARADR(I)
390 IF I=15 THEN B=B+2^(8-(X+8)/8)
400 NEXT X
410 B((Y+8)/8)=INT(B+.4)
420 NEXT Y
430 PUT 31:PUT 13,13,13,13,13,13,13
440 C=0
450 C$=CHR$(C)
460 CALL"DEFCHAR",C,B(8),B(7),B(6),B(5),B(4),B(3),B(2),B(1)
470 CALL ST$,90,50,VARADR(C$),-15
480 FOR N=8 TO 1 STEP -1
490 ?TAB(25)"Row";N;"=";B(N)
500 NEXT
510 ?:?:?"Again (Y/N) ?";:A$=GET$()
520 IF A$="Y" THEN RUN
530 CALL"RESOLUTION",0,0:PUT 31
540 END
```



Interex

I HAVE AMASSED a large number of magazines such as *Practical Computing,* writes George Raven of Walton on Naze, Essex, and ever since I became the proud owner of a Pet I have been buying computer books and monthly magazines regularly. Matters reached a stage when I knew the program or routine I was looking for was in one of them but could not remember which, and had neither the time nor the inclination to go through them all to find it.

Interex can be used to index all the useful or interesting bits as you come to them in a way that would help you to recover them whenever you want to. Yet it can easily be adapted for use in other areas such as cookery or woodwork.

Interex was written on a 32K Pet with Basic 4 and uses 4040 disc drive and a 4022 printer. The routines should not be difficult to adapt to other machines if required. The program is quite simply an index of interesting subjects and works on a simple menu system. There are four selections

1. Enter name of Index
2. Main classifications
3. Sub-classifications
4. Close index

Selection 1 uses a little routine which allows you to name the index the very first time you use it, and thereafter it tells you its name, waits and then returns to the menu. Selection 2 allows you to access the main classifications, add more and print a list of them in alphabetical order. Selection 3 gives access to the sub-classifications and enables you to print a list of entries under a particular main heading, and selection 4 closes down the system by use of SYS64790.

The main variables used are:-

mm$	Main classifications
nm$	Sub-classifications
sd$	Provision for further detail
mg$	Name of magazine
y	Year of publication
vv$	Volume or volume and issue
p	Page number
nn	Number of main classifications

Each of the 50 main classifications becomes the subject of a file which can

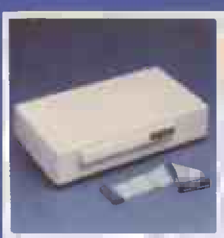
(continued on page 149)

```
5 PRINT"]QQQQQQ"
10 PRINT"
15 PRINT"
20 PRINT"
25 PRINT"
30 PRINT"
35 REM*******************************
40 REM*                             *
45 REM*        INTEREX              *
50 REM*     GEORGE P. RAVEN         *
55 REM*        JAN  1982            *
60 REM*                             *
65 REM*******************************
70 FORJ=1TO750:NEXT
75 DIMMM$(50),NM$(100),SD$(100),Y(100),VV$(100),P(100),MG$(100)
80 CO$="                                        ":POKE144,88
85 C1$="========================================":C$=CHR$(29)
90 T$="OPTION MENU":POKE59468,12:OPEN7,4,7:PRINT#7:CLOSE7
95 PRINT"]":FORJ=1TO40:PRINT"_";:NEXT:FORJ=1TO40:PRINT"*";:NEXT
100 PRINT"]"SPC((40-LEN(T$))/2);T$:FORJ=1TO40:PRINT"-";:NEXT
105 PRINT"QQQ]]]]]]]1.  ENTER NAME OF INDEX
110 PRINT"]]]]]]]2.  MAIN CLASSIFICATIONS
115 PRINT"]]]]]]Q3.  SUB CLASSIFICATIONS
120 PRINT"]]]]]]Q4.  CLOSE INDEX.
125 PRINT"QQQQQRSELECT  ==>
130 GETA$:IFA$=""THEN130
135 IFA$="1"THEN165
140 IFA$="2"THEN220
145 IFA$="3"THEN545
150 IFA$="4"THENPOKE59468,14:OPEN8,4,8:PRINT#8:CLOSE8:POKE144,85:SYS64790
155 IFVAL(A$)<1ORVAL(A$)>4THEN130
160 IFA$=CHR$(20)THEN130
165 GOSUB205:IFAA$<>""THEN185
170 PRINT"]":PRINT"WHAT DO YOU WISH TO CALL THIS FILE ?QQ":GOSUB990:AA$=Z$
175 PRINT"SQQQQQQQQQQ]]]]]]]]]]]RWAIT! - FILING DATA"
180 GOSUB200:GOTO210
185 PRINT"]THIS FILE IS NAMED :-"
190 PRINT"QQ]]]]]]]]]]]R";AA$
195 FORJ=1TO1500:NEXT:GOTO95
200 OPEN103,8,9,"0:F/N,S,W":PRINT#103,AA$:CLOSE103:RETURN
205 OPEN103,8,9,"F/N,S,R":INPUT#103,AA$:CLOSE103:RETURN
210 OPEN101,8,8,"@0:INDEX NAME,S,W":GOSUB1015:PRINT#101,AA$:GOSUB1015:CLOSE101
215 OPEN102,8,8,"@0:MAIN SUBJECTS,S,W":GOSUB1015:CLOSE102:GOTO95
220 PRINT"]QQQQQQQQQQ]]]]]]]]]]]]]RWAIT DATA LOADING
225 OPEN101,8,8,"0:INDEX NAME,S,R":GOSUB1015:INPUT#101,N$:GOSUB1015:CLOSE101
230 OPEN102,8,8,"0:MAIN SUBJECTS,S,R":GOSUB1015
235 INPUT#102,NN:IFNN=0THEN250
240 IFNN=0THEN250
245 FORJ=1TONN:INPUT#102,MM$(J):NEXT
250 GOSUB1015:CLOSE102:PRINT"]"
255 FORJ=1TO40:PRINT"_";:NEXT:FORJ=1TO40:PRINT"*";:NEXT
260 PRINT"]"SPC((40-LEN(N$))/2);N$
265 FORJ=1TO40:PRINT"-";:NEXT
270 IFNN=1THENPRINT"]]]QQQQTHERE IS ";NN "MAIN TITLE":GOTO280
275 PRINT"]]]QQQQTHERE ARE ";NN "MAIN TITLES"
280 PRINT"SQQQQQQQQQQQQQQQQQQQQQQ":FORJ=1TO40:PRINT"-";:NEXT
285 PRINT"RA ADD SUBJECTS RV VIEW/PRINT RS SELECT R* MENU
290 GETA$:IFA$=""THEN290
295 IFA$="V"THEN400
300 IFA$="A"THEN320
305 IFA$="S"THEN485
310 IFA$="*"THEN95
315 IFA$<>"A"ANDA$<>"S"ANDA$<>"*"ANDA$<>"V"THEN290
320 PRINT"]RENTER MAIN SUBJECTS AS PROMPTED"
325 PRINT"(15 LETTERS MAX) TYPE '*'TO END":FORJ=NN+1TO200:PRINT:PRINT
330 PRINTTAB(25)"RENTRY NO. ";J:PRINT"Q"
335 PRINT"RMAIN SUBJECT NAME    ";:GOSUB990:PRINTCHR$(141)
340 IFLEFT$(Z$,1)="*"THENGOSUB380:GOTO95
345 PRINT"QQQIS ENTRY CORRECT Y/N ";:INPUTYN$
350 IFYN$="Y"THEN365
355 IFYN$="N"THENPRINT"SQ":GOTO320
360 IFYN$<>"Y"ANDYN$<>"N"THENPRINT"IIIII":GOTO345
365 NN=NN+1:MM$(J)=Z$:PRINT"]"
370 V=J:OPENV,8,8,"@0:"+Z$+",S,W":CLOSEV
375 NEXT
380 PRINT"]QQQQQQQQQQ]]]]]]]]]]]RWAIT! FILING SUBJECTS"
385 OPEN102,8,8,"@0:MAIN SUBJECTS,S,W":GOSUB1015:PRINT#102,NN
390 FORJ=1TONN:PRINT#102,MM$(J):NEXT
395 GOSUB1015:CLOSE102:PRINT"]"CO$:RETURN
400 PRINT"]QQQQQQQQQQQQ]]]]]]]]]]]]]]]]]RSORTING
405 X=NN:GOSUB1035:PRINT"]"
410 FORJ=1TONN:PRINTMM$(J):NEXT
415 PRINT"SQQQQQQQQQQQQQQQQQQQQQQ":FORJ=1TO40:PRINT"-";:NEXT
420 PRINT"RP PRINT       R* MENU
425 GETA$:IFA$=""THEN425
430 IFA$="P"THEN445
435 IFA$="*"THEN95
440 IFA$<>"*"ANDA$<>"P"THEN425
445 OPEN1,4:OPEN2,4,1:OPEN3,4,2:OPEN4,4,4
450 PRINT#1,CHR$(1)"LIST OF MAIN SUBJECTS"
455 PRINT#1,"--------------------------------------------------"
460 S$="           AAAAAAAAAAAAAAA"
465 PRINT#3,S$
470 FORJ=1TONN:PRINT#2,MM$(J)C$
475 NEXT
480 CLOSE1:CLOSE2:CLOSE3:CLOSE4:GOTO280
485 PRINT"]RENTER NAME OF INDEX REQUIREDQQ"
490 GOSUB990:M$=Z$
495 FORJ=1TONN
500 IFM$=RIGHT$(MM$(J),LEN(M$))THEN520
505 NEXT
510 PRINT"QQRNO SUCH FILE
515 FORJ=1TO1200:NEXT:GOTO280
520 PRINT"QQ";M$;" IS FILE NO ";J
525 PRINT"SQQQQQQQQQQQQQQQQQQQQQQ":FORJ=1TO40:PRINT"-";:NEXT
530 PRINT"    R*
535 GETA$:IFA$<>"*"THEN535
540 GOTO280
545 PRINT"]QQQQQQQQQQQ]]]]]]]]]]]]]RWAIT! DATA LOADING
```

(listing continued on page 149)

ingenious ...but lonely!

Buying your first Genie I microcomputer is just the start of a long and enthralling adventure, for it won't be long before you will want to expand your system with some of the wide range of peripherals which make up the complete Genie System.



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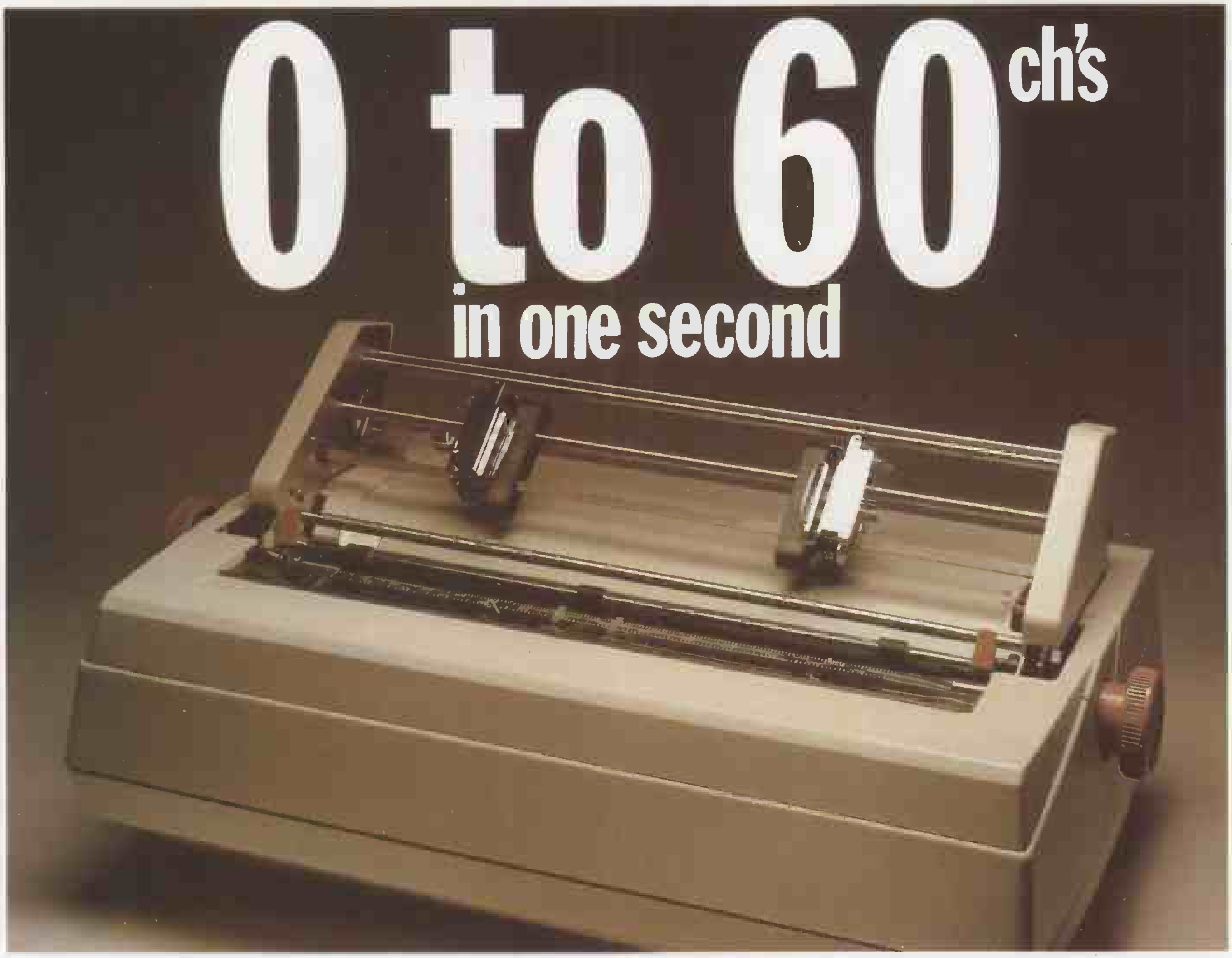

THE RICOH 1600S

If it's high performance you're looking for, the Ricoh 1600S is for you, offering an amazing 60 characters in just 1 second. An updated version of the tried-and-tested 1600, the new S model has been re-designed and fitted with all sorts of extras. Yet one thing hasn't changed — the price, making the 1600S cheaper than any equivalent model on the market. This superb performer incorporates the Z80 micro-processor, auto bidirectional printing and look-ahead logic, increasing speed and efficiency. Other capabilities include proportional spacing, graph plotting and word processing enhance-ments. The printer includes a standard centronics interface, and RS232 and IEEE options are available.

The Ricoh 1600S is available only from Micropute and their authorised dealers, all backed up with a nation-wide service network. If you're interested in the 1600S either as a customer or as a dealer, send the coupon now.

"Picture shows 1600s fitted with tractor feed option"

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Position
Company
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FEATURES	COMPETITORS				
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PRINT SPEED (CPS)	40	45/55	55	60	**60**
PRINT ELEMENT	DAISY-WHEEL	DAISY-WHEEL	THIMBLE	DOUBLE DAISY-WHEEL	**DOUBLE DAISY-WHEEL**
AUTO BIDIRECTIONAL	Yes	No	No	No	**Yes**
AUTO LOGIC SEEKING	Yes	No	Yes	No	**Yes**
PROPORTIONAL PRINT CAPABILITY	Yes	Yes	Yes	No	**Yes**
EXTENDED CHARACTER SET	No	No	Yes	Yes	**Yes**
LETTER QUALITY PRINT	Yes	Yes	Yes	Yes	**Yes**
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PRICE	£1675	£1950	£1950	£1450	**£1450**

The above information was gathered from distributors and abstracted from their current literature. Prices shown are those advertised at the present time.

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● Circle No. 209

(listing continued from page 144)

```
550 OPEN101,8,8,"0:INDEX NAME,S,R":GOSUB1015:INPUT#101,N$:GOSUB1015:CLOSE101
555 OPEN102,8,8,"0:MAIN SUBJECTS,S,R":GOSUB1015:INPUT#102,NN
560 FORJ=1TONN:INPUT#102,MM$(J):NEXT
565 GOSUB1015:CLOSE102:PRINT"□"
570 FORJ=1TO40:PRINT"_";:NEXT:FORJ=1TO40:PRINT"*";:NEXT
575 PRINT"□"SPC((40-LEN(N$))/2);N$:FORJ=1TO40:PRINT"¯";:NEXT
580 PRINT"■■ENTER MAIN SUBJECT HEADING REQD.■"
585 GOSUB990:M$=Z$:IFLEFT$(Z$,1)="*"THEN90
590 FORJ=1TONN
595 IFM$=RIGHT$(MM$(J),LEN(M$))THEN610
600 NEXT
605 PRINT"■■■NO SUCH SUBJECT RECORDED":FORJ=1TO1200:NEXT:PRINT"□":GOTO570
610 V=J
615 OPENV,8,8,"0:"+M$+",S,R":GOSUB1015
620 INPUT#V,NB
625 FORJ=1TONB
630 INPUT#V,NM$(J),SD$(J),MG$(J),Y(J),VV$(J),P(J):NEXT:GOSUB1015:CLOSEV
635 PRINT"□■■"SPC((40-LEN(M$))/2)M$
640 PRINTSPC((40-LEN(M$))/2)LEFT$(C1$,LEN(M$))
645 IFNB=1THENPRINT"■THERE IS ";NB; "ENTRY IN THIS FILE":GOTO655
650 PRINT"■THERE ARE ";NB;"ENTRIES IN THIS FILE"
655 PRINT"■■■■■■■■■■■■■■■■■■■■■■■■■■■":FORJ=1TO40:PRINT"¯";:NEXT
660 PRINT"■V■IEW/PRINT   ■E■NTER MORE   ■*■ MENU
665 GETA$:IFA$=""THEN665
670 IFA$="V"THEN815
675 IFA$="E"THEN685
680 IFA$="*"THEN95
685 FORJ=NB+1TO100
690 PRINT"□",M$SPC(9)"TYPE '*' TO EXIT"
695 PRINT"■■■■■■"SPC(26)"■ENTRY NO. ";J
700 PRINT:PRINT"■SECONDARY TITLE ■ ";:GOSUB990:NM$(J)=Z$:PRINTCHR$(141)
705 IFLEFT$(NM$(J),1)="*"THEN755
710 PRINT"■FURTHER DETAIL  ■ ";:GOSUB990:SD$(J)=Z$:PRINTCHR$(141)
715 PRINT"■MAGAZINE        ■ ";:GOSUB990:MG$(J)=Z$:PRINTCHR$(141)
720 PRINT"■YEAR OF MAGAZINE■ ";:GOSUB995:Y(J)=Z:PRINTCHR$(141)
725 PRINT"■VOLUME NUMBER   ■ ";:GOSUB995:VV$(J)=LEFT$(Z$,6):PRINTCHR$(141)
730 PRINT"■PAGE   NUMBER   ■ ";:GOSUB995:P(J)=Z:PRINTCHR$(141)
735 PRINT"■IS ENTRY CORRECT Y/N";
740 GETA$:IFA$=""THEN740
741 IFA$<>"N"ANDA$<>"Y"THEN740
745 IFA$="N"THEN695
750 NB=NB+1:PRINT"□"    :NEXT
755 PRINT"□■■■■■■■■■■■■■■■■■■■■■■■■■■FILING DATA"
760 OPENV,8,8,"@0:"+M$+",S,W":GOSUB1015
765 PRINT#V,NB:FORJ=1TONB
770 PRINT#V,NM$(J)
775 PRINT#V,SD$(J)
780 PRINT#V,MG$(J)
785 PRINT#V,Y(J)
790 PRINT#V,VV$(J)
795 PRINT#V,P(J)
800 NEXT:GOSUB1015:CLOSEV
805 PRINT"□"CO$
810 GOTO95
815 PRINT"□";M$
820 FORI=1TO40:PRINT"¯";:NEXTI
825 FORJ=1TONB
830 IFLEN(NM$(J))<15THENNM$(J)=NM$(J)+" ":GOTO830
835 IFLEN(SD$(J))<15THENSD$(J)=SD$(J)+" ":GOTO835
840 PRINTLEFT$(NM$(J),15)SPC(3)LEFT$(SD$(J),15)
845 PRINTLEFT$(MG$(J),15)SPC(2);Y(J)SPC(3);VV$(J)SPC(3);P(J)
850 FORI=1TO40:PRINT"¯";:NEXTI
855 NEXTJ
860 PRINT"■■■■■■■■■■■■■■■■■■■■■■■■■■■":FORJ=1TO40:PRINT"¯";:NEXT
865 PRINT"■P■RINT    ■*■MENU
870 GETA$:IFA$=""THEN870
875 IFA$="P"THEN890
880 IFA$="*"THEN95
885 IFA$<>"*"ANDA$<>"P"THEN870
890 PRINT"□■■■■■■■■■■■■■■■■■■■■■■■■■■PRINTING"
895 OPEN1,4:OPEN2,4,1:OPEN3,4,2:OPEN4,4,4
900 PRINT#1,SPC(19),CHR$(1)M$
905 PRINT#1,SPC(29)LEFT$(C1$,(LEN(M$)*2))
910 PRINT#1,"SUB.CLASSN,       OTHER DESCRIPTN. MAGAZINE          YEAR    VOL";
915 PRINT#1,"      PAGE"
920 H$="────────────────────────────────────────────────"
925 H$=H$+"────────────────────────────────────────────────"
930 PRINT#1,H$
935 FORJ=1TONB
940 G$="AAAAAAAAAAAAAAA  AAAAAAAAAAAAAAA  AAAAAAAAAAAAAAA  9999    AAAAAA  999"
945 PRINT#3,G$
950 FORJ=1TONB
955 PRINT#2,SPC(6),NM$(J),C$,SD$(J),C$,MG$(J),C$,Y(J),VV$(J),C$,P(J)
960 NEXT
965 PRINT#1,H$
970 POKE59468,12
975 CLOSE1:CLOSE2:CLOSE3:CLOSE4
980 GOTO95
985 STOP
990 REM***INPUT TRAP*****
995 OPEN1,0:INPUT#1,Z$
1000 Z=VAL(Z$):IFZ$=""THEN995
1005 Z$=LEFT$(Z$+CO$,15)
1010 CLOSE1:RETURN
1015 REM***ERROR CHECK***
1020 IFDS<20THENRETURN
1025 PRINTDS$:IFDS=50THENRETURN
1030 STOP
1035 REM***SORT***
1040 N=X:M=X
1045 M=INT(M/2):IFM=0THENRETURN
1050 J=1:K=N-M
1055 I=J
1060 L=I+M
1065 IFMM$(I)<MM$(L)THEN1080
1070 F$=MM$(I):MM$(I)=MM$(L):MM$(L)=F$:I=I-M:IFI<1THEN1080
1075 GOTO1060
1080 J=J+1:IFJ>KTHEN1045
1085 GOTO1055
```

Interex program.

Line numbers	Function
5-70	Titles and time delay
75	Dimensioning the arrays
80	Spaces for padding and c$=CR
90	Screen heading and condition printer for lower-case printing
95-165	Heading and menu; line 150 re-enables the Stop key, resets printer and ends program with SYS64790
165-215	Subroutine to name index on first use and subsequently to name itself
220-540	Routine for accessing, filing and printing main classifications
545-985	Routine for accessing filing and printing sub-classifications
990-1010	Input trap
1015-1030	Disc-error check
1035-1085	Sort routine for mm$(x)

(continued from page 144)

contain up to 100 sub-classifications filed sequentially. These numbers are arbitrary and can be varied to suit the user. Each main classification is also filed sequentially in a file named Main Subjects, which is used to sort and print a list of main headings if required.

Entries are made by use of a simple input trap and the whole program made crashproof by the use of Poke 144,88, to disable the stop key, at line 80. Entering an asterisk* will return you to the menu, and there is a facility to correct entries before acceptance.

To start an index first select 1 on the menu and give the file a name, say, Pet Programs, then select 2 and enter all the main headings you can think of. Then select 3 and proceed to enter all your favourite programs/routines or what have you. Should you come to a subject that has no main heading, then go back to selection 2.

If you are not sure whether a particular main heading has been entered you can either refer to the printed list of main subjects or use the Select facility shown at the bottom of the screen after pressing 2 on the main menu. It is all quite simple really. The main features of the Basic coding are shown in the table.

ASCII codes

THIS SHORT PROGRAM for the 3000 series Pet by Jonathan Turpin of Stanford-le-Hope, Essex, resides in the second cassette buffer, and is used for converting the Pet's character set to true ASCII.

The routine works through a Sys Call, and operates on the characters in C$. If C$ is not present then the routine returns having done nothing, otherwise all the Pet's upper- and lower-case characters

(continued on next page)

(continued from previous page)
are changed to the standard ASCII codes.

The equivalent program in Basic using the string functions is very slow and can double the printing time of an output, and also creates problems with the garbage collection routines. The code is used in the routine is totally relocatable, and only needs to be entered at a different start location to be used on any of the other Pet computers.

To use the routine the string to be output is put in C$, a SYS 826 command is given and then the string is printed in the normal way.

The hexadecimal locations used are as follows:

$00,01,02 These locations are usually the USR vector, and are used as temporary storage.

$2C,2D These locations contain the Basic interpreter's pointer to the end of the variable table.

$2A,2B These locations contain the Basic interpreter's pointer to the start of the variable table.

$033A to $03A3 These locations hold the routine, and are part of the second cassette buffer.

$03A4 This is used by the program for temporary storage; if relocating the program the instructions relating to these locations should be changed to suit the new location of the code, locations $036F and $0377.

The important parts of the routine are as follows:

$033A to $035F Find any variables with C as the first character of their name.

$0360 to $0366 Check to see if it is C$.

$0367 to $037B Store the length and position of the string in zero page for use in the conversion part of the program.

$037C to $037F Check that the string is not a null string.

$0380 to $0382 Decrement the string length count and restore it in zero page.

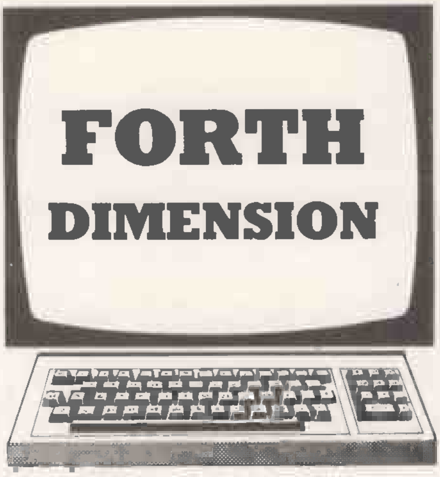
$0383 to $039E Load the part of the string presently being dealt with into the accumulator, and if it is a lower-case or upper-case letter, then adjust its value to the true ASSII value for that letter.

$039F to $03A3 Check the string length count to see if there are any more characters to be processed. If not then return to Basic otherwise start on the next character.

ASCII codes.

```
      PC  IRQ  SR AC XR YR SP
.; 1055 133A 32 00 10 00 F6
.
., 033A A5 2A     LDA $2A
., 033C 85 00     STA $00
., 033E A5 2B     LDA $2B
., 0340 85 01     STA $01
., 0342 A0 00     LDY £$00
., 0344 B1 00     LDA ($00),Y
., 0346 C9 43     CMP £$43
., 0348 F0 16     BEQ $0360
., 034A 18        CLC
., 034B A5 00     LDA $00
., 034D 69 07     ADC £$07
., 034F 85 00     STA $00
., 0351 90 02     BCC $0355
., 0353 E6 01     INC $01
., 0355 C5 2C     CMP $2C
., 0357 D0 E9     BNE $0342
., 0359 A5 01     LDA $01
., 035B C5 2D     CMP $2D
., 035D D0 E3     BNE $0342
., 035F 60        RTS
., 0360 C8        INY
., 0361 B1 00     LDA ($00),Y
., 0363 C9 80     CMP £$80
., 0365 D0 E3     BNE $034A
., 0367 C8        INY
., 0368 B1 00     LDA ($00),Y
., 036A 85 02     STA $02
., 036C C8        INY
., 036D B1 00     LDA ($00),Y
., 036F 8D A4 03  STA $03A4
., 0372 C8        INY
., 0373 B1 00     LDA ($00),Y
., 0375 85 01     STA $01
., 0377 AD A4 03  LDA $03A4
., 037A 85 00     STA $00
., 037C A4 02     LDY $02
., 037E F0 DF     BEQ $035F
., 0380 88        DEY
., 0381 84 02     STY $02
., 0383 B1 00     LDA ($00),Y
., 0385 C9 41     CMP £$41
., 0387 90 16     BCC $039F
., 0389 C9 5B     CMP £$5B
., 038B B0 05     BCS $0392
., 038D 18        CLC
., 038E 69 20     ADC £$20
., 0390 90 0B     BCC $039D
., 0392 C9 C1     CMP £$C1
., 0394 90 09     BCC $039F
., 0396 C9 DB     CMP £$DB
., 0398 B0 05     BCS $039F
., 039A 18        CLC
., 039B E9 7F     SBC £$7F
., 039D 91 00     STA ($00),Y
., 039F A4 02     LDY $02
., 03A1 D0 DD     BNE $0380
., 03A3 60        RTS

      PC  IRQ  SR AC XR YR SP
.; 0401 E62E 32 04 5E 00 E6
.
.: 033A A5 2A 85 00 A5 2B 85 01
.: 0342 A0 00 B1 00 C9 43 F0 16
.: 034A 18 A5 00 69 07 85 00 90
.: 0352 02 E6 01 C5 2C D0 E9 A5
.: 035A 01 C5 2D D0 E3 60 C8 B1
.: 0362 00 C9 80 D0 E3 C8 B1 00
.: 036A 85 02 C8 B1 00 8D A4 03
.: 0372 C8 B1 00 85 01 AD A4 03
.: 037A 85 00 A4 02 F0 DF 88 84
.: 0382 02 B1 00 C9 41 90 16 C9
.: 038A 5B B0 05 18 69 20 90 0B
.: 0392 C9 C1 90 09 C9 DB B0 05
.: 039A 18 E9 7F 91 00 A4 02 D0
.: 03A2 DD 60 FF FF FF FF FF FF
.?
```



Factorials

AFTER SEEING F S Dewhirst's program for factorials on page 126 of the September 1981 issue of *Practical Computing,* J Yale of Corfe Mullen, Dorset, decided to write a similar program in Forth. The program takes 13 seconds to calculate 100! and $1\frac{1}{2}$ minutes to compute and display all the factorials up to 100. The 2,568 digits of 1,000! only take 40 minutes or so to compute.

The program is contained in three blocks or screens. The function of each of the new words is:

BYTE-ARRAY — This is the definition of a new data type, an array of bytes. This is the only word in the program which is CPU specific as it contains some Z-80 assembly code for speed of array access.

MAX-DIGITS — A constant giving the maximum length of number to be used, set to an arbitrarily large value.

F-BUFF — The buffer to hold the factorial defined using Byte-Array of length Max-Digits. To access the Nth element of F-Buff the code is:

```
N F-BUFF
```

LAST — A variable containing the last index to be used in F-Buff.

*BUFF — This word is the heart of the program. Given a number on the stack it multiplies F-Buff by that number. The second half of the word extends the buffer as required by incrementing Last to accommodate the final carry.

SETUP — This word initialises F-Buff by putting a one in the first element and setting Last to zero.

.FAC — Displays the factorial in F-Buff with a comma in every third position.

FAC — Given a number on the stack, computes its factorial in F-Buff.

FACS — Given a number on the stack, computes and displays all the factorials up to this number.

This program was developed on a Research Machine 380-Z using a cassette-based Forth system available from F Donovan, 35 St Julians Road, St Albans, Hertfordshire, AL1 2AZ.

." — Prints the following string up to a terminating ".

/MOD — Divides the second stack item by the first leaving the quotient and remainder, with the quotient on the top of the stack.

0= — Tests the top stack item against zero. Leaves true, 1, or false, 0, on the stack.

: — Starts a new Forth definition. The word immediately following the ":" is the name of the new word.

; — Ends a Forth definition.

;CODE — Introduces the assembly-code portion of a new defining word.

;S — Marks the logical end of a block. Any text after this point will not be compiled.

ALLOT — Given a number on the top of the stack, allocates that amount of dictionary space, in this case for an array. This word is sometimes called DP+!

ASCII — Leave the ASCII code of the next character on the top.

BEGIN . . . IF . . . AGAIN — On some systems this is Begin-While-Repeat. This structure is equivalent to Do-While-End of some languages except it is more versatile in that the test can be anywhere in the loop.

C@ — Fetch a byte from the address given on the stack, and leave the byte on the stack in place of the address.

CR — Output a carriage return.

DO . . . LOOP — Equivalent to a For – Next loop. The limit plus 1 and the start value should be on the stack before the Do.

EQU — Defines a constant. Sometimes called Constant.

FORGET — Truncates the dictionary just before the definition of the word which follows. Used to discard the code from a previous compilation.

HPUSH — An assembler macro which assembles a jump to code which pushes the HL register on to the stack before returning to the Forth inner interpreter.

I — Pushes the current innermost Do loop index on to the stack.

IF . . . THEN — The condition comes before the If, like all conditions in Forth.

MOD — As /Mod except only leaves the remainder.

NOT — Reverses the truth condition on the top of the stack.

OVER — Pushes the second stack item on to the top of the stack. Thus

1 2 OVER

leaves 1 2 1 on the stack.

SWAP — Swaps the two top stack items.

TASK — A dummy definition used to mark the top of the system dictionary.

U.R. — Print the second stack item in the field width specified by the top stack item. Thus

23 5 U.R

prints 23 in a field width of 5.

VARIABLE — Defines a variable and initialises it to zero. When the variables name appears in a program, or is typed at the terminal, the address of the variable is left on the stack and the contents may be accessed or altered by @ and !. On some systems Variable requires an initialisation value to be specified.

```
1 LIST
( Large Factorial ) DECIMAL

FORGET TASK      : TASK ;

: BYTE-ARRAY   CREATE ALLOT   ;CODE
    DE INC,  HL POP,  DE HL ADD,  HPUSH

4000 EQU MAX-DIGITS
MAX-DIGITS BYTE-ARRAY F-BUFF
VARIABLE LAST   ( Last buff element )

2 3 THRU

;S
                                              ;S

2 LIST
    ( Factorial 2 )

: *BUFF                         ( Multiplier )
    0 ( Carry )   LAST @ 1+ 0
    DO  OVER I F-BUFF C@ * +
        10 /MOD SWAP I F-BUFF C!
    LOOP
( Extend buffer to accept final carry )
    BEGIN ?DUP
    IF    10 /MOD SWAP
          1 LAST +!   LAST @ DUP 1+
          MAX-DIGITS >
          IF ." Out of buffer" QUIT THEN
          F-BUFF C!
    AGAIN DROP
;
                                              ;S

3 LIST
    ( Factorial 3 )

: SETUP  1 0 F-BUFF C! ( Start buff=1 )
    0 LAST !
;
: .FAC   LAST @ 1+  0
    DO  LAST @ I -   DUP 1+ 3 MOD 0=
      I 0= NOT AND IF ASCII , EMIT THEN
      F-BUFF C@ 1 U.R
    LOOP
;
: FAC
    SETUP
    1+ 1 DO I *BUFF LOOP
;
: FACS   TEXT  SETUP 1+ 1
    DO  I *BUFF ." Factorial" I 3 U.R
        ."  = " .FAC CR
    LOOP
;                                             ;S
```

Sample run.

```
20 FACS
Factorial  1 = 1                  Factorial 11 = 39,916,800
Factorial  2 = 2                  Factorial 12 = 479,001,600
Factorial  3 = 6                  Factorial 13 = 6,227,020,800
Factorial  4 = 24                 Factorial 14 = 87,178,291,200
Factorial  5 = 120                Factorial 15 = 1,307,674,368,000
Factorial  6 = 720                Factorial 16 = 20,922,789,888,000
Factorial  7 = 5,040              Factorial 17 = 355,687,428,096,000
Factorial  8 = 40,320             Factorial 18 = 6,402,373,705,728,000
Factorial  9 = 362,880            Factorial 19 = 121,645,100,408,832,000
Factorial 10 = 3,628,800          Factorial 20 = 2,432,902,008,176,640,000

>100 FAC .FAC
93,326,215,443,944,152,681,699,238,856,266,700,490,715,968,264,381,621,468,592,9
63,895,217,599,993,229,915,608,941,463,976,156,518,286,253,697,920,827,223,758,2
51,185,210,916,864,000,000,000,000,000,000,000,000
```

Telephone charges.

```
10 LET D=0
20 LET E=0
30 LET F=0
40 PRINT AT 7,0;"LOCAL=A,<35 MLS=B,>35 MLS=C"
50 INPUT A$
60 PRINT "PEAK=1,STD=2,CHEAP=3"
70 INPUT G
80 IF G=1 THEN LET D=1
90 IF G=2 THEN LET E=1
100 IF G=3 THEN LET F=1
110 PRINT "MINS AND SECS"
120 INPUT M
130 INPUT S
140 LET T=M+S/60
150 IF A$="B" THEN GOTO 190
160 IF A$="C" THEN GOTO 210
170 LET  X=F*INT(1+T/8) + E*INT(1+T/2) + D*INT(1+T/1.5)
180 GOTO 220
190 LET X=F*INT(1+T/2.4) + E*INT(1+T/.75) + D*INT(1+T/.5)
200 GOTO 220
210 LET X=F*INT(1+T/.8) + E*INT(1+T/.2667) + D*INT(1+T/.2)
220 LET X=X*4.945 + .645
230 PRINT,,"COST IS ";X;"P"
```

Telephone charges

THIS PROGRAM by Michael Miller of Sheffield calculates telephone call charges at the new rates from May 1, 1982. It just fits into 1K so avoid adding frills such as extra print explanations or input checks unless you have an expanded memory.

The program prompts you to specify the call distance, using letters A, B, or C, then the charge rate, using digits 1, 2 or 3. Next you input the length of the call in minutes and seconds, pressing Newline after each. The cost of the phone call then appears on the screen.

The main problems to be dealt with by the program are the complex interaction between distance and charge periods and the charge increments in units, rather than direct proportion. The crucial lines are 170, 190 and 210 which respectively calculate call units for local calls, those up to 35 miles and those over 35 miles, also taking account of the charge time band.

Note that time is worked in minutes. Line 220 calculates the cost, the factor 4.945 representing the unit cost of 4.3p plus VAT at 15 percent.

Machine-code command

USERS of machine code on the ZX-81 often wish to switch between Fast and Slow modes while still using machine-code writes Iain Stewart of Alva, Clackmannan. After studying the Syntax table at 0C29 to 0CB9 of the 8K ROM, which tells the interpreter where to go to execute each keyword of a Basic program, he has found what he thinks is a foolproof method for switching between modes in machine code.

The instruction

CALL FAST (CD200F)

will put the ZX-81 in Fast mode; and similarly,

CALL SLOW (CD280F)

will put the ZX-81 in Slow mode.

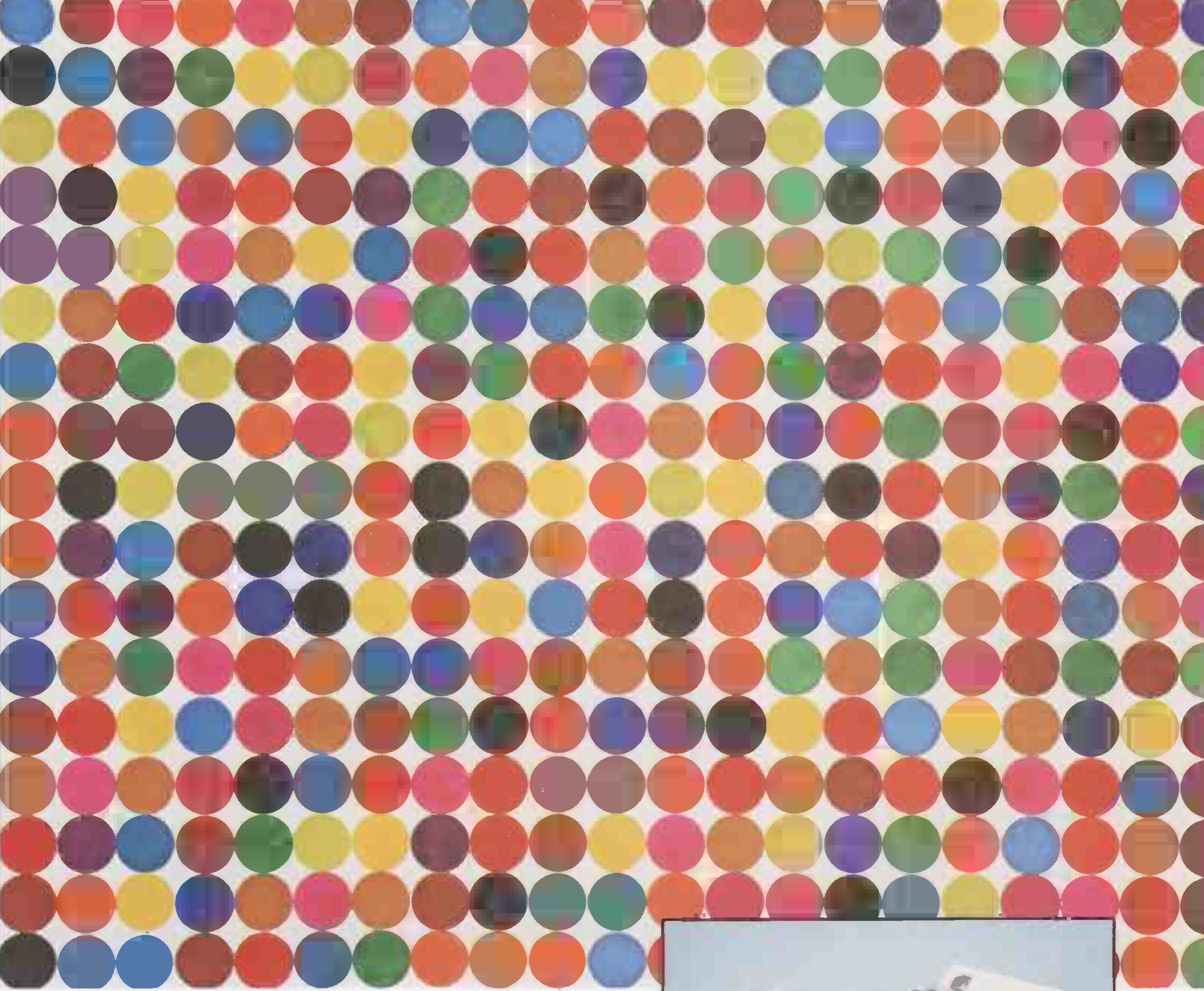
Cricket

CRICKET by Keith Driscoll of Bootle, Merseyside, runs on the 1K ZX-81. The wickets are set up on the left-hand side of the screen. Your man is controlled by keys I and O.

The ball is bowled at you and you must hit it. If you hit it you score one run. You start with 11 men. You lose them by being bowled out or by landing on the black lines to be found on either side of the wickets.

Cricket.

```
1.   let s=0
2    let k=0
4    let b=10
9    cls
10   for a=9 to 11
20   print at a,0 ;"GRAPHIC
     SHIFT  H"
30   next a
45   let z=int(rnd*15+3)
46   let x=10
50   print at b,1;"0 GRAPHIC
     SHIFT 5"; at b-1,1;" ";at
     b+1,1;" "
60   let b=b+(inkey$="0")-
     (inkey$="1")
70   print at 5,1;"-";at
     15,1;"-"
80   print at z,x;"o"
90   let x=x-1
100  if x=-1 then goto 9
110  if z=b and x=1 then goto
     500
120  if x=0 and z>8 and z<12
     then goto 800
130  if b=5 or b=15 then goto
     400
140  if k=11 then goto 600
200  goto 50
400  print "L.B.W."
410  let k=k+1
420  pause 20
430  goto 9
500  let s=s+1
510  goto 9
600  print s;" runs all out "
610  stop
800  let k=k+1
810  print"man out"
820  pause 40
830  goto 9
```



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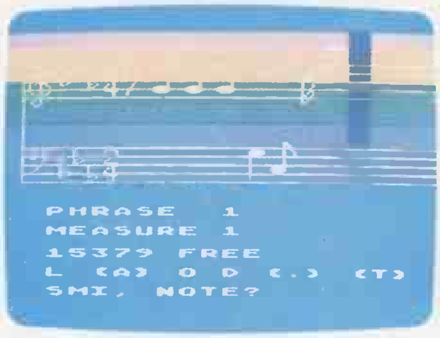
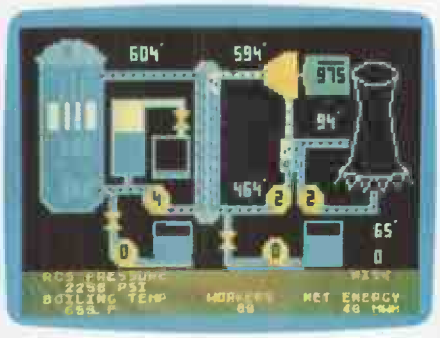


Music Composer


Scram

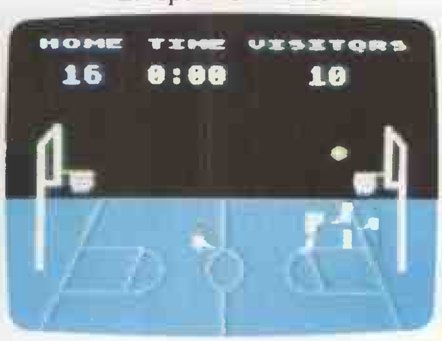
Graph-it


Intro to BASIC 1


Star Raiders

European Countries

Missile Command



Basketball

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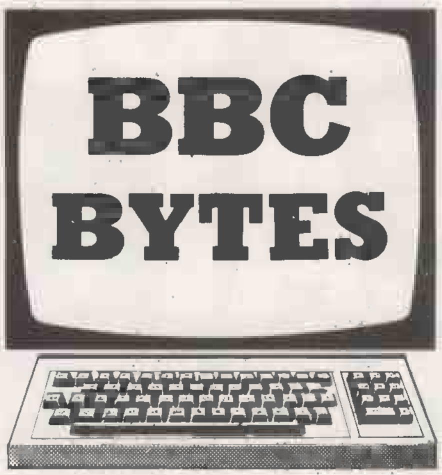

Random numbers

BASIC CAN GENERATE random numbers with ease, using the RND function, but anything written entirely in assembler for speed or size benefits requires special arrangements, writes A Phillips, of Lancaster.

The listings show three assembler routines which access the random-number generator in the Basic ROM, and which can be incorporated into an assembler program. The routines are extremely simple: the random-number generator is entered at &AF41; the other calls all move data in and out of Basic's 32-bit register located at &2A to &2D. The comments on the instruction lines indicate their functions.

The routines are not intended to be used directly from Basic; there would be no point in so doing, so the listing shows them being compiled with two demonstration routines which are entered from Basic in order to produce some example values. The three routines are as follows:

Initrand initialises the random-number generator using the elapsed-time clock as seed. This is exactly equivalent to RND(—TIME) in Basic. No registers need to be set before the call.

Randbyte generates a random number in the range 1 to N, where N is any value up to 255, that is, it generates a random byte. On entry, A holds N, the maximum required value. On exit, A holds the random byte.

Randinteger generates a random number in the range 1 to N, where N is any value up to &7FFFFFFF. On entry, X points the first of four page-zero bytes where the value of N is held. The value is stored low byte first, that is, &11223344 would appear in store as 44 33 22 11. Y points the first of four page-zero bytes where the random number is left, also low byte first.

Calling either with N = 0 will repeat the last-generated value, as does RND(0) in Basic; calling either with N = 1 will give an unpredictable result, since RND(1) is defined as giving a floating-point result which these routines do not handle. If this latter causes a problem, the value of N can easily be checked before the routines are called.

```
 100 REM RANDOM NUMBERS FROM ASSEMBLER
 110 DIM code 100:          REM space for mc code
 200 P% = code:             REM tell assembler where it is
 250                        REM one pass only needed
 300 [
 400 \ initrand - initialise generator using
 500 \            -TIME as seed. No setup needed
 600 \
 700 .initrand
 800   JSR &AEE3     \ read TIME
 900   JSR &ADB5     \ negate it
1000   JSR &AF41     \ call random generator
1100   RTS           \ back to caller
1200 \
1300 \ randbyte - returns a random byte. A holds
1400 \            max wanted value on entry;
1500 \            on exit it holds random value
1600 \
1700 .randbyte
1800   LDY #&0       \ build 32 bit value
1900   JSR &AF19     \ out of value in A
2000   JSR &AF41     \ call random generator
2100   LDA &2A       \ get ls byte of 32 bit
2200   RTS           \ reply and exit
2300 \
2400 \  randinteger - returns a 32 bit random value.
2500 \            On entry X points max value; Y points
2600 \            where reply goes (both being
2700 \            4 consecutive page 0 bytes)
2800 \
2900 .randinteger
3000   TYA
3100   PHA           \ save destination ptr
3200   JSR &AF85     \ pick up max val from page 0
3300   JSR &AF41     \ call generator
3400   PLA
3500   TAX           \ get destination ptr
3600   JSR &BE5C     \ move random value over
3700   RTS           \ and return
3800 \
3900 \
4000 \
4100 \ DEMONSTRATION CALLS
4200 \ ===================
4300 \
4400 \ dembyte - generate byte in range 1 to 32
4500 \
4600 .dembyte
4700   LDA #32       \ load max value
4800   JSR randbyte
4900   STA &70       \ put answer where BASIC can
5000   RTS           \ find it in page 0
5100 \
5200 \ deminteger - generate integer in range
5300 \         range 1 to &FFFF (65535)
5400 \
5500 .deminteger
5600   LDA #&FF      \ set &FFFF as 32 bit int
5700   STA &70       \ in &70 to &73, remembering to
5800   STA &71       \ store bytes in reverse order
5900   LDA #&0
6000   STA &72
6100   STA &73
6200   LDX #&70    \ point to max read value
6300   LDY #&74    \ point to where reply goes
6400   JSR randinteger
6500   RTS
6600 ]
6700 REM
6800 REM
6900 REM Initialise random number generator
7000 REM
7100 REM
7200 CALL initrand
7300 REM
7400 REM
7500 REM Generate and print 5 random bytes
7600 REM
7700 REM
7800 PRINT"Random byte values : "
7900 FOR I% = 1 TO 5
8000   CALL dembyte
8100   PRINT?&70:          REM answer left in byte &70
8200   NEXT I%
8300 REM
8400 REM
8500 REM Generate and print 5 random integers
8600 REM
8700 REM
8800 PRINT"Random integer values"
8900 FOR I% = 1 TO 5
9000   CALL deminteger
9100   PRINT!&74:          REM answer in &74 to &77
9200   NEXT I%
>RUN
173A
173A          \ initrand - initialise generator using
173A          \            -TIME as seed. No setup needed
173A          \
173A          .initrand
173A 20 E3 AE JSR &AEE3     \ read TIME
173D 20 B5 AD JSR &ADB5     \ negate it
1740 20 41 AF JSR &AF41     \ call random generator
1743 60       RTS           \ back to caller
1744          \
1744          \ randbyte - returns a random byte. A holds
1744          \            max wanted value on entry;
1744          \            on exit it holds random value
1744          \
1744          .randbyte
1744 A0 00    LDY #&0       \ build 32 bit value
1746 20 19 AF JSR &AF19     \ out of value in A
1749 20 41 AF JSR &AF41     \ call random generator
174C A5 2A    LDA &2A       \ get ls byte of 32 bit
174E 60       RTS           \ reply and exit
174F          \
174F          \  randinteger - returns a 32 bit random value.
174F          \            On entry X points max value; Y points
174F          \            where reply goes (both being
174F          \            4 consecutive page 0 bytes)
174F          \
174F          .randinteger
174F 98       TYA
1750 48       PHA           \ save destination ptr
1751 20 85 AF JSR &AF85     \ pick up max val from page 0
1754 20 41 AF JSR &AF41     \ call generator
1757 68       PLA
1758 AA       TAX           \ get destination ptr
1759 20 5C BE JSR &BE5C     \ move random value over
175C 60       RTS           \ and return
175D          \
175D          \
175D          \
175D          \ DEMONSTRATION CALLS
175D          \ ===================
175D          \
175D          \ dembyte - generate byte in range 1 to 32
175D          \
175D          .dembyte
175D A9 20    LDA #32       \ load max value
175F 20 44 17 JSR randbyte
1762 85 70    STA &70       \ put answer where BASIC can
1764 60       RTS           \ find it in page 0
1765          \
1765          \ deminteger - generate integer in range
1765          \         range 1 to &FFFF (65535)
1765          \
1765          .deminteger
1765 A9 FF    LDA #&FF      \ set &FFFF as 32 bit int
1767 85 70    STA &70       \ in &70 to &73, remembering to
1769 85 71    STA &71       \ store bytes in reverse order
176B A9 00    LDA #&0
176D 85 72    STA &72
176F 85 73    STA &73
1771 A2 70    LDX #&70    \ point to max read value
1773 A0 74    LDY #&74    \ point to where reply goes
1775 20 4F 17 JSR randinteger
1778 60       RTS
Random byte values :
        14
        16
        11
         3
         6
Random integer values
     5656
    40042
    45051
    23693
    26384
```

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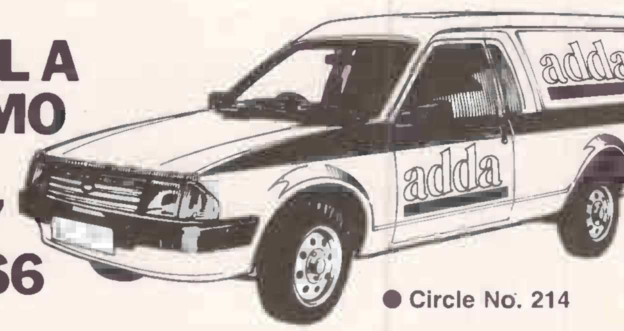

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Cassette word processor

WORD PROCESSING normally demands the use of discs to give the required fast direct access to lines of text for adding or deleting lines or words within the body of the text, writes Peter Hodson of High Wycombe, Buckinghamshire. This program provides simple word-processing facilities for a personal computer with a printer but limited to cassette storage.

The program does not attempt to provide all the features of a full word-processing system, but does provide the basic text-editing capability which can make the production of letters and short reports so much easier. The full text is transferred from cassette to RAM and is held in RAM during processing; the amount of text which can be handled in a 16K machine is about 8,000 characters.

The program has been written for a 16K Video Genie with the full set of cursor keys, and with lower-case characters available on the screen by Poke but not Print. A machine-code routine is used to print lower-case characters; it can be omitted if your machine has a proper lower-case driver, or if you do not need lower case. The program should work with the TRS-80 Model 1 and should be adaptable to many other systems without too much trouble.

About 80 bytes of high memory should be reserved for the machine-code routine before loading the program. When you Run, the first prompt is for the address at which the routine should be loaded. It is completely relocatable, and should be placed at a convenient address in high memory.

The File Create or Update message should be answered:

- C to create a new text file, in which case variables will be re-initialised.
- U to update an existing text file, when the Program will ask whether cassette 1 or 2 is being used, and then load the text file. It will pause after loading the first record, which holds the title of the file, to allow you to restart if you have loaded the wrong cassette.

The program gives the opportunity to change the title of the file, and then

(continued on next page)

```
2 REM ***        W O R D   P R O C E S S O R
3 REM ***
5 GOTO8000
30 REM **ARRAY PUSH/PULL
40 FOR I=NTOM:J=VARPTR(D$(I)):K=VARPTR(D$(I-T)):POKEJ,PEEK(K):POKEJ+1,PEEK(K+1):
POKEJ+2,PEEK(K+2):NEXTI:D$(M)="":M=M+T:GOTO70
60 FOR I=M-TTON-TSTEPT:J=VARPTR(D$(I)):K=VARPTR(D$(I+T)):POKEJ,PEEK(K):POKEJ+1,P
EEK(K+1):POKEJ+2,PEEK(K+2):NEXTI:D$(N)="":M=M-T:GOSUB600
70 N=(8-N)*(N>9):GOTO1500
90 REM **PRINT HEADING
100 CLS:PRINT"TITLE: "F$:PRINT"NO    TEXT":PRINT"--- ---------------------------
-------------------------------":RETURN
190 REM **PRINT A LINE
200 PRINT RIGHT$(STR$(I),3);TAB(4)"";
210 IFLCTHENR2=USR(VARPTR(D$(I))):IFR2=FTHENRETURN
220 PRINT D$(I);:RETURN
390 REM**EDIT CONTROL
400 PRINT@896,B$;:P=964:C=F:D=F
420 PRINT@P-64,"*";
422 IFPEEK(16444)=FTHEN430
425 IFR1<>10ANDR1<>91THEN FOR LP=FTO10:NEXTLP
427 POKE16444,F: 'ZERO KB BUFFER FOR KEY-RPT
430 FOR R1=FTO-TSTEPF:I$=INKEY$:IFI$=""THENNEXTR1ELSEPRINT@P-64," ";
435 R1=ASC(I$)
440 IFR1=13THENRETURN
445 IFR1=26THEND=F:C=F:RETURN: ' CTL=ABORT CHANGE
450 IFR1=31THEND=T:RETURN: ' CLEAR=DELETE LINE
455 IFR1=9THEN490
460 IFR1=8THENP=P+(P>960):GOTO420
465 C=T
470 IFR1=91THEN520
475 IFR1=10THEN550
480 IFR1>63THENIFR1>95THENR1=R1-32ELSER1=R1+32
485 POKE15360+P,R1
490 P=P-(P<1022):GOTO420
519 REM **INSERT BLANK
520 FORI=16383TO15361+PSTEPT:POKEI,PEEK(I+T):NEXTI:POKE15360+P,32:GOTO420
549 REM **DELETE CHARACTER
550 FORI=15360+PTO16382:POKEI,PEEK(I-T):NEXTI:POKE16383,32:GOTO420
590 REM **DECODE EDIT STRING
600 I=VARPTR(A$)-T:POKEI+T,60:POKEI,196:POKEI-T,63
620 FORI=60TO-TSTEPT:IFMID$(A$,I,-T)<>" "THEND$(N)=LEFT$(A$,I):RETURN
630 NEXTI:D$(N)=" ":RETURN
990 REM **DISPLAY ACTION LIST
1000 PRINT@960,CHR$(255);:PRINT@896,"D-DSPLY  A-ADD  C-CHANGE  P-PRINT  E-END  U
-USER DEF'D";
1010 INPUTI$:A$=LEFT$(I$,-T)
1020 PRINT@832,B$;:PRINT@896,B$;:PRINT@960,B$;
1030 IFA$="U"THEN5000
1040 IFA$="E"THEN3000
1050 IFA$="D"ORA$="A"ORA$="C"ORA$="P"THEN1060ELSEPRINT@832,"ACTION '"A$"' NOT RE
COGNISED";:GOTO1000
1060 IFLEN(I$)>-TTHEN1100
1070 IFA$="A"THENN=M:GOTO2500
1080 IFA$="D"THENN=0:GOTO1500
1085 IFA$="P"THENN=0:GOTO4000
1090 PRINT@832,"NO LINE NUMBER";:GOTO1000
1100 N=VAL(RIGHT$(I$,LEN(I$)+T))
1110 IFN>MTHENPRINT@832,"LINE NO > RECORD COUNT";:GOTO1000
1120 IFA$="D"THEN1500ELSEIFA$="C"THEN2000ELSEIFA$="A"THEN2500ELSE4000
1490 :REM **DISPLAY
1500 GOSUB100
1510 FORI=NTON+9:IFI>MTHEN1000
1520 GOSUB200:PRINT
1530 NEXTI
1540 GOTO1000
1990 REM **CHANGE
2000 I=N:PRINT@959," ";:GOSUB200
2010 GOSUB400
2020 IFDTHEN40
2025 IFNOTCTHEN2040
2027 I=VARPTR(A$):POKEI,3:POKEI-T,192:POKEI+2,63:I=VAL(A$):IFI=NTHEN2038
2030 IFI<FTHENN=TELSEIFI>MTHENN=M-TELSEN=I
2035 GOTO2550
2038 GOSUB600
2040 N=(8-N)*(N>9):GOTO1500
2490 REM **ADD
2500 N=N-T:IFN>255THENPRINT@832,"MAX NO OF RECORDS EXCEEDED";:GOTO1000
2510 PRINT@960,CHR$(255);:PRINT@960,RIGHT$(STR$(N),3);:PRINT@963,">";:GOSUB400
2530 IFDORNOTCTHEN1000
2550 IFN<>M-TTHEN60ELSEGOSUB600:M=N:N=(8-N)*(N>9):GOTO1500
2990 REM ** END
3000 CLS
3010 INPUT"OUTPUT FILE # (1 OR 2, OR 0 FOR NO SAVE)";J:IFJ=0THEN3100
3020 IFJ<1ORJ>2THEN3010
3030 PRINT#-J,Q$;F$;Q$
3040 D$(M-T)=CHR$(191): ' 191=END OF FILE
3045 FORI=FTOM-TSTEP4:PRINT#-J,Q$;D$(I);Q$,Q$;D$(I-T);Q$,Q$;D$(I+2);Q$,Q$;D$(I+3
);Q$:NEXTI
3100 INPUT"C-CONTINUE  N-NEW FILE  E-END";A$
3110 IFA$="E"THEN9990
3120 IFA$="C"THEN9200
3130 IFA$="N"THEN9000ELSE3100
3990 REM **PRINT
4000 PS=INP(253):IFPS<>63THENPRINT@832,"PRINTER NOT READY - STATUS IS"PS;:GOTO1000
4010 CLS:PRINTCHR$(23);TAB(6);"PRINT ROUTINE";CHR$(28):PRINT@76,"-------------
4015 PRINT"PRINT STARTING AT LINE"N;:A$="Y":INPUT" OK";A$:IFLEFT$(A$,1)<>"Y"THEN 1000
4020 PS=66:PRINT@896,"PAGE SIZE";:INPUTPS:PRINT@896,B$;
4025 IFPS<20ORPS>130THEN4020ELSEPRINT@192,"PAGE SIZE"PS;
4030 IFPS>63THENLP=60ELSELP=PS-4
4040 PRINT@896,"LINES PER PAGE";:INPUTLP:PRINT@896,B$;
4045 IFLP<12ORLP>PS-4THEN4030ELSEPRINT@256,"LINES PER PAGE"LP;
4050 IT=12:PRINT@896,"LEFT MARGIN";:INPUTIT:PRINT@896,B$;
4055 IFIT<F ORIT>20THEN4050ELSEPRINT@320,"LEFT MARGIN"IT"SPACES";
4060 PH$="N":PRINT@896,"PRINT TITLE (Y/N)";:INPUTPH$:PRINT@896,B$;
4065 IFPH$<>"Y"ANDPH$<>"N"ANDPH$<>"1"THEN4060ELSEPRINT@384,"PRINT TITLE - ";:IFP
H$="Y"THENPRINT"YES";ELSEIFPH$="1"THENPRINT"1ST PAGE ONLY";ELSEPRINT"NO";
4067 IFPH$="Y"THENPN=1:PRINT@896,"STARTING PAGE NO";:INPUTPN:PRINT@896,B$;:PRINT
@448,"STARTING AT PAGE"PN;:PN=PN+TELSEPN=F
4070 DE$="N":PRINT@896,"CHANGE '$' SIGNS TO POUND";:INPUTDE$:PRINT@896,B$;
```

(listing continued on next page)

(listing continued from previous page)

```
4072 IFDE$="N"THENPRINT@512,"NO ";ELSEIFDE$<>"Y"THEN4070
4073 PRINT@515,"'$' CHANGED TO POUND";
4075 PRINT
4080 A$="Y":INPUT"PARAMETERS CORRECT";A$:IFLEFT$(A$,1)<>"Y"THEN4010
4100 PRINT:PRINT"POSITION PAPER AT A NEW PAGE  --"
4110 PRINTTAB(12);"--  THEN PRESS <NEWLINE>"
4120 A$=INKEY$:IFA$<>CHR$(13)THEN4120
4125 PRINT@920,"PRINTING";
4130 LN=PS
4200 FORI=NTOM:IFLN>=LPTHENGOSUB4400
4205 IFLEFT$(D$(I),3)="#P"THENGOSUB4400:GOTO4240
4208 IFLEFT$(D$(I),3)="#s "THEN4300
4210 LPRINTTAB(IT);"";:LN=LN-T:LD=F
4212 IF DE$="N"THENLPRINTD$(I):GOTO4240
4220 FORJ=-TTOLEN(D$(I))
4225 IF MID$(D$(I),J,-T)<>"$"THENELSELPRINTMID$(D$(I),LD-T,J-LD+T);G$;:LD=J
4230 NEXTJ
4235 LPRINTMID$(D$(I),LD-T,J-LD+T)
4240 NEXTI
4250 LPRINT:LPRINT:LPRINT:GOTO1000
4300 J=VAL(MID$(D$(I),4,-T)):IFJ<=FTHENJ=-T
4310 FORK=-TTOJ:IFLN>=LPTHENGOSUB4400:GOTO4240
4320 LPRINT:NEXTK:GOTO4240
4400 PN=PN-T:IFLN<PSTHENFORJ=LN-TTOPS:LPRINT:NEXTJ
4405 LN=F:IFPH$="N"THENRETURN
4410 LPRINTTAB(IT);F$;:IFPH$="1"THENPH$="N":LPRINT:RETURNELSELPRINTCHR$(16);"69"
;PN:LPRINT:LN=2
4430 RETURN
4980 REM **
4990 REM **USER-DEFINED PROCESS
5000 PRINT@832,"NO USER-DEFINED PROCESS ESTABLISHED";:GOTO1000
6990 REM **
7990 REM **LOAD LOWER CASE ROUTINE
8000 DEFINTA:A1=PEEK(16561)+256*PEEK(16562)
8010 CLS:PRINT@384,"MEMORY END IS"A1:INPUT"LOAD LOWER CASE ROUTINE AT";A2
8020 IFA2<=A1THEN8010
8030 A1=A2/256:POKE16527,A1:POKE16526,A2-A1*256
8040 FORA1=1TO255:READA:IFA=-1THEN9000
8050 POKEA1+A2,A:NEXTA1
8060 DATA 205,127,10,229,6,0,78,42,32,64,124,203,47,203,47,214,15,40,7,225,33,16
,0,195,154,10
8062 DATA 9,203,116,225,40,6,33,8,0,195,154,10
8064 DATA 35,94,35,86,42,32,64,235,237,176,122,203,47,203,47,214,15,40,3,17,0,60
,237,83,32,64,33,0,0,195,154,10,-1
8990 REM **INITIALISE
9000 CLEAR8500:DEFINTA-Z:DIMD$(257)
9010 T=-1:F=0:Q$=CHR$(34):B$=CHR$(255):LC=(PEEK(16527)+PEEK(16526)<>F)
9015 G$=CHR$(18)+CHR$(232)+CHR$(188)+CHR$(202)+CHR$(201)+CHR$(194)+CHR$(128)+CHR
$(30) 'POUND SIGN ON TANDY LINEPRINTER VII
9017 J=F:K=F
9020 CLS:INPUT"FILE CREATE (C) OR UPDATE (U)";A$
9030 IFA$="U"THEN9100ELSEIFA$<>"C"THEN9020
9040 M=T:F$="FILENAME":GOTO9200
9100 INPUT"INPUT FILE # (1 OR 2)";J:IFJ<1ORJ>2THEN9100
9110 INPUT#-J,F$:GOSUB100
9120 INPUT"IS THIS THE RIGHT FILE";I$
9130 IFLEFT$(I$,-T)="N"THEN9010ELSEIFLEFT$(I$,-T)<>"Y"THEN9120
9140 FORI=FTO256STEP4:INPUT#-J,D$(I),D$(I-T),D$(I+2),D$(I+3):FORK=ITOI+3:IFD$(K)
=CHR$(191)THENM=K+T:GOTO9200
9150 NEXTK:NEXTI:M=255
9200 GOSUB100:A$="  (NULL=NO CHANGE)"
9210 I$="":PRINT@256,"NEW '"F$"'"A$;:INPUTI$
9220 IFI$<>""THENF$=I$:GOTO9200
9280 GOSUB100
9290 IFM=TTHENPRINT@832,"FILE IS EMPTY";ELSEPRINT@832,"HIGHEST RECORD NO IS"M
9300 GOTO1000
9990 CLS:PRINT@528,"***   END  OF  RUN   ***";:PRINT@960,"";:END
9998 REM ***
9999 REM ***        E N D   O F   P R O G R A M
```

(continued from previous page)

displays a list of options, as follows:

Dnn displays up to 10 lines of text starting at line nn, or at the top line — line 0 — if nn is omitted.

Ann adds a new line following line nn, or at the end of the text if nn is omitted, and then goes into Change mode for entry of text into the new line.

Cnn retrieves line nn for alteration at the bottom of the screen. In this change mode, the text can be overwritten as required. The Clear key will cause the line to be deleted; left- and right-arrow keys move the cursor within the line of text; the up arrow inserts a space and the down-arrow deletes the character at the current cursor position. The space bar and arrow keys have auto-repeat. Press Enter to return the changed line to the body of the text. The Control code — shift plus down arrow on the Genie — will cancel the change and return to the list of options.
A line may be copied to a different line number by Changing the original line and overkeying the line number to the new number. The new line will be inserted, with any changes which have been made, and the original line will be untouched.

Pnn invokes the Print module, which will set up the necessary parameters for print formatting and then print the text starting at line nn.
Print formatting is further aided by two special text elements:

- a line containing only #p starts a new page;
- a line containing only #s followed by one or two digits skips that number of lines or to the next page, whichever comes first.

E allows the text file to be saved, and then gives the option to continue processing on the same file, bring in a different file, or finish the program.

U is an additional option included to allow special requirements to be met by including special code which would be invoked by this option.

All initialisation has been placed at the end of the program, and the most frequently used modules have been placed at the top for speed.

Lines 40 to 70 shift the text array up or down as lines are added or deleted. This is done by altering the length and address fields for the array elements in the Basic variable table, rather than by reassigning the strings themselves. This reduces the use of string space and the frequency of "garbage collection", which can become a problem with large text files and many changes.

Line 100 clears the screen and prints the title at the top.

Lines 200 to 220 print the line number of the line of text and then use the USR routine to print the text. If the routine is not present (LC=0), a Print statement is used.

Lines 400 to 550 control the operation of the program in Change mode; P is the current cursor position, and is marked on the screen by * on the line above, printed by line 420.

Lines 422 to 427 control the auto-repeat feature; 16444 is the address of the keyboard buffer byte for the cursor and space keys, and if reset to zero the key will be detected by Inkey$ again if it is still being pressed.

Line 480 reverses the effect of the shift key, so that text can be typed in the usual typewriter manner with the shift key giving upper case.

Lines 600 to 630 take the text on the bottom line of the screen and assign it to the relevant element of the array of text. This is done by changing the contents of the Basic variable table for A$ to point to the bottom line of the screen, 16320; the length of A$ is held at VarPTR its address at VarPTR+1 and VarPTR+2. A$ is then moved, without trailing blanks, to the current element of the array D$.

Lines 1000 to 1120 display the list of options and direct the processing to the relevant control routine:

display	1500-1540
change	2000-2040
add	2500-2550
end	3000-3130
user	5000

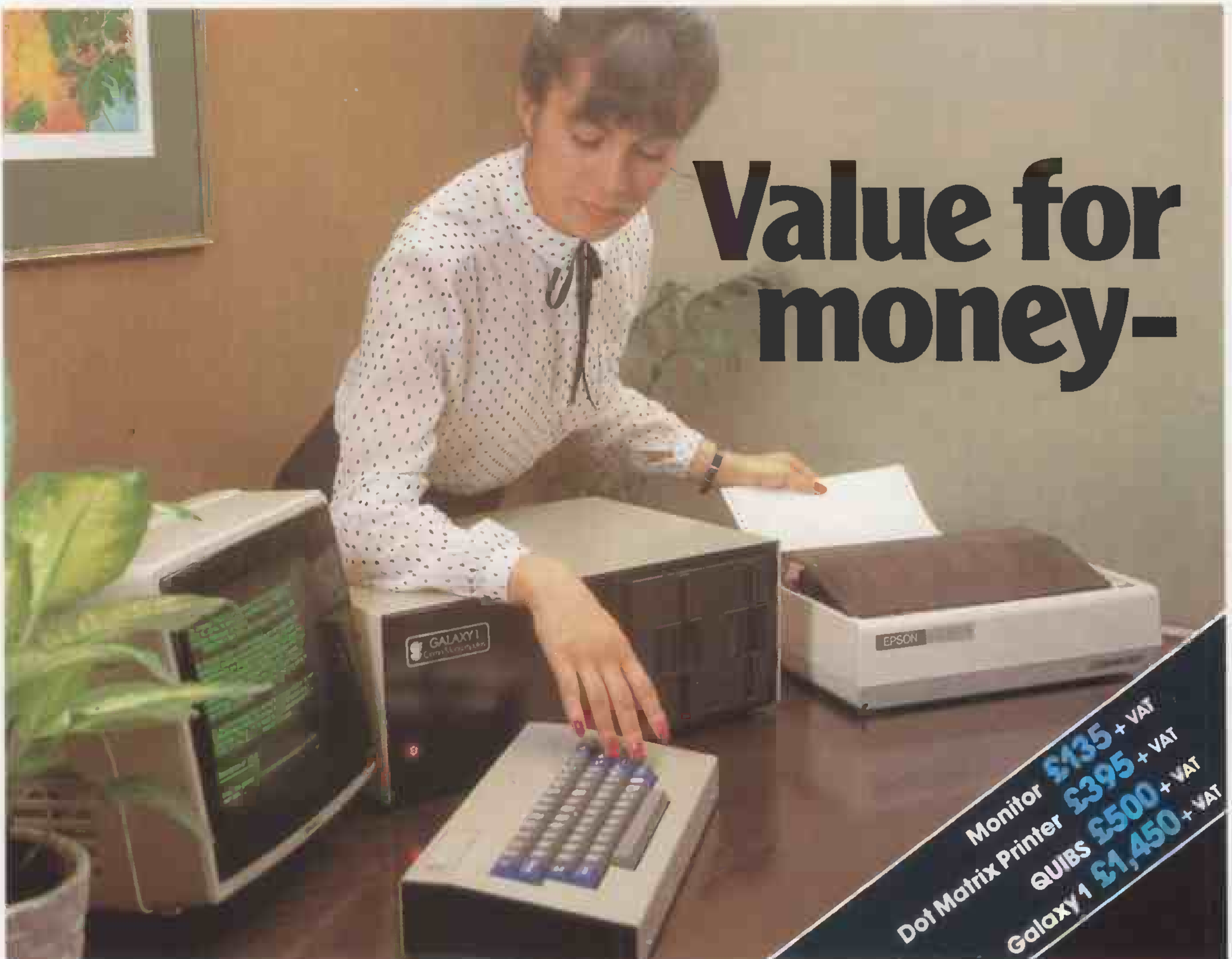
Lines 8000 to 8064 load the machine-code routine to handle lower-case characters, and should be omitted if you do not need it.

The print routine, lines 4000 to 4430, exposes one of the few significant differences between the Genie and the TRS-80. The Genie addresses its Printer via Port 253, whereas the TRS-80 uses memory-mapped I/O via address 14312.

Line 4000 in this program includes Inp(253) which reads the status of the printer; for the TRS-80 this should be Peek (14312). This check is included to prevent the program "hanging up" if the printer is not ready or not connected.

The printer used when developing this program was a Tandy Line Printer VII, which has no £ sign. The program can produce a £ sign by use of the printer's graphics, and this is the function of lines 4070 to 4073 and 4212 to 4235.

The program runs on a 16K Video Genie. It could be improved by faster Loading and Saving of the text, perhaps using the machine-code routine given in *Practical Computing* February 1982, page 125.



in a word: MicroValue.

The Galaxy 1 computer utilises the widely acclaimed Gemini multiboard modules which make it one of the most reliable 2.2 CP/M computer systems on the market.

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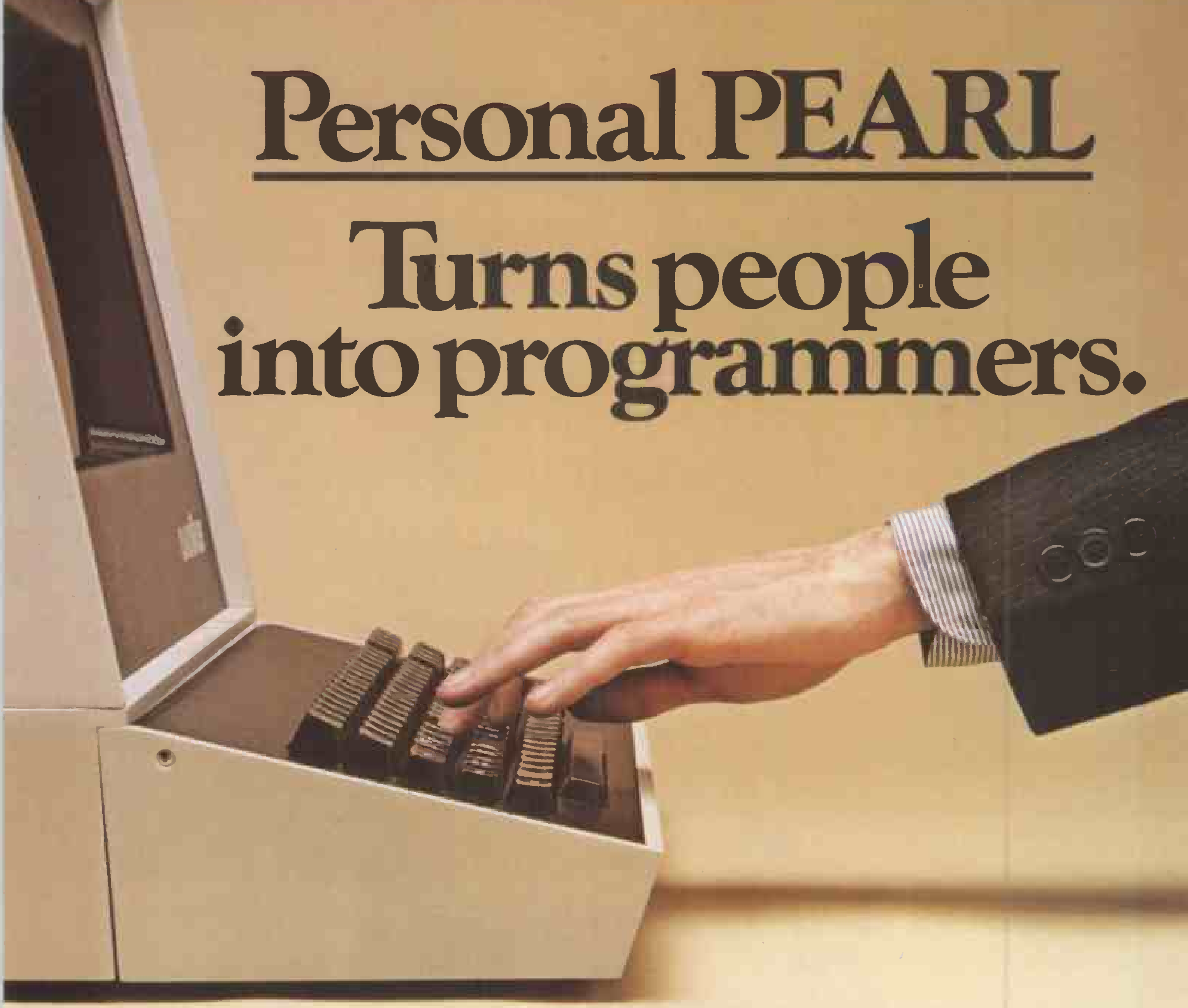

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● Circle No. 216

Terminal emulation

AS BOTH the number and range of available computer systems increase, observes Philip Robertson, it is important that one computer system can communicate with another. The computer industry is investing sizeable resources in this area. The program described here allows a CP/M machine, in this case a Superbrain, to behave as a terminal on a remote computer. With the exception of an escape character — which in this case is control-E, that is ASCII code 05 — the Superbrain keyboard and screen behave as if they were a VDU directly connected to the other machine.

The physical connection is through the main port of the Superbrain, which is RS-232 standard, to a similar port on the remote machine. Some flexibility exists in the exact details of the connection, for example regarding parity and the number of bits per character. The port is set up for seven-bit characters with even parity and one stop bit. These factors along with line speed are easily altered to suit local conditions.

The program polls between the port to the remote computer and the keyboard, checking for input. It gives slightly higher priority to the remote machine, since it is likely to produce the longer sustained sequences of input. The program is written in Z-80 assembler and uses two system calls of CP/M. The program is assumed to follow the CP/M conventions and therefore will be loaded at 100hex in memory. The program defines its stack to be at 200hex. In the program listing, the numbers which appear as comments refer to the notes of explanation:

1. The first three commands define: the addresses of the data register of the port; its status register; and the top of the stack, respectively.
2. The counter, loaded into register B, ensures that the input port for the remote computer is polled ten times as often as the keyboard.
3. Three lines test the status of the input port, checking if a character has been received. If so, the program jumps to the section of code to read in that character. If not, it continues to check for input.
4. This section reads in a character, truncates it to seven bits, then calls the section of code to echo the character to the screen.
5. To read a character from the keyboard, the program uses a system call in CP/M. The direct console I/O routine returns a character in register A should there be one waiting, otherwise register A holds a zero. Having checked whether it is the escape character, the program terminates and returns to the CP/M operating system. If it is some other character, the necessary section of code to relay it to the remote computer is then called. Note that register B is saved on the stack before the system call is made.
6. The routine to write a character to the screen uses a CP/M system call.
7. Before the character can be sent, the status port must be checked to ascertain that it is ready to accept data. When this is so, the character is sent.

Wordno

WORDNO is a simple MBasic program to estimate the number of words in a text file, writes David Green of Nairobi, Kenya. It was written to count words in WordStar files, so it is capable of dealing with control characters and non-zero high bits.

The file is read in one byte at a time, then Anded with 127 to mask the high bit; Control characters are ignored. If a printable character is found a flag is set. If a space or carriage return is found when the flag is set then a word is counted and the flag reset. When the file ends the total is printed.

It is a little slow — it takes about 80 seconds to count 1,000 words on an Osborne1, but it is not the sort of program you need to run all the time. It certainly beats counting by hand.

The program counts hyphenated words as one, unless at the end of a line when it counts two. Things like an isolated asterisk or a row of stars count as single words. The last word will not count unless you finish with a return.

Terminal emulation.

```
;        Initialise constants
;
MDATA    EQU      58H                         ; 1
MSTAT    EQU      59H
;
         LD       SP,200H
BEGIN:
         LD       B,10                        ; 2
;
;        Check for input from remote
;
LOOP:
         IN       A,MSTAT                     ; 3
         AND      02
         JP       NZ,REMIN
         DEC      B
         JP       NZ,LOOP
         JP       TERMIN
;
;        Read character in from remote
;
REMIN:
         IN       A,MDATA                     ; 4
         AND      07FH
         CALL     TERMOUT
         DEC      B
         JP       NZ,LOOP
;
;        Look for input from keyboard
;
TERMIN:
         LD       C,6                         ; 5
         LD       E,0FFH
         PUSH     B
         CALL     5
         POP      BC
         AND      07FH
         CP       0
         JP       Z,BEGIN
         CP       5
         JP       Z,0H
         CALL     REMOUT
         JP       LOOP
;
;        Echo character to screen
;
TERMOUT:
         LD       C,2                         ; 6
         LD       E,A
         PUSH     BC
         CALL     5
         POP      BC
         RET
;
;        Echo character to remote
;
REMOUT:
         LD       C,A                         ; 7
R1:
         IN       MSTAT
         AND      01
         JP       Z,R1
         LD       A,C
         OUT      MDATA,A
         RET
```

Wordno

```
100 '   WORDNO - A PROGRAM TO ESTIMATE WORDS
110 '   IN A "WORDSTAR" FILE.

120 '   C 1982 by D. R. Green
130 '   P.O. Box 50973, Nairobi, Kenya

140 DEFINT A - Z
150 N = 0          'SET COUNT TO ZERO
160 LINE INPUT "  What is the filename?  ";FILENAME$
170 OPEN "I",1,FILENAME$

180 FLAG = 0     'MARKS A "NON-SPACE" CHARACTER
190     WHILE NOT EOF(1)
200 '
        REMOVE HIGH BIT FROM CHARACTER ON INPUT

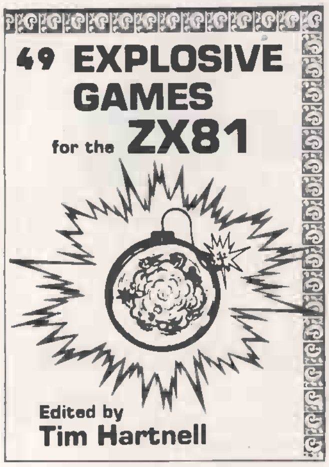
210     CHAR = ASC(INPUT$(1,£1)) AND 127

220     IF CHAR > 32 THEN FLAG = 1
        ELSE IF (CHAR = 32 OR CHAR = 13) AND FLAG
        THEN N = N + 1 : FLAG = 0
230     WEND
240 '  ************  FINISH HERE ON EOF **********

250 PRINT:PRINT:PRINT "  There are";N;"words"
260 CLOSE
270 END
```

49 Explosive Games for the ZX-81

Edited by Tim Hartnell. Published by Interface. £5.95. 140 pages. ISBN 0 907563 08 2.



THOUGH THERE ARE more than 49 programs for the ZX-81 in this book, only about 10 of them could conceivably be termed "explosive". They include card cames, an Adventure and a program to draw pictures on the screen.

Most are written in Basic, with the exception of one which produces a moving display on the ZX-80 and has been written in machine code for speed. The size of the programs varies as much as the quality. Some are so small they are not worth saving on tape while others require a sizeable chunk of memory.

All the ZX-81 programs work well, with few programming errors. This accuracy is achieved by using the listings straight from the Sinclair printer, but clarity of text suffers as a result. In several of the programs the inverse characters are completely illegible. Some of the screen photographs are also unsatisfactory.

The presentation of the book is in typical Interface style: the software is interspersed with diagrams, quotations, and humorous interludes — some of them in Latin or French. Frequently the diagrams are of a Victorian style, and do not appear to have any connection with the programs.

The last 51 pages of the book contain a section of 28 programs for the 4K ROM ZX-80. There is a wide selection of programs, many of which could be converted for the ZX-81 and vice versa. Conversion techniques are explained in a section detailing the difference between the two machines.

Conclusions

- **The quality of the book is generally high, but is let down in some areas by the clarity of reproduction.**
- **The descriptions of the programs could have been improved by including an explanation of how they actually worked.**
- **There should be something in the book to suit all members of the Sinclair community.**

Andrew Jones

Basic Programming on the BBC Microcomputer

By Neil Cryer and Pat Cryer. Published by Prentice-Hall International. 195 pages, £5.95. ISBN 0 13 066407 3.

THIS BOOK aims to teach the user how to program in BBC Basic. It is written using non-technical language which allows the beginner to understand the concepts fully, though it assumes that you have a BBC model A or B in front of you.

The programming starts off at a very simple level which accustoms the beginner with the machine. Once the basic skills have been established, more complex commands are covered, for some of the advanced commands only the main points are discussed. The colour and animation facilities are covered well, although advantage is not taken of the full potential of the model B. This means that all the programs will run on both models.

A section on peripherals listing add-ons for the BBC Micro is already out of date and was obviously written before the price rises in February. The glossary includes a short explanation of all the command words.

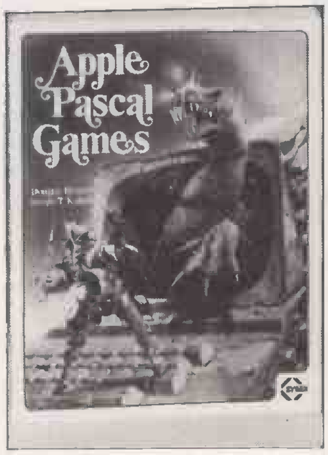
Conclusions

- **This book provides an excellent introduction to the BBC Microcomputer. It is especially useful as an alternative to the BBC's manual.**
- **It teaches BBC Basic in a non-technical easy-to-understand way, ideal for the beginner.**
- **The book should appeal to anyone who has or intends to use a BBC Micro, and explains how to use the extended facilities offered on this powerful computer. It is approved by Acorn.**

Andrew Jones

Apple Pascal Games

By Douglas Hergert and Joseph T. Kalash. Published by Sybex. 371 pages.



THIS BOOK has two potential audiences: those interested in games and those interested in Pascal. The games are mostly familiar examples published many times before in Basic. A comparison of Basic and Pascal versions shows nicely the power and effectiveness of Pascal. The text should persuade the programmer who works in Basic that Apple Pascal offers a better medium for writing games.

Most of the features of Apple Pascal are illustrated, including records, sets, pointers, files and recursion. Turtlegraphics are used in the third part of the book. Particularly good is the presentation of a more substantial program at the end of the book, for it is in bigger programs that the advantages of Pascal are most apparent. Programmers who study the examples should learn a great deal about how to use Pascal.

Conclusions

- **Since most textbooks on Pascal are short on worked examples, collections such as this one are valuable.**
- **The book provides particularly welcome examples on features specific to the Apple implementation.**

John Cookson

My Micro Speaks Basex (and loves it)

By Paul Warme. Published by Hayden, distributed by John Wiley, £7.75.

BASEX, another variant on the well-worn Basic theme, is a language which combines some features of Basic with some of assembly languages. The advantages of Basic which would be particularly applicable are its simplicity and the convenient environment in which Basic programs are run. From the point of view of assembler one would hope for the speed of assembly languages without their inscrutability.

Basex programs run in an environment which is similar to Basic's but which is more complex and more difficult to use. For example, if after running a program you wish it to remain in store you must type 0 followed by Carriage Return.

The obvious nature of most Basic control commands has been lost. In Basic, to alter a line normally one only has to retype the line with the same line number. In the case of Basex an extra command, Loc, has to be used. To insert a line, a combination of Ins and Dlt commands has to be used because the numbers identifying lines refer to absolute addresses in store.

Since Basex is a compiled language for 8080 or Z-80 machines it runs faster than Basic — up to 10 times faster, it is claimed, so in terms of speed Basex does offer substantial advantages. Basex can be used in a machine with as little as 16K of store.

The bad news is that Basex can handle only integer numbers in the range −32,768 to 32,767. Moreover it cannot handle real numbers, and has no way of handling arithmetic expressions, so they have to be broken down into a sequence of single operations.

Conclusions

- **Basex is a fast, compiled integer Basic hybrid with assembly language.**
- **It is more difficult to use than Basic and offers little advantage over assembler.**
- **My micro does not speak Basex (and doesn't miss it).**

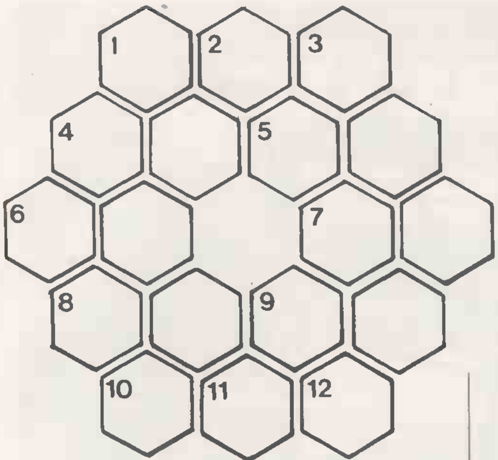
John Cookson

Age Square

by

Tony

Roberts



TODAY is my birthday, and my age is now a perfect square. Strangely, it is also the sum of the ages of my children.

The children's ages are all in the grid — in binary, of course:

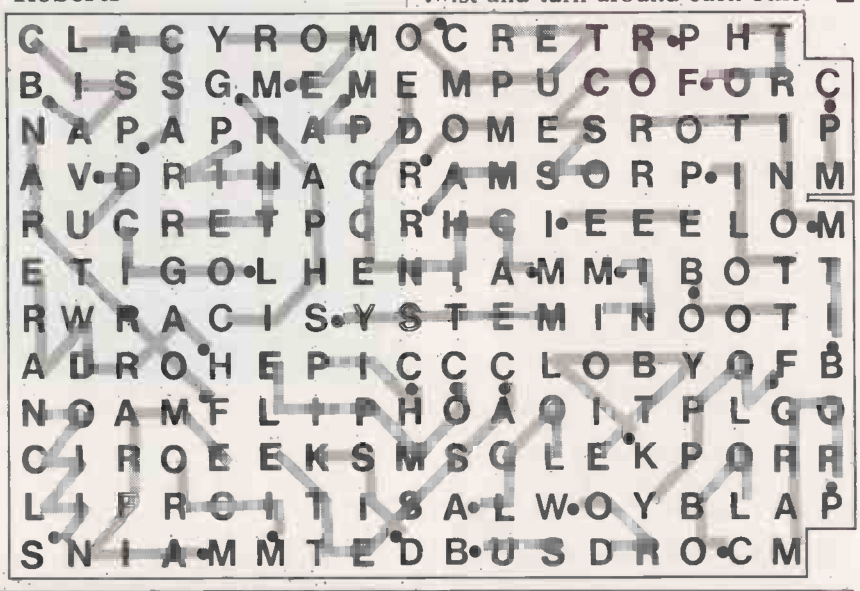
1 across × 5 up, or 4 across
1 down + 6 up, or 8 up
6 across × 2 down − 7 across, or 3 down
9 down × 6 down − 12 up, or 11 up
10 up × 10 across + 4 down, or 8 across

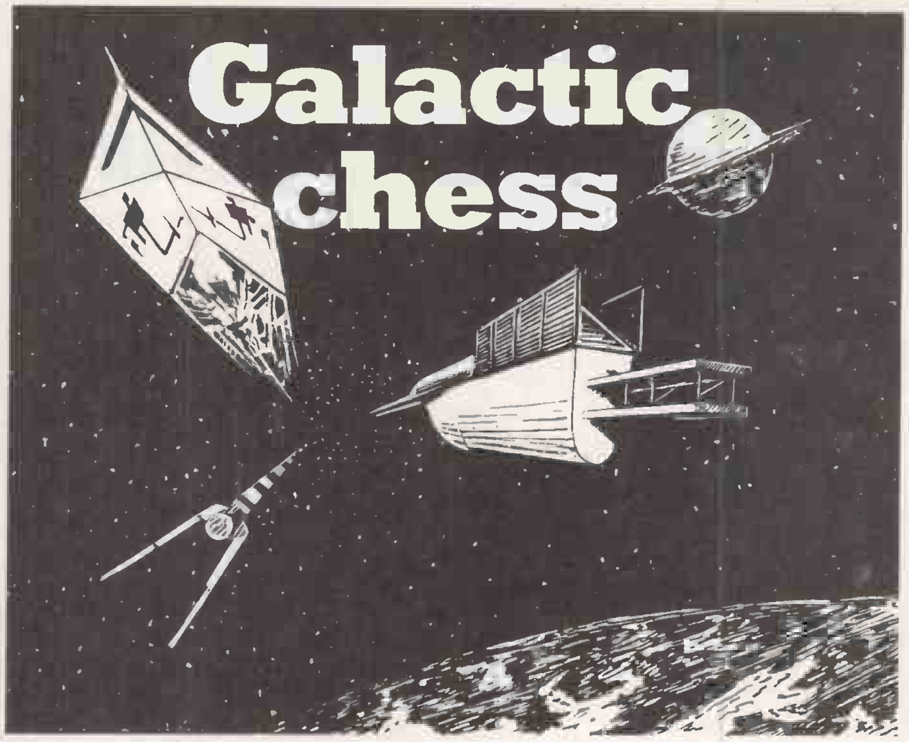
How old am I?

Solution to August puzzle

"Sir. This is as twisted as my stick, not straight and nasty like your English ones. Our ancestors never wasted a thing but, like a haggis, you can only eat each bit the once."

Well, did you manage, with the help of that clue, to unravel the mystery shrouding the solution to the code on the stone? As you can see nothing is wasted, and the words twist and turn around each other.






```
10 REM ******* GALACTIC CHESS *******
20 REM *                            *
30 REM * An S & S Wallis game based *
40 REM *     on the video game      *
50 REM *        "STAR CHESS"        *
60 REM *                            *
70 REM *         (C) 8.5.82         *
80 REM *                            *
90 REM ******************************
100 TEMPO 5:DIM P$(5,1),S(7,7),C(7,7),M(7,7),D(7,7),X(5),W(1),WM(1),WD(1)
110 W(0)=9:W(1)=9:FOR I=0 TO 5:READ P$(I,0),P$(I,1):NEXT
120 DATA [illegible]
130 DATA [illegible]
140 FOR I=0 TO 5:READ X(I):NEXT
150 DATA 2,4,4,6,8,8
160 FOR I=0 TO 7:FOR J=0 TO 7:READ S(I,J)
170 IF S(I,J)=9 THEN NEXT J
180 M(I,J)=X(S(I,J)):D(I,J)=M(I,J):NEXT J,I
190 DATA 3,0,9,9,9,9,0,3,2,0,9,9,9,9,0,2,1,0,9,9,9,9,0,1,4,0,9,9,9,9,0,4
200 DATA 5,0,9,9,9,9,0,5,1,0,9,9,9,9,0,1,2,0,9,9,9,9,0,2,3,0,9,9,9,9,0,3
210 FOR I=0 TO 7:C(I,6)=1:C(I,7)=1:NEXT
220 REM ** INSTRUCTIONS **
230 PRINT"          GALACTIC CHESS"
240 PRINT"          ______________"
250 PRINT"This is the game of GALACTIC CHESS, the "
260 PRINT"game of strategy. Four options are"
270 PRINT"available to you:"
280 PRINT"    i) M ... to move a piece."
290 PRINT"   ii) F ... to fire from a piece."
300 PRINT"  iii) W ... to place a piece in warp            drive."
310 PRINT"   iv) R ... to report on a piece's              status."
320 PRINT"  The cursor can be manipulated about"
330 PRINT"the screen by the cursor keys."
340 REM ** BOARD **
350 GOSUB 1900:PRINT"";:FOR I=1 TO 8
360 PRINT"*   *   *   *   *   *   *   *   *":PRINT:PRINT:NEXT
370 PRINT"*   *   *   *   *   *   *   *   *"
380 PRINT"        ┌───\";TAB(32);"/───┐"
390 PRINT"    |    \";TAB(32);"/    |"
400 FOR I=1 TO 3:PRINT"    |    |";TAB(32);"|    |":NEXT
410 PRINT"    |    /";TAB(32);"\    |"
420 PRINT"    └───/";TAB(32);"\───┘"
430 FOR Y=0 TO 7:X=0:GOSUB 1710:X=1:GOSUB 1710:X=6:GOSUB 1710:X=7:GOSUB 1710
440 NEXT:WD(0)=9:WD(1)=9
450 REM ** FLASHING SCREEN AND LED WITH SOUND EFFECTS **
460 POKE 59555,0:POKE 57347,4:FOR I=1 TO 20:POKE 4514,I:USR(68):NEXT
470 POKE 59555,1:POKE 57347,5:FOR I=20 TO 1 STEP-1:POKE 4514,I:USR(68):NEXT
480 GET A$:IF A$=""THEN 460
490 USR(71)
500 REM ** PLAYERS' TURNS **
510 FOR CC=0 TO 1
520 CX=0:CY=0:CR=90:IF CC=1 THEN CX=7:CR=69 : REM 90 = "→" 69 = "←"
530 MM=0:GOSUB 1740:ZX=CX:ZY=CY:IF(A$="F")*(C(CY,CX)=CC)*(S(CY,CX)<9)THEN590
540 IF(A$="M")*(C(CY,CX)=CC)*(S(CY,CX)<9)THEN MM=1:GOTO 590
550 IF A$="R" THEN 1100
560 IF(A$="W")*(C(CY,CX)=CC)*(S(CY,CX)<9)THEN 1210
570 REM ** ERROR **
580 POKE X,X1:POKE 4514,30:USR(68):FOR I=1 TO 500:NEXT:USR(71):GOTO 520
590 POKE X,X1:GOSUB 1740:IF A$=CHR$(102) THEN 620: REM Carriage Return
600 GOTO 580
```

Earth at war is the dramatic setting for this futuristic game. Steven and Sean Wallis replace normal chess pieces with spaceships equipped with laser bolts.

THE YEAR IS 2082. The date is July 10.

From deep in the gigantic caverns of the moon, fires blazed. An enormous slender gleaming white spacecraft burst free of the weak lunar gravity and disappeared into the void. Other fighters soon followed. Eight white shuttle craft, removed from normal service, were equipped with laser weapons and launched. Finally, the Earth Command flagship, Toronto, reached escape velocity and blasted away into space. With space-scarred Space Bases, the captured Pluto II, and Earth's Pluto I providing back-up and recharging facilities for the two monstrous fleets, both sides were equally equipped. Earth was at war.

This is the setting for Galactic Chess, a futuristic version of chess with firing and warping facilities. Normal chess pieces are replaced by spaceships, which start with allotted numbers of laser bolts and shields. Two players alternately control opposing fleets. Their aim is to destroy the opposing king, winning the battle.

All ships except the pawn move as in chess but castling does not exist. Pawns can move one square vertically or horizontally but cannot queen. Firing takes place in the same directions and distances as moving. The king and queen's squares on each side are space bases and may not be entered by an opposing ship under any circumstances. Ships inside are automatically replenished with laser bolts at a rate of one per turn, but may not hold more than the allotted capacity. Ships are manipulated by moving an arrow-shaped cursor, which indicates the square in front and below. It is moved with the cursor keys. An illegal response sends the cursor to its starting position.

To move, move the cursor to the ship's

(continued on next page)

```
610 REM ** VALIDATE MOTION OR SHOT **
620 DX=CX-ZX:DY=CY-ZY:IF(DX=0)*(DY=0)THEN 580
630 ON S(ZY,ZX) GOTO 660,680,700,720,740
640 IF(DX=0)*(ABS(DY)=1)+(DY=0)*(ABS(DX)=1)THEN 750
650 GOTO 580
660 IF ABS(DX)=ABS(DY) THEN 750
670 GOTO 580
680 IF(ABS(DX)=2)*(ABS(DY)=1)+(ABS(DX)=1)*(ABS(DY)=2)THEN 750
690 GOTO 580
700 IF(DX=0)+(DY=0)THEN 750
710 GOTO 580
720 IF(DX=0)+(DY=0)+(ABS(DX)=ABS(DY))THEN 750
730 GOTO 580
740 IF(ABS(DX)>1)+(ABS(DY)>1)THEN 580
750 POKE X,X1:SX=DX:SY=DY:ST=1
760 IF ABS(DX)=ABS(DY)THEN SX=SGN(DX):SY=SGN(DY):ST=ABS(DX)
7.70 IF DX=0 THEN SY=SGN(DY):ST=ABS(DY)
780 IF DY=0 THEN SX=SGN(DX):ST=ABS(DX)
790 IF MM THEN 990
800 REM ** FIRING **
810 M(ZY,ZX)=M(ZY,ZX)-1:IF M(ZY,ZX)<0 THEN H1=9:M(ZY,ZX)=0:POKE X,X1:GOTO1250
820 REM ** MOVE LASER BOLT **
830 GOSUB 1890:CX=ZX:CY=ZY:FOR SS=1 TO ST:CX=CX+SX:CY=CY+SY:IF SS=1 THEN 870
840 REM ** RANDOM DEFLECTIONS **
850 IF RND(1)<.1 THEN CX=CX-SX
860 IF RND(1)<.1 THEN CY=CY-SY
870 IF S(CY,CX)<9 THEN 900
880 POKE 4465,CX*4+5:POKE 4466,CY*3+1:PRINT"—333~333";
890 FOR I=1 TO 100:NEXT:PRINT"  333  ";:NEXT SS
900 H1=S(CY,CX):H2=C(CY,CX):POKE 4465,CX*4+5:POKE 4466,CY*3+1
910 PRINT"-.:3333.*-3333";:FOR I=10 TO 30:POKE 4514,I:USR(68):NEXT
920 FOR I=1 TO 20:FOR J=10 TO 7 STEP-1:POKE 4514,J:USR(68):NEXT J,I:USR(71)
930 IF H1=9 THEN 970
940 REM ** CALCULATE EFFECT OF HIT **
950 D(CY,CX)=D(CY,CX)-INT(RND(1)*8/SQR(SS)):IF D(CY,CX)<0 THEN 970
960 X=CX:Y=CY:GOSUB 1710:H1=9:GOTO 1250
970 S(CY,CX)=9:PRINT"   3333   ";:GOTO 1250
980 REM ** MOVING **
990 IF ST=1 THEN 1040
1000 REM ** ANYTHING IN THE WAY ? **
1010 MX=ZX:MY=ZY:FOR SS=1 TO ST-1:MX=MX+SX:MY=MY+SY
1020 IF S(MY,MX)<9 THEN 580
1030 NEXT SS
1040 IF(C(CY,CX)=CC)*(S(CY,CX)<9)THEN 580
1050 IF(CX=7-CC*7)*((CY=3)+(CY=4))THEN 580
1060 H1=S(CY,CX):H2=1-CC:POKE 4465,ZX*4+5:POKE 4466,ZY*3+1:PRINT"   3333   "
1070 S(CY,CX)=S(ZY,ZX):C(CY,CX)=CC:M(CY,CX)=M(ZY,ZX):D(CY,CX)=D(ZY,ZX)
1080 S(ZY,ZX)=9:X=CX:Y=CY:GOSUB 1710:GOTO 1250
1090 REM ** REPORTING **
1100 POKE X,X1:MI=M(CY,CX):DF=D(CY,CX):PRINT"0";:IF S(CY,CX)=9 THEN MI=0:DF=8
1110 IF MI=0 THEN 1130
1120 PRINT"0";:FOR I=1 TO MI:PRINT" —333~3":NEXT
1130 IF DF=0 THEN 1150
1140 PRINT"0";:FOR I=1 TO DF:PRINT TAB(38);"3333":NEXT
1150 POKE 4465,CX*4+5:POKE 4466,CY*3+1:PRINT"   3333   ":X=CX:Y=CY:GOSUB 1710
1160 POKE 4514,15:FOR I=4 TO 27:POKE 4513,I:USR(68):NEXT
1170 GET A$:IF A$=""THEN 1150
1180 USR(71):PRINT"0";:FOR I=1 TO 24:PRINT"   ";TAB(38);" ":NEXT
1190 H1=9:GOTO 1250
1200 REM ** WARPING **
```

(listing continued on next page)

SHOPWINDOW

(continued from previous page)

square, press M, and move the cursor to the target square and press Return. If the move is legal, the ship moves and destroys an opposing ship on the target square if any.

To fire, press F to fire from a ship to a target square. If it has no laser bolt, you forfeit the move. The laser bolt proceeds towards the target square but may be deflected or slowed down on the way. If it hits a ship, a number of shields may be destroyed. If the ship has too few shields, it will be destroyed. Shots are most powerful and accurate at close range.

To report, press R to obtain a report on the ship on the cursor square. The ship's laser bolts and shields are then displayed. An empty square has no laser bolts and eight shields.

To warp a ship, press W with the cursor on its square. At any time each player can have one ship in warp. It may return later in the game in a random position on the board and will destroy any ship on that square. If another of the player's ships is already in warp it will never return, and if this is the king, the game is lost.

Quite interesting and complex games can be played, and there are a number of strategic points which should be taken into account. The king should normally remain in its space base so that it is fairly safe, but sometimes must be moved to avoid being fired at. It may also be wise to move it to recharge other ships. Always keep it in a safe position. Try to break through the opposing defence to get in a position to attack the king from as near as possible to be most effective.

Main variables.

- P$(5,1) Array of ships. P$(x, 0) face right, P$(x,1) face left.
- S(7,7) Ship type 0-5, 9 empty square.
- C(7,7) Colour of ship, O or 1.
- M(7,7) Number of laser bolts for ship.
- D(7,7) Number of shields.
- X(5) Maximum number of laser bolts and shields per ship type.
- W(1) Ship type in warp.
- WM(1) Number of laser bolts for ship in warp.
- WD(1) Number of shields.
- X Cursor address on screen, ship plotting control variable.
- Y Ship plotting control variable.
- CC Player, 0 or 1.
- CX & CY Cursor position.
- ZX & ZY Old cursor position.
- DX & DY Distance between old and current cursor positions.
- SX & SY Step towards target square.
- ST Number of steps.
- CR Cursor character.

Program lines.

- 100-210 Initialization. 120 and 130 contain the spaceship character strings.
- 230-330 Instructions.
- 350-440 Set up board.
- 460-490 Optional visual and sound effects.
- 510-1240 Accept and process option.
- 1250-1350 Replenish stocks in space bases, return from warp and next player.
- 1370-1690 Game ends. Optional picture.
- 1710-1720 Plot ship on board.
- 1740-1870 Move cursor.
- 1930-2030 Optional music.

(listing continued from previous page)

```
1210 POKE X,X1
1220 H1=W(CC):H2=CC:W(CC)=S(CY,CX):WD(CC)=D(CY,CX):WM(CC)=M(CY,CX):Y=CY:X=CX
1230 FORI=25TO1STEP-1:GOSUB 1710:POKE 4514,I:FORJ=255 TO 0 STEP-5:POKE 4513,J
1240 USR(68):NEXT J:PRINT"         ";:NEXT I:USR(71):S(CY,CX)=9
1250 IF H1=5 THEN 1370
1260 FOR I=3 TO 4:IF S(I,CC*7)=9 THEN 1280
1270 M(I,CC*7)=M(I,CC*7)+1:IF M(I,CC*7)>X(S(I,CC*7))THEN M(I,CC*7)=M(I,CC*7)-1
1280 NEXT
1290 IF(RND(1)>.2)+(W(CC)=9) THEN 1350
1300 REM ** RETURN FROM WARP **
1310 X=INT(RND(1)*8):Y=INT(RND(1)*8):IF(X=7-CC*7)*((Y=3)+(Y=4))THEN 1310
1320 H1=S(Y,X):H2=C(Y,X):S(Y,X)=W(CC):C(Y,X)=CC:M(Y,X)=WM(CC):D(Y,X)=WD(CC)
1330 FORI=1 TO 25:GOSUB 1710:POKE 4514,I:FORJ=0 TO 255 STEP 5:POKE 4513,J
1340 USR(68):NEXT J:PRINT"         ";:NEXT I:GOSUB 1710:USR(71):W(CC)=9
1350 NEXT CC:GOTO 510
1360 REM ** DESTRUCTION OF KING - LOSS OF GAME **
1370 FOR I=0 TO 7:FOR J=0 TO 7
1380 IF(S(I,J)=9)+(C(I,J)<>H2)THEN 1410
1390 POKE 4465,J*4+5:POKE 4466,I*3+1:PRINT".:.*";
1400 FORX=25TO1STEP-1:POKE 4514,X:USR(68):NEXT X:PRINT"         ":USR(71)
1410 NEXT J,I:POKE 4466,12:POKE 4465,16:FOR I=1 TO 5:PRINT"GAME OVER";
1420 MUSIC"R3":PRINT"*   *   *";:MUSIC"R3":NEXT
1430 PRINT"";
1440 PRINT"";
1450 PRINT"
1460 PRINT"
1470 PRINT"                                   .";
1480 PRINT"
1490 PRINT"                                   .";
1500 PRINT"
1510 PRINT"
1520 PRINT"
1530 PRINT"
1540 PRINT"
1550 PRINT"
1560 PRINT"          GREY   FLEET
1570 PRINT"
1580 PRINT"
1590 PRINT"";
1600 PRINT"
1610 PRINT"";
1620 PRINT"
1630 PRINT"";
1640 PRINT"
1650 PRINT"";
```

Type	White	Grey	Laser bolts and Shields maximum
Pawn			2
Bishop			4
Knight			4
Rook			6
Queen			8
King			8


Table of ships.

Take opposing ships where possible, but keep your ships safe at the same time. Ships have different attacking powers, laser bolts from queens and bishops may swerve and hit another ship, possibly your own. Those from knights are most effective but have a limited range. Bishops and knights often need recharging.

It is quite often worth warping, but you should usually warp pawns; avoid it when one of your ships is already in warp. Use warping as a last resort for major ships, and only warp your king under very severe conditions. Reporting is not a very good use of a turn but is used to survey the situation or to use up a turn if you do not wish to or cannot move. When you move a ship be careful not to leave it where it may be taken. Beware of the way pawns move: try to destroy as many of the opposing ships as possible to lessen the chances of mistakes.

The board occupies all lines of the 40-by-25 screen and is 33 characters wide starting from the fourth column. The corners of most squares are marked by asterisks. Each square can contain a ship of dimensions 3 × 2. The spaces on either side are used for reports. Galactic Chess is written for the Sharp MZ-80K with at least 24K — 10K user RAM — but should fit into an 8K computer with a few modifications.

In line 1740, 120 is the line length multiplied by 3, and 53252 is the top left of the screen + 4.

```
POKE 4465,X:POKE 4466,Y
```

is equivalent to

```
PRINT @ X, Y
```

or

```
PRINT"[HOME]"+LEFT$(AC$,X)
        +LEFT$(DN$,Y);
```

where AC$ is a string of right cursors and DN$ is a string of down cursors. Alternatively, the ships, laser bolts, etc. could be plotted in high resolution. Note that all ships are plotted in line 1720.

Poking of X should be retained. All the other Pokes and the USRs produce sound and visual effects and may be removed, although they add an extra dimension to the game. In Print statements a reverse-C clears the screen and moves the cursor to 0, 0, reverse-H moves the cursor to 0, 0 and reverse arrows move the cursor one character in the direction indicated. In line 1420, Music "R3" causes a short wait.

```
1660 PRINT"▒          ▒ ▒ ▒ ▒
1670 PRINT"I          ▒ ▒ ▒ ▒ ▒";:FOR I=54226 TO 54247:POKE I,208:NEXT : REM ▒
1680 GOSUB 1930:IF A$="Q" THEN END
1690 RUN
1700 REM ** DISPLAY OF PIECE **
1710 IF S(Y,X)=9 THEN RETURN
1720 POKE 4465,X*4+5:POKE 4466,Y*3+1:PRINT P$(S(Y,X),C(Y,X));:RETURN
1730 REM ** ACCEPT KEY **
1740 X=CX*4+CY*120+CC*4+53252:X1=PEEK(X):POKE X,CR
1750 GOSUB 1900:IF A$="▒" THEN 1800
1760 IF A$="▒" THEN 1820
1770 IF A$="▒" THEN 1840
1780 IF A$="▒" THEN 1860
1790 RETURN
1800 CY=CY-1:IF CY<0 THEN CY=0:GOTO 1750
1810 POKE X,X1:GOTO 1740
1820 CY=CY+1:IF CY=8 THEN CY=7:GOTO 1750
1830 GOTO 1810
1840 CX=CX+1:IF CX=8 THEN CX=7:GOTO 1750
1850 GOTO 1810
1860 CX=CX-1:IF CX<0 THEN CX=0:GOTO 1750
1870 GOTO 1810
1880 REM ** FIRING SOUND **
1890 FOR I=0 TO 9:FOR J=10 TO 20:POKE 4514,J:USR(68):NEXT J,I:RETURN
1900 A=RND(1):GET A$:IF A$="" THEN 1900
1910 RETURN
1920 REM ** TUNE **
1930 MA$="¯C2R0¯C2G¯C¯E¯C¯E¯G¯C¯#B¯B¯A¯G6R1"
1940 MB$="¯G2¯F¯DBGB¯D":MC$="¯F¯E¯C¯A¯G¯G":MD$="¯#B¯A¯F¯CA¯C¯F¯A¯G¯C¯G¯GR"
1950 FOR T=4 TO 6:TEMPO T
1960 MUSIC MA$:GET A$:IF LEN(A$) THEN RETURN
1970 MUSIC MB$,MC$,"¯GR1":GET A$:IF LEN(A$) THEN RETURN
1980 MUSIC MA$:GET A$:IF LEN(A$) THEN RETURN
1990 MUSIC MB$,"B¯CG¯E¯C¯C¯CR":GET A$:IF LEN(A$) THEN RETURN
2000 MUSIC MD$,MB$:GET A$:IF LEN(A$) THEN RETURN
2010 MUSIC MC$,"RR",MD$,"RR":GET A$:IF LEN(A$) THEN RETURN
2020 MUSIC MB$,"B¯CG¯E¯C¯C¯CRR":IF LEN(A$) THEN RETURN
2030 NEXT:RETURN
```

BUYERS' GUIDE

Printers

The Peripherals Buyers' Guide is a survey of printers suitable for small computers. We have excluded any system which costs significantly more than £2,000. The printers are listed in alphabetical order. The addresses of the main suppliers are listed at the end of the guide.

Printers may be divided into several categories. The highest-quality printing is produced by the daisywheel-type which creates text in various type-faces, according to the wheel used. The quality ranges from excellent typing to rather poor book printing and generally there is a proportional-spacing facility. Those machines tend to be expensive and slow. Daisywheels can be either plastic — inexpensive, but must be replaced often — or metal — expensive but durable.

For faster printing, you must turn to dot-matrix machines. The print quality tends to be poor and the machines noisy. Older machines use a 7-by-5 matrix which puts the descenders of letters such as 'y' above the line. That makes bulk text difficult to read. Better printers use a matrix nine dots deep to give true descenders. Recently, several firms have produced dot-matrix printers which give an approximation to typewriter printing and proportional spacing. They are less expensive than daisywheel machines, work faster and could well be used for correspondence-quality work.

Some dot-matrix printers employ sensitised paper to produce printing by more direct electrical effects. They are often quiet and fast, but the paper can be expensive, unpleasant to handle and hard to obtain.

The trend is to build more processing power into printers. That means they offer increasingly varied features, so it is hard to categorise them precisely.

A printer has to be connected to the computer by a cable and a more or less standard interface. The normal interfaces are the Centronics parallel, RS232 serial port — also known as the V-24 — and 20mA current loop. IEEE is a parallel interface used by Pet; 'cpl' means characters per line, 'cps' means printing speed in characters per second. Allow five characters to the word.

The more intelligent printer prints as its head moves in both directions across the paper — bi-directional printing. Still more

intelligent ones end the head movement at the ends of short lines. These two features can more then treble the working speed.

Printers use two types of paper: plain paper fed — like a typewriter — pinch- and pin- or sprocket- or tractor-fed with holes along the margins. That paper can be supplied fan-folded or in rolls.

Pinch feeding is more expensive but is convenient for letters. Only a few machines will accept both pinch- and pin-fed paper. It is possible to obtain headed letter paper bonded lightly on to pin-fed, fan-folded computer paper for word processors.

Some printers allow direct control of the print-head to give graphics. KSR means keyboard, send and receive, ASR means automatic send and receive, RO means receive only. KSR machines can be used as electric typewriters in local mode.

Comb or line printers have a whole line's worth of dot hammers so they can print a line of text at a time. They tend to be very expensive and very noisy but produce an enormous quantity of work.

ACCESS DATA COMMUNICATIONS

ADC 1251 *£560*
Matrix printer, continuous paper, £13 per box, 80 or 132 cpl, 125 cps, 7x9 matrix. RS232, Centronics and IEEE interfaces.

ADC 2401 *£1,350*
9x9 dot-matrix printer, continuous paper, 136 cpl, 240 cps, RS232, Centronics and IEEE interfaces. Available from Access Data Communications.

ADDMASTER

400 receive only *£242*
Uses 2.5in. Tally roll paper, 16 cpl, 48 cps. Main U.K. agent Clary Ltd.

420-426 receive only *£246*
Dot matrix grade-one Tally roll paper at £5 for 20 rolls. BCD serial or 10-line serial interfaces, 12 cpl, 36 cps.

AMBER

Amber 2400 *£70*
Low-cost inked-ribbon dot-matrix printer using plain paper rolls. Unusual mechanism involves only four print needles, which oscillate horizontally across paper to build up line of dots. 24 normal-size five-by-seven dot characters per line on 58mm. wide paper at speed of 0.7 lines per second. Upper- and lower-case ASCII set, expanded characters and dot graphics. Acorn, BBC, Pet, TRS-80, UK 101 and ZX interfaces available.
Main U.K. distributor Amber Controls Ltd.

ANADEX

Main U.K. agent Anadex Ltd

DP-500 *from £367*
Dot matrix, tractor feed, parallel interfaces, 18 cpl, 45 cps.

DP-660 *from £700*
Dot matrix, pinch feed for printing labels, uses sprocket feed. Parallel interface. 19 cpl, 57 cps.

DP-750A *from £800*
Dot matrix, RS232C 20mA current loop, 21 cps, 25 cps.

FP-600 — *from £65*
Dot matrix ticket or form printer, from four columns to 19 columns parallel interface, 19 cpl, 44 cps.

DP-9500 Series — *£895 upwards*
Dot matrix, tractor feed, nine-wire print head, bi-directional printing, three ASCII interfaces as standard — parallel bit, RS232C, current loop — 120-200 cps, 132-220 columns, 7x9, 9x9 or 11x9 matrices depending on model. Also from: Peripheral Hardware, Kode Services, Robox, Stack Computer Services and Data Design Techniques Ltd.

DP-8000 — *£550*
Dot matrix, pinch feed, bi-directional printing, fan-fold paper up to 9.5 in. up to three copies. Three ASCII interfaces — parallel bit, RS232C, current loop — 112 cps, 80 column, 9x7 matrix. Also from: Peripheral Hardware, Kode Services, Robox, Stack Computer Services and Data Design Techniques Ltd.

DP-1000 Series — *from £395*
Dot matrix, tractor feed, internal data storage, roll-type paper for 40 columns at £11 for box of 10 rolls, three basic ASCII-compatible interfaces are available. 40 cpl, 50 cps, 40 columns, 5x7 matrix. Also from: Peripheral Hardware, Kode Services, Robox, Stack Computer Services.

AXION CORPORATION

Main U.K. agent Memec Systems Ltd

EX-820 receive only — *£500*
Electro-sensitive dot matrix includes plotting capability for full graphics, paper at £3 for a 240ft. roll, RS232C or 20mA serial and ASCII parallel, 20/40/80 cpl and up to 160 cps, 5x8 matrix.

EX-850 Video Printer — *£500*
Electro-sensitive dot matrix, aluminised paper at £3 for a 240ft. roll. Needs only the video signal from user's. Normal resolution 13.5 seconds per screen, high resolution 27 seconds per screen.

EX801/802 receive only — *£279*
Electro-sensitive, dot matrix, aluminised paper at £3 for a 240ft. roll, RS232C, Centronics, Apple, Pet, and Tandy interfaces, 20/40/80 cpl, 160 cps, 5x8 matrix.

CENTRONICS

Main U.K. agents Bytech, ITT Electronic Services, Cable and Wireless, Dacoll Engineering.

Model 150 — *£499*
Table-top demand document dot-matrix printer, 150 cps, bidirectional logic-seeking, using fan fold, roll and cut sheet paper up to 9.5in. wide 80 columns, RS-232 and parallel models available.

Model 152 — *£695*
As model 150, but 132 columns 15in. wide.

Model 352 — *£1,400*
Print station; advanced dot-matrix printer, 132 column 200 cps bidirectional logic seeking printer. Three-way paper-handling with built-in single-sheet feeder. Has second printing mode which at 60 cps gives very high-definition letter-quality printing, and high-quality pin addressable.

Model 353 — *£1,740*
Print Station; similar to model 352 but with liquid-crystal display for status indication and user-selectable parameter set-up.

Model 739 — *£504*
Table-top correspondence-quality mini-printer with three-way paper handling and proportional character set.

Model 6300 — *P.O.A.*
Industrial 300 line per minute band printer.

Model 6600 — *P.O.A.*
Same as 6300 but with 600 lines per minute.

Model 6080 — *£5,583*
Very quiet 600 line per minute band printer for office use. Has a variety of interfaces to suit most micro, mini or mainframe computers.

COMPUTER DEVICES INC

Miniterm 1201, 1202, 1203 — *from £936*
Thermal mechanism, uses Thermal Type B paper at £2.40 per roll, RS232 or parallel — 1201 only — interfaces, 80 or 132 cpl, 10/30 cps, 7x5 matrix. Main U.K. agent Teleprinter Equipment Ltd.

DATAC

Main U.K. agent Datac Ltd
414 free-standing assembly receive only — *£130*
Electro-sensitive, matrix printer type 245L, electro-sensitive roll paper, 59mm. wide x 30m. long at 90p per roll for 20 off, six-bit parallel ASCII, character serial interfaces, 16, 20, 32 or 40 cpl, 32 to 80 character per serial, 7x5 matrix.

DMI-40P free-standing terminal, receive only — *£350*
Impact, matrix, uses pressure-sensitive roll paper, 10mm.-wide ordinary paper version, using ink ribbon. Cost of paper £1 per roll, seven-bit parallel ASCII, character serial, RS232C or graphics, 40 or 20 cpl, up to 80 cps, 7x5 matrix.

411C compact panel mounting, receive only — *£209*
Electro-sensitive matrix type 245L or R, uses electro-sensitive roll paper, 59mm. wide x 30m. long at 90p per roll, six-bit parallel, serial interfaces, 16, 20, 32 or 40 cpl, 32 to 80 cps, 7x5 matrix.

411 panel mounting, receive only — *£189*
Electro-sensitive matrix printer type 245L or R, uses electro-sensitive roll paper, 59mm. wide x 30m. long at 90p per roll. Interfaces include six-bit parallel ASCII, character serial, four-bit parallel BCD, character parallel EIA/RS232C, CCITT/V24 and 20mA current loop, under development 40 cpl, 32 to 80 cps, 7x5 matrix.

313 panel-mounting, receive only and
312 free-standing, receive only — *£269*
Impact matrix type PU-1100, Tally roll paper, 59mm. wide x 36m. long at 60p per roll, CCITT/V24 or EIA RS232C or 20mA current loop interfaces, up to 20 cpl and up to 36 cps, 7x5 matrix.

412/1 and 412/5 receive only — *£255*
Electro-sensitive dot matrix type 245L, uses electro-sensitive aluminium-coated paper, 59mm. x 30m. at 90p per roll, six-bit parallel, ASCII, character serial and four-bit parallel BCD, character parallel, RS232C/V24 interfaces, 20mA current loop under development, 16, 20, 32 or 40 cpl, 32-80 cps, 7x5 matrix.

522/1 and 522/4 receive only — *£499 (522/1)* *£535 (522/4)*
Impact matrix type, roll paper, 114mm. x 75m. up to three copies plus original, cost of paper £1.10 per roll. Parallel interface and RS232C, 20mA current loop and parallel buttered, asynchronous interfaces — (522/4). 40 cpl, 100 cps instantaneous rate, 33 cps average rate — including CR and LF. 7x5, 7x10.

DATA DYNAMICS

Main U.K. agent Data Dynamics Ltd

303 Printer — *£980*
Dot matrix, up to six-part stationery width from 3m to 15.375in., V24/RS232C, 20mA current loop, 132 cpl, 30 or 60 cps, 7x7 matrix.

ZIP ASR/K7 twin cassette — *£2,000*
Dot matrix format, uses standard Teletype roll paper, V24, RS232C, or 20mA current loop operating at half or full duplex, 80 cpl, 10 or 30 cps switch selected, 5x7 matrix.

ZIP 30 keyboard printer, RO, ASR, or KSR — *ASR £1,800; RO & KSR £950*
Dot matrix, standard roll paper, 20mA half or full duplex current loop or V24 RS232C, 80 cpl, 10 or 30 cps — switch selected, 5x7 matrix.

390 eight-level and 392 five-level — *ASR from £1,250; LSR from £900; RO from £800*
ASR, KSR and read-only versions. Impact printers, friction or sprocket feed, 8.5in. paper with roll diameter 5in. 74 or 86 cpl, 6.6 or 10 cps.

Models 32 and 33 page printers — *ASR from £1,100; KSR from £800; RO from £700*
Available in ASR, KSR and receive-only versions. Friction or sprocket feed, 20mA or 60mA parallel, up to 86 cpl, 6.6 or 10 cps.

DATA GENERAL CORPORATION

Dasher TP1 Printer models 6040 and 6041 — *From £1,598*
6040 standard keyboard and can be used as a typewriter. 6041 is a receive-only terminal printer without keyboard, 30 or 60 cps, switch selectable, EIA-RS232C interfaces, 5x7 dot matrix. Main U.K. agent Data General.

DATAPLUS

400 series receive-only Model 480 — *£475*
Impact dot matrix, uses standard Tally roll, up to 3.75in. side, from 80p per roll, RS232C, V24, 20mA current loop, but parallel IEEE, Pet and Apple interfaces, 30/40 cpl, 110 cps, 7x5 and 7x10 matrices. Main U.K. agent Dataplus Ltd.

DATASOUTH CORPORATION

DS-180 — *£1,360*
Impact, matrix printer, uses fan-fold paper, RS232C, current loop, and parallel interfaces, 132 cpl, 180 cps, 9x7 matrix. Main U.K. agent Datatrade Ltd.

DIABLO

HY type II receive only — *P.O.A.*
Impact daisywheel plastic or metal print wheel, parallel, interface, 132 10-pitch cpl or 158 12-pitch cpl, 40/45/55 cps. Main U.K. agent Diablo Systems Ltd.

630 receive only — *£1,725*
Daisywheel, metal/plastic printwheels, standard listing or single sheet paper, RS232C, V24 with optional bus interface, 132 cpl at 10 pitch, 158 cpl at 12, 198 cpl at 15, up to 40 cps with automatic bi-directional printing. Main U.K. agent Geveke Electronics.

DIGITAL EQUIPMENT

DecWriter LA34 KSR — *£824*
Dot matrix, uses roll or fan-fold paper, friction-feed, up to five copies, RS-232 or 20mA interfaces, adjustable up to 256 cpi, 30 cps, 7x9 matrix. Main U.K. agent Bytech.

A120 — *from £1,645*
7x7 dot matrix, EIA or 20mA option, up to 217 cpl, 180 cps. Main U.K. agent Bytech.

DIGITRONIX

Mini-Printer — *£195*
32 column electro-sensitive, 110-4,800 baud, ASCII Serial inputs at RS232C, 20mA, 64 font at 64 cps. Main U.K. agent Digitronix.

DRG

Starwriter FP1500-25 — *£923*
96-character daisywheel printer. Up to 136 cpl, 25 cps, RS232 interface, compatible with sheet feeders. Self-testing, programmable vertical format unit. Available from DRG Business Machines.

ELECTROGRAPHIC AV

EG-800 receive only — *from £450*
Impact, matrix printer, uses any type of paper, parallel, RS232C, TRS-80, Apple interfaces, 80 cpl, 150 cps, 7x5 or 7x6 matrices. Main U.K. agent Electrographic AV Ltd.

500 series receive only — *from £175 for mechanism only*
Impact, matrix printer, uses 3.5in. Tally roll paper and flat documents, serial or parallel interfaces, 40 cpl, 120 cps, 7x5 or 7x6 matrices. Main U.K. agent Electrographic AV Ltd.

EPSON

TX-80 — *£395*
Impact, dot matrix, friction pin-feed RS232C, V24, 20mA current loop, bit parallel, Centronics, IEEE, Pet, Apple and TRS-80 interfaces, 80 cpl, 150 cps, 7x5 or 7x10 matrices and graphics. Optional PROM chips for high-resolution graphics. Main U.K. agent Dataplus Ltd.

MX-80 — *£425*
Impact, dot matrix, accepts any type of paper, Centronics parallel interface, optional serial and IEEE 488 interfaces, 44, 66, 80, 132 cpl, 80 cps, 9x9 matrix — 2.1 x 3.1mm. High resolution graphics.

EXTEL CORPORATION

M30 receive only keyboard send/receive and automatic send/receive — *£895*
Impact, dot matrix printer, uses roll or fan-fold paper, V24 or 20mA interfaces, 80 cpl, 30 cps (50 with buffer) 5x7 matrix, 5- or 8-level operation. Main U.K. agent Extel.

M30 B208L keyboard send/receive — *£1,270*
Dot matrix, uses roll paper, V24 or 20mA interfaces, 80 cpl, 30 cps, 5x7 matrix, 5- or 8-level operation. Main U.K. agent Extel.

FACIT

4520 and 4521 — *£583*

Seven-wire print head, uses roll paper Telex type (Facit 4520), friction feed, fan-fold (Facit 4521) pin feed, serial, V24/RS323C, Centronics parallel interfaces, both fitted as standard, 80 cpl, 100 cps at 12 characters per inch, 9x7 matrix. Main U.K. agent Facit Ltd.

GENERAL ELECTRIC, U.S.A.

ITT 3330 — *£1,496*

Impact dot matrix, pin feed, V24 interface, 132 cpl, 10, 20 or 30 cps, 7x9 matrix. Main U.K. distributor ITT Business Systems U.K.

HEATH ELECTRONICS

WH14 — *£510*

Dot matrix, uses edge-punched fan-fold paper, 20mA, RS232C interfaces, 80, 96, 132 cpl, 132 cps, 5x7 matrix. Main U.K. agent Heath Electronics U.K. Ltd. (OEM sales).

INTEGRAL DATA SYSTEMS

Paper Tiger Model 460 — *from £700*

Dot Matrix, impact printer, pin-feed fan-fold paper, parallel, RS232C, 150 cps, 24x9 matrix. Main U.K. agent Teleprinter Equipment Ltd.

LEAR SIEGLER INC

300 series — *from £965*

Dot matrix, uses standard paper, RS232C, 20mA parallel interfaces, Centronics 701/703 type 132 cpl, 180 cps, 9x7 or 9x9 matrices. Main U.K. agent Penny & Giles Data Recorders Ltd.

LOGABAX

LX-213 — *£1,590*

Dot matrix printer, plain paper, fan-fold or cut up to six-ply, RS232C or V24 interfaces, 132 cpl, 218 cpl, 180 cps, 9x7 matrix, optimised bi-directional printing. Main U.K. agent Brospa Data Ltd.

LRC EATON

7000+ — *£250*

Dot matrix printer, uses roll paper, RS232, IEEE, current loop and parallel interfaces, 20, 32, 40 and 64 cpl software selectable by option, 40 cps, 7x7 matrix. Main U.K. agent Russet Instruments.

MALIBU ELECTRONICS CORPORATION

Masterprint 165 — *£1,400*

Dot matrix, fan-fold paper, RS232C, current loop and parallel interfaces, 132 cpl, 165 cps, 10x9 matrix with 18x9 matrix character set which approaches word-processing quality, graphics. Main U.K. agent MBS Terminals Ltd.

MANNESMAN TALLY

Main U.K. agent Peritronic Ltd

M-80 MC — *from £875*

Dot matrix, 9.5in. pin feed paper, all interfaces, 80/132 cpl, 200 cps, 7x9 or 9x9 matrices.

T1612 keyboard send/receive *£1,612*
Dot matrix, single or multi-part paper, pin feed, RS232C or 20mA interfaces, 132/218 cpl, 160 cps, 7x9 or 9x9 matrices.

T1612 receive only *£1,475*

T1602 *£1,395*
Dot matrix single- or multi-part paper, pin feed, Data Products, Centronics and serial interfaces, 132 cpl, 160 cps, 7x9 matrix.

MICRO PERIPHERALS INC

MPI-88T *£535*
Dot matrix printer, uses fan-fold, roll and cut-sheet paper, RS232C, current loop and parallel interfaces, 80/96/120/132 cpl, all software-selectable, 120 cps, 7x7 matrix. Main U.K. agent Russet Instruments.

NEWBURY LABORATORIES

Model 8300 *from £475*
Dot matrix, pin-feed paper up to 9.5in., eight-bit parallel interface or CCITT V24, RS232C interfaces, 10 characters per inch, 125 cps, 7x9 matrix. Main U.K. agent Newbear Computing Store.

NIPPON ELECTRIC COMPANY

Spinwriter *£1,500*
Combines golf-ball daisywheel and thimble mechanism, uses continuous or single-sheet computer paper, RS232C serial (RO and KSR), Centronics-compatible and Diablo-compatible interfaces, 8080 input bus line, current loop, 55 cps, solid-font matrix. Main U.K. agents Northamber the Printer People, and Memec Systems.

OKI

Microline 80A *£299*
Dot matrix, 9x7, 80 cps, 80 or 132 cpl, pin, traction or friction feed, RS232, 20mA Centronics. Main U.K. agent X-Data.

Microline 82A *£399*
Dot matrix, impact printer, 80 cps, bi-directional logic-seeking, 40, 66, 80 or 132 cpl, pin, friction or tractor feed, serial and parallel interface, 160 characters. Main U.K. agent X-Data.

QUME

Sprint 5/45 receive only *£1,795*
Daisywheel mechanism, uses plain paper, fan-fold or cut appear A4 up to six-ply, RS232C or V24 interfaces, 156 cpl at 12 pitch, 45 cps.

Sprint 9-35 KSR *£1,400*
35 cps daisywheel printer, exceptionally quiet operation, integral keyboard.

Sprint 9-45 RO and Sprint 9-55 RO *£1,650*
Similar to the 9/35 KSR but with no keyboard, 45 or 55 cps. Main U.K. agent Qume (U.K.) Ltd.

RAIR

Main U.K. agent Rair Ltd

820/825 Desk-top printer — *£1,090*
Dot matrix, RS232C interface, 132 cpl, 75 or 150 cps, 7x7 matrix.

DecWriter IV keyboard printer, KSR and read only — *£795*
Dot matrix, uses standard listing paper, RS232C current loop interface, 215 cpl, 30 or 180 cps, 9x7 matrix.

M200 — *£1,995*
Dot matrix, uses continuous paper, parallel or serial interface, 132 cpl, 340 cps, double 7x9 matrix.

DecWriter III — *£1,550*
Dot matrix, uses continuous listing paper, RS232C or 20mA, current loop interfaces, 132-215 cpl, 180 cps, 7x7 matrix.

RICOH

RP-1600 — *£1,295*
Daisywheel, uses single-sheet or continuous paper, Centronics and compatible interfaces, 132 cpl, 60 cps. Main U.K. agent Nexos (U.K.) Ltd.

ROXBURGH PRINTERS

X80 SP printer/plotter — *from £896*
Dot matrix, impact printer/plotter, pin-feed, fan-fold paper, RS232C, IEEE488, CBM, Centronics, HP85, 20mA, Tektronix, 80/96 cpl, 100 cps bi-directional, 8x8 matrix, three character generators, various other generators. U.K. dealer Roxburgh Printers Ltd.

RP 8021 — *from £176*
Dot matrix, impact printer, Tally roll, parallel, RS232C, 20mA, 21 cpl, 150 lpm, 5x7 matrix, sprocket-feed option for labels. U.K. dealer Roxburgh Printers Ltd.

RP 8040 — *from £197*
Dot matrix, impact printer, Tally roll, parallel, RS232C, 20mA, 40 cpl, 72 lpm, 5x7 matrix, sprocket-feed option for labels. U.K. dealer Roxburgh Printers Ltd.

RX8000 — *from £228*
Dot-matrix impact printer, friction or tractor/friction feed versions. Centronics, RS-232/20mA loop, 80, 96 or 132 cpl, 80 lpm bidirectional logic seeking, 9x7 matrix, double-width characters.

RX40 — Apple — *£152*
Dot-matrix thermal printer, tally roll, direct Apple II connection, 40 cpl, 120 lpm, high-resolution graphics printing, 10 seconds for 1 page. U.K. dealer Roxburgh Printers.

SEIKOSHA

GP-100 — *£185*
Impact dot-matrix printer forming five-by-seven dot characters using an unusual system involving a single hammer hitting a rotating star-shaped bar. Centronics, RS-232, 20mA current loop or IEEE interfaces. Prints 80 characters a line at 30 cps on standard 10in. paper; dot graphics capability. Optional 8K buffer. Main dealer Watford Electronics.

S FARID (SPECTRONICS) MANUFACTURING

TP-40 and TP-65 receive only — *from £660*
Thermal, matrix, uses thermal paper, cost of paper £1.80 each roll, seven-bit parallel interface, push-button control and self-test, 40 or 64 cpl, 13 or 18 cps, 7x5 dot matrix. Main U.K. agent S Farid (Spectronics) Manufacturing Ltd.

SMITH-CORONA

TP-1 — *£500*
Daisywheel printer with Centronics or RS-232 interface. Prints at 17 cps on fanfold or cut-sheet paper up to 15.5in. wide. 10 pitch or 12 pitch versions giving 105- or 126-character lines. Main distributor Smith-Corona.

TELETYPE CORPORATION

Model 43 keyboard send/receive — *£800*
Impact matrix printer, uses pin-feed or friction-feed, dual RS232C and 20mA current loop interfaces, 132 cpl, 30 cps, 4x7 matrix on nine-wire printhead. Main U.K. agent Geveke Electronics Ltd.

TEXAS INSTRUMENTS

Main U.K. agents Taxas Instruments and Rair Ltd
OMNI 800 series
Models 810, 820 and 825 — *from £1,090 to £1,650*
Dot matrix printers, uses paper, EIA, current loop, parallel interfaces, 132-216 cpl compressed print (models 820 and 825), 132 cpl (model 810), 75 cps (model 825), 150 cps (models 810 and 820), 9x7 matrix.
Silent 700, model and 745 portable — *£1,250*
Thermal mechanism, uses thermal paper at £1.50 per 100ft. roll, integral acoustic coupler, EIA interfaces, 80 cpl, 30 cps, 5x7 matrix.
Silent 700, 743 Keyboard send/receive version — *£1,105*
Thermal mechanism, uses thermal paper at £1.50 per 100ft. roll, EIA, 20mA current loop interfaces, 80 cpl, 30 cps, 5x7 matrix.

TRANSDATA

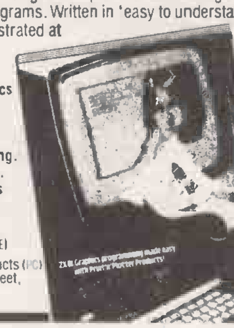
313 Receive only — *£790*
Dot matrix mechanism, uses thermal paper at £60 per box of 24 rolls x 150ft. RS232C and parallel interfaces, designed for use as VDU hard copy, 80/132 cpl, 30 to 45 cps, 7x5 matrix. Main U.K. agent Transdata Ltd.

TRANSTEL COMMUNICATIONS

AR receive only — *P.O.A.*
Dot matrix, uses standard teleprinter paper, V24, current loop interface, 80 cpl, 30 cps, 7x5 matrix. Main U.K. agent Transtel Communications Ltd.

UNITED SYSTEMS CORPORATION

Main U.K. agent Aviquipo Ltd.
DigiTec 6320 — *£483*
Electro-sensitive dot matrix, electro-sensitive line roll paper at £1.80 per roll, RS232C or isolated 20mA current loop, 21 or 32 cpl, prints two lines per second, 1,200 Baud receive, 5x7 matrix.
DigiTec 6330 — *£421*
Dot matrix, electro-sensitive paper at £1.80 per roll, 8-bit parallel/character serial, 21 or 32 cpl, 5x7 matrix.
DigiTec 6410 — *£237*
Dot matrix, electro-sensitive paper at £1.80 per roll, RS232C or 20mA current loop, 21 or 32 cpl, two lines per second, 5x7 matrix.
DigiTec 6420 — *£237*
Dot matrix, electro-sensitive paper at £1.80 per roll, 8-bit parallel serial, 21 or 32 cpl, prints two lines per second, 1,200 Baud receive, 5x7 matrix.
DigiTec 6450 — *£266*
Dot matrix, thermal paper at £1.80 per roll, RS232C 20mA current loop, 21 cpl, prints two lines per second, 110 or 300 Baud receive, 5x7 matrix.



DigiTec 6460 — *£266*

Dot matrix, thermal paper at £1.80 per roll, eight-bit parallel serial 21 cpl, two lines per second, up to 1,000 Baud receive, 5x7 matrix.

DigiTec 6550 — *£289*

Dot matrix, thermal paper at £1.80 per roll, RS232C or 20mA current loop, 21 or 32 cpl, prints two lines per second, 110 or 300 Baud receive, 5x7 matrix.

VECTOR GRAPHIC

MP printer — *£599*

Uni-directional seven-wire x five-column dot matrix, original and one copy, maximum paper thickness 0.2mm., uses pin-wheel paper feed, 70 lines per minute, 150 cps, TTL level interface, two parallel output ports and one-parallel input port. Main U.K. agent Almarc Data Systems Ltd.

WALTERS MICROSYSTEMS

Dolphin BD-80P — *£525*

Impact, dot matrix, adjustable sprocket feed, any one of three interface choices, 10 characters per inch, 80 cpl, full ASCII character set, self-testing, 64 graphics characters, 9x7 and 11x7 matrices, double-width characters, bi-directional printing. Main U.K. dealers Texas Instruments or Walters Microsystems.

Dolphin BD-136 — *£1,200*

Impact, dot matrix, forms tractor, fully interfaceable, 136-226 column width, full graphics capability, 7x9, 9x9 matrices, 32 user-definable characters plus full ASCII set, data-formatting functions, fully logic seeking, self-testing. U.K. dealers Nexos.

WENGER DATENTECHNIK

Sole U.K. distributor Access Data Communications Ltd

Print Swiss Matrix Printer — *from £700*

Dot matrix RS232C, 20mA, 60mA and parallel interfaces, Centronics-compatible, 80 cpl, constant throughout 80 cps, 55-1000 lines per minute, 7x7 matrix. KSR version also available.

Penny & Giles hard copies — *from £365*

Electro-static RMP paper 127mm. x 70m. at £3.50 per roll, RS232C, current loop option, 80/40/20 cpl, 80 columns, 110 lines per minute, 8x5 line printer, 5x7 message printer matrix.

WHYMARK INSTRUMENTS

Main U.K. agent Whymark Instruments Ltd

Model 201 — *£440*

Dot matrix, Tally-roll paper printer, IEEE, RS232C, serial, and parallel interfaces, 40 cpl, 40 cps, 52 character set with four-character sizes.

Model 204 label printer — *£515*

Dot matrix, impact printer for self-adhesive labels, IEEE, RS232C, serial and parallel interfaces, 40 cpl, 40 cps, 52 character set with four-character sizes.

Model 3011 ticket/form printer — *£690*

Dot matrix, plain paper, options automatic date and time, IEEE, RS232C, 40 cpl, 40 cps, 52 character set with four character sizes.

Model 501 rack-mounting printer — *£625*

Dot matrix plain paper, options automatic date and time, IEEE, RS232C, 40 cps, 40 cpl, 52 character set with four character sizes.

Model 801 80/120 column printer — *£750*

Dot matrix, plain or fan-fold paper, proportional spacing up to 120 cpl, 120 cps, bi-directional printing, user-definable character set, up to 4K selectable character fonts, graphics, and user-definable characters, also available; very large characters seven lines high.

Alphabetical list of suppliers

Supplier	Address
Access Data Communications Ltd, 0895-30831	Unit 17, Eskdale Road, Uxbridge Industrial Estate, Uxbridge, Middlesex UB8 2RT.
Almarc Data Systems Ltd, 0602-52657	Great Freeman Street, Nottingham NG3 1FR
Amber Controls Ltd, 0264-65951	Central Way, Walworth Industrial Estate, Andover, Hampshire
Anadex Ltd, 025672-3401	Weaver House, Station Road, Hook, Hampshire RG27 9HU
Aviquipo of Britain Ltd, 0628-34555	St. Peter's Road, Maidenhead, Berkshire SL6 7QU
Bytech Ltd, 0734-61031	Suttons Industrial Park, London Road, Earley, Reading, Berkshire RG6 1AZ
Cable and Wireless 01-928 0261	83 Blackfriars Road, London SE1 8HQ
Cifer Systems Ltd, 0225-704502	Avro Way, Bowerhill, Melksham, Wiltshire SN12 6TP
Clary Ltd, 01-680 2222	12-14 Lower Addiscombe Road, Croydon, Surrey CR9 6AG
Comma Computers, 0277-811 131	West Horndon Ind Park, West Horndon, Essex CM13 3MJ
Dacoll Engineering Services Ltd, 0438-4381/0506-56565	Gardners Lane, Bathgate, West Lothian
Datac Ltd, 061-941 236/2	Tudor Road, Broadheath, Altrincham WA14 5TN
Data Design Techniques Ltd, 01-207 1717	12 Leeming Road, Borehamwood, Hertfordshire WD6 4DU
Data Dynamics, 01-848 9781	Data House, Springfield Road, Hayes, Middlesex
Data General Ltd, 01-572 7455	3rd and 4th Floors, Hounslow House, 724-734 London Road, Hounslow, Middlesex TW3 1PD
Dataplus Ltd, 0242-30030/37373	39-49 Roman Road, Cheltenham GL51 8QQ
Datatrade Ltd, 0604-22289	17 Billing Road, Northampton NN1 5AW
Davinci Computers Ltd, 01-952 0526	65 High Street, Edgware
Diablo Systems Ltd, 04862-71991	Regent House, 20 The Broadway, Woking, Surrey GU21 5AP
Digitronix Ltd, 0908-566888	10 Burners Lane, Kiln Farm Industrial Estate, Milton Keynes
DRG Business Machines, 0934-416392	13-14 Lynx Crescent, Winterstoke Road, Weston-super-Mare, Avon.
Electrographic AV Ltd, 01-573 1826	Printinghouse Lane, Hayes, Middlesex UB3 1AP
Extel, 01-739 2041	Engineering Division, The Exchange Telegraph Company Ltd, 73-75 Scrutton Street, London EC2 4TA
Facit Ltd, 0634-40172/7	Maidstone Road, Rochester, Kent
Fortronic Ltd, 0383-823121	Donibristle Industrial Estate, Dunfermline
Geveke Electronics Ltd, 04862-71337	RMC House, Vale Farm Road, Woking, Surrey
Heath Electronics (U.K.) Ltd, 0452-29451	Bristol Road, Gloucester GL2 6EE
ISG Data Sales Ltd, 95-57955	Unit 9, Fairacre Industrial Estate, Dedworth Road, Windsor, Berkshire
ITT Electronic Services, 0279-26777	Edinburgh Way, Harlow, Essex
ITT Business Systems, 0273-507111	Crowhurst Road, Hollingbury, Brighton BN1 8AN

SHOPWINDOW

PRINTER? — use this ASR33 teletype terminal. Full 80 column width plus RS232 interface. Also gives keyboard and paper tape punch/reader for offline storage. Bargain at £99. Tel: High Wycombe (0494) 25938.

MUST SELL — North Star Horizon 48K/Quad Drives £1420; IMS or Godbout 8K ram boards £48; Tandon 80 track 5in/800K drives £220; Apple/SSM serial card £78; other items — offers? Phone Crawley 515201.

TELETYPE KSR33, printer plus keyboard, RS232 interface, plus stand, excellent condition, £120. 01-950 0416.

ZX81/16K with typewriter keyboard, over £40 software, tons info etc. £99.50. Twyford 0962-713771.

SUPERBOARD II £110. psu, programmable sound generator, new metal case, all manuals, excellent condition. Ring 04946-5311 after 6.

CASIO FX702 NEWSLETTER £6.50 per year, issue 1 free. R. Cooper, 11 Braintree Road, Dunmow, Essex.

MZ-80K horse race analysis, winners galore. Cassette £5.75. Details: S.A.E. P. C. Birch, Moorside, Woodlands, Wimborne, Dorset.

APPLE II+, 64K, disc, DOS 3.3,3.2.1, dual AY-3-8910 sound board, Pascal system, 12 inch Hitachi monitor, software £1400. Complete sets PCW, Practical Computing — offers. Gary Fuller 01-886 5789.

TRS-80 Level II 16K monitor and CTR-81, numeric keypad, books, manuals and £90 software. Offers around £300. Phone (0742) 301310, 6-8 pm.

FOR SALE: Pet 4016 and cassettes and deck, cover, manual, nearly new. Ring G. T. Baker (0562) 885182 weekends or evenings. £450 o.n.o. — buyer collects.

PET/CBM ARCADE GAMES in machine code. Scramble, Puckman, Frogger, Missile Command. Very fast graphics, sound. State Basic 2 (new Rom)/Basic 4 (9in/12in screen). £4 each, all 4 £12. On cassette. I. Gray, 175 Pershore Road, Evesham, Worces.

COMPLETE HOBBYIST'S SYSTEM (inc. word processing), based on Superboard. TV, cassette recorder, heavy duty line printer. CEGMON, new BASICS 1 & 3, enhanced video, 2MHz, word processing program in EPROM. Manuals, programs, many extras, £500. Bradford 639463.

FOR SALE, Sharp MZ80K, 48K and software £320 o.n.o. Pertec 5¼ disc drive cased with p.s.u. £85. L. J. Stubbs, 96 Coleridge Way, Crewe. Tel: 0270 581657.

VIC 10, 16K EDUCATIONAL PROGRAM, primary school age. Maths in a castle maze situation, and 5K rocket launch maths and spelling test. £7.50 — S.A.E. for more details. D. Darroch, 12 Herbert Road, Bath, Avon.

TRS-80 32K Level II, fitted Tandy's high-res graphics. ROM for flashing cursor, system load/save, single key entries and lower case, interface, VDU, cassette, £500. Tandy line printer U.C. £150. All with books/boxes etc. Plenty of software, scripsit, IRV, XREF, EDTASM, TBUG and games. Phone Chandlers Ford 2002.

SHOPWINDOW

COLOUR GRAPHICS OUTPUT from most computers connects via RS232 or Kansas City interface with domestic television, £189.95 inclusive. (0272) 502008.

MZ80K 48K with £1,000 software. Year old. Business software, languages, CP/M, games, £695. Tel: 0344 884336.

PET 3032 (Basic 4), toolkit, picchip, mikro, cassette, sound, 3040 disc drive, £ offers. 952-0815

FOR SALE. Quality software for BBC micro. Write for details: P. Swah, 13 Woodberry Gardens, North Finchley, London N12 0HD.

16K MICROTAN 65, basic, Watford expansion motherboard, graphics, toolkit, cased keyboard, latest mod's, much more, worth over £500, accept £280 o.n.o. Tel. 073082 (Liss) 3910 after six.

COMMODORE 40 col. 32K Basic 4. With dual disc drive DOS 2.1 and Commodore 80 col. tractor, matrix printer, lot of software. Tel. 0492 67288.

BBC SOFTWARE (A/B): Adventure £6.50, pontoon £4.95, cassette, S.A.E. to Michael Durcy, 2 Foulds Road, Trawden, Colne, Lancs.

S-100 cards various 8K RAM £70. 32K £140. F.D.C. £80. 6809 CPU £80. Newbury 7000 VDU £150. ICL 7181 £70. Oscilloscope 10-18U £20. Tel. Portsmouth 699593 (evenings for details).

ACULAB floppy tape for sale, plus over £100 worth of software on wafer: utilities, games. All just £150. Tel. (0403) 55674.

VIDEO GENIE: EG3003 16K v.g.c., 7 months old, extra manuals and some software. £199 o.n.o. Tel. Parbold 2696.

SPECTRUM BUSINESS SOFTWARE. Matrix Planner, the popular on-screen business planning and modelling system (similar to VisiCalc) is now available for the 48K Spectrum. Includes powerful replicate and print commands. Ideal for home and small business financial planning, forecasting and 'what-if' analysis. £8 from Graham Asher, 60 Maryland Road, Wood Green, London N22 5AN. Price includes cassette and full instructions.

APPLE USERS! Try "Fraction Action" the latest program from Kingfisher Computer Services. Writers of quality educational software. Catalogue available. Tel. 02-756 5009.

MZ-80K software. Collection of games/utility cassettes, £3 each. S.A.E. 38 South Parade, Bramhall, Stockport.

TRS-80 MODEL 1, level two, little used, green screen, tape drive, nearly new, 16K, cassettes and 10 manuals. Tel. Harlow

TRS-80, 48K dual drive, daisywheel printer, VDU, scripsit, upper/lower case, excellent condition. Offers £1,000+ Demonstration. Tel. Mike 01-674 1563.

PET 32K, Basic 4.0, 3040 disk, cassette, 40 col. thermal printer, Command-O, KRAM filing system, Pronto-PET reset, green screen, covers, cables, Visicalc, Papermate +, disks, manuals etc. Excellent condition, new price £2150, accept £1400. 01-427 4088 any time.

Buyers' Guide

Kode Services, 0249-813771	Station Road, Calne, Wiltshire SN11 0JR
MBS Terminals Ltd, 09323-53151	Aldwych House, Madeira Road, West Byfleet, Surrey KT14 6BA
Memec Systems Ltd, 084421-3149	Park Industrial Estate, Thame, Oxon
MIBF 0734-415191	Barclays Bank Chambers, Pegg Lane, Kirkgate, Tadcaster, North Yorkshire
Microsense Computers Ltd, 0442-48151/41191	Finway Road, Hemel Hempstead, Hertfordshire HP2 7PS
Northamber the Printer People Ltd, 0372 62071	3-5 Dawes Court, Esher, Surrey KT10 9QA
Newbear Computing Store, 0635-30505	49 Bartholomew Street, Newbury, Berkshire
Nexos U.K. Ltd, 084421-3151	3 Jefferson Way, Thame, Oxfordshire OX9 3FU
Penny & Giles Data Recorders Ltd, 042-5271 511	Mudeford, Christchurch, Dorset BH23 4AT
Peritronic Ltd, 0506 410041	Lomond House, Almond Vale, Livingston, Scotland
Peripheral Hardware Ltd, 01-941 4806	Armfield Close, West Molesey, Surrey
Qume (U.K.) Ltd, 0734 384646	Bridgewater Close, Reading, Berkshire
Rair Ltd, 01-836 4663	30-32 Neal Street, London WC2H 9PS
Robox (Office Equipment) Ltd, 041-221 5401	Unit 14, Anderston Shopping Centre, Glasgow G2 7PH
Roxburgh Printers Ltd, 07973-3777	22 Winchelsea Road, Rye, E. Sussex TN31 7BR
Russet Instruments Ltd, 0734-868147	Unit 1, Nimrod Way, Nimrod Industrial Estate, Reading, Berkshire RG2 0EB
S. Farid (Spectronics) Manufacturing Ltd, 02013-77337	Dawkins Road, Industrial Estate, Poole, Dorset BH15 4JY
SEN Electronics 09328-66744	5 London Street, Chertsey, Surrey
Smith-Corona 01-965 7766	SCM House, North Circular Road, Stonebridge Park. London NW10 7SS
Stack Computer Services Ltd, 051-933 5511	290-298 Derby Road, Bootle, Liverpool L20 8LN
Teleprinter Equipment Ltd, 044282-4011/9	70 Akeman Street, Tring, Hertfordshire HP23 6AJ
Terminal Display Systems Ltd, 0254-662244	Hillside, Whitbrik Estate, Blackburn, Lancashire BB1 5SN
Texas Instruments Ltd, 0234-67466	Manton Lane, Bedford MK41 7PA
Transdata Ltd, 01-403 5115	Battlebridge House, 87-95 Tooley Street, London SE1 2RA
Watford Electronics 0923 40588	33-35 Cardiff Road, Watford, Hertfordshire WD1 8ED
Wilkes Computing Ltd, 0272-25921	Bush House, 72 Prince Street, Bristol BS1 4HU
Whymark Instruments Ltd, 07372-21753	6 Holmsdale Road, Reigate, Surrey RH2 0BQ
X-Data 0753 49117	Marish Wharf, St Mary's Road, Langley, Slough, Berkshire SL4 1HE

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As wise men do; more and more users are choosing microcomputer hardware by North Star. The North Star reputation is based on the quality, performance, reliability and cost-effectiveness of their products.

HORIZON

The Horizon is a 64K RAM, dual 5.25" floppy disk drive, 4MHz Z80A based microcomputer. Designed to fit a wide range of business, educational, scientific and industrial applications. There are now over 100,000 Horizons in operation throughout the world in offices, schools, universities, laboratories and industrial plants.

For those who need to handle, store and retrieve larger amounts of data, the Horizon is available with a variety of integral Rodime mini-winchester hard disk drives. Available as 3, 6, 9, 10, 12, or 21Mb versions (formatted capacities), the Rodime series of 5.25" hard disk drives represent the best in Winchester drive technology.

The Horizon's versatility enables it to adapt to an almost unlimited number of uses, and with the addition of a hard disk the Horizon's capabilities can be expanded to meet your growing system requirements.

ADVANTAGE

The Advantage is a compact 64K RAM 4MHz Z80A based integrated graphics computer. Suitable for business and educational use the Advantage can instantly convert data into precise graphs, line charts, bar charts, pie charts or 3-Dimensional images.

The Advantage uses a second 8035 processor to service keyboard and disk I/O, and the 12" display screen operating in both Character and/or Bit-Mapped graphics mode uses a further 20K of memory. By adding a printer hard copy may be obtained, ideal for illustrating statistical data at board meetings and lectures. For extra computing power the Advantage is available with an integral hard disk drive.

Complete with sample business graphics, self-diagnostic and graphics demo software the Advantage is backed up by North Star's G-BASIC/G-DOS and Graphics CP/M, each of which support both graphics and character mode.

Two new developments for the Advantage are an 8/16 Upgrade, which adds the 8088 16 bit CPU's processing power with an additional 64K RAM. And NorthNet, a low-cost local network. By adding the appropriate cards up to sixty-four 8 or 16 bit Advantages may be utilised as interconnecting workstations or servers allowing transfer of both 8 and 16 bit files.

STARLINK

Starlink is a multi-user CP/M timesharing executive that logically integrates the North Star Horizon with a range of hard disks. Designed and developed at Interam, Starlink can cater for small business and educational applications and in addition provide a powerful and yet reasonably economical solution to office automation.

Under Starlink large amounts of data that are stored on hard disk can be accessed by one or more users in a time sharing or multi-processing environment.

Advantages can be used under Starlink as interactive workstations whilst retaining the functions of an independent computer.

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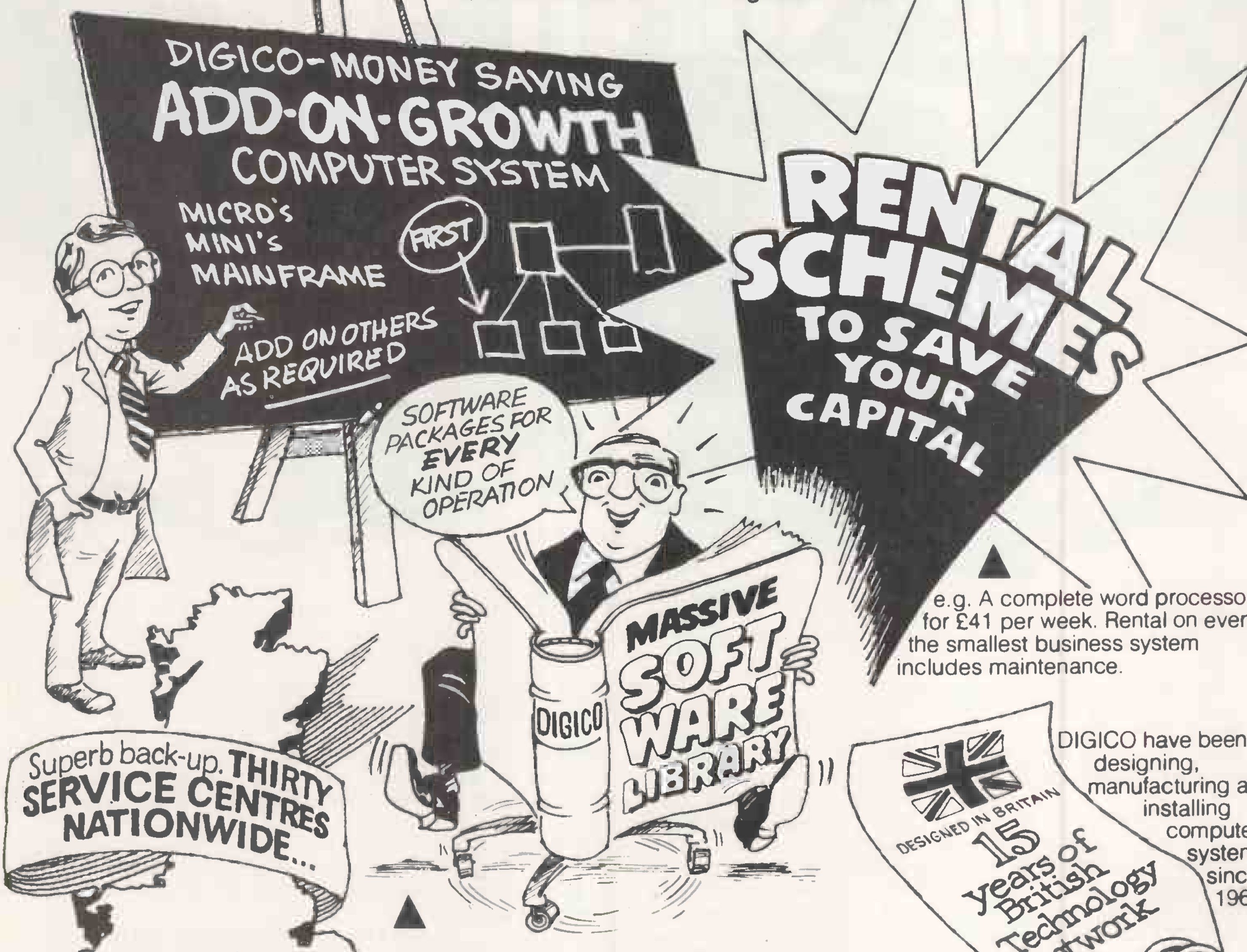

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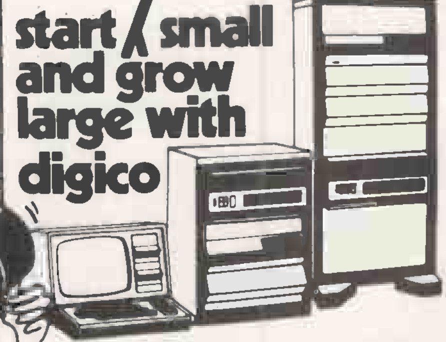

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Users' Groups

Our users' group list is organised on a region-by-region basis. If you wish to make contact with one of these groups, feel free to phone them using the number given. Club meetings are, on the whole, monthly. Most clubs are of a "general" variety, and are pleased to hear from all prospective members, whether or not they have a computer.

In order to keep our records up to date, it is important for club secretaries to contact us, with at least the amount of detail given in the list below. This is even more important if there is a change in the club telephone number. Send all details to: Practical Computing, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.

AVON

BAUD, Bristol Apple Users and Dabblers
Geoff Smythe
Datalink Microcomputer Systems Ltd
10 Waring House
Redcliffe Hill
Bristol BS1 6TB.
Tel: 0272 213427.

Bristol Computing Club
Leo Wallis
6 Kilbernie Road
Bridge Farm Estate
Bristol BS14 0HY.
Tel: 0272 832453.

Brunel Computer Club
S W Rabone
18 Castle Road
Worle
Weston-Super-Mare
Avon BS22 GJW
Tel: 0934 513068.

Tandy Bristol Users Group
Roger J Bamkin
19 Wood Street
Easton
Bristol BS5 6JA.
Tel: 0272 512283.

BEDFORDSHIRE

U.K. Intel MDS Users' Group
Lewis Hand
29 Chaucer Road
Bedford
Tel: 0234 41685.

6502 Users' Club
Joe Manifold
16 Bun Yam Close
Pirton, near Hitchin
Hertfordshire.
Tel: 0462 18522.

BERKSHIRE

Commodore Pet User Club
M Gulliford
818 Leigh Road
Slough Industrial Estate
Slough
Berkshire.
Tel: 0753 74111.

BUCKINGHAMSHIRE

Apple Users' Group
S F Proffitt
The Granary
Hill Farm Road
Marlow Bottom
Buckinghamshire.
Tel: Marlow 73074
01-750 7298, day.

National TRS-80 Users' Group
Brian Pain
40a High Street
Stony Stratford
Milton Keynes
Buckinghamshire.
Tel: 0908 566660.

International Nascom Microcomputer Club
The Secretary
c/o Oakfield Corner
Sycamore Road
Amersham
Buckinghamshire.
HP6 6SU.

Milton Keynes Microcomputers Users' Group
Brian Pain
40a High Street
Stony Stratford
Milton Keynes
Buckinghamshire.
Tel: 0908 566660 (work);
0908 564271 (home).

CAMBRIDGESHIRE

Peterborough Computer Club
Trevor Marchant.
Tel: 0733 76681.

CHESHIRE

North-west Computer Club
John Lightfoot
135 Ashton Drive
Frodsham, Warrington
Cheshire WA6 7PU.
Tel: 0928 31519.

CLEVELAND

Cleveland Microcomputer Club
J H Telford
13 Weston Crescent
Norton, Cleveland.
Tel: 0642 550061.

CORNWALL

Cornish Radio Amateur Club — Computer Section
Bob Reason
24 Mitchell Road
Camborne
Cornwall TR14 7JH.
Tel: 0209 713637.

DEVON

Acorn Atom User Group
T G Merdeith
Sheerwater
Yealm View Road
Newton Ferrers
South Devon.

Exeter and District Amateur Computer Club
Doug Bates
2 Station Road
Pinhoe
Exeter.
Tel: 0392 69844.

Plymouth and District Amateur Computer Club
Keith E Gould
Willoby House
Meavy Lane
Yelverton
Devon PL20 6AL.
Tel: 082285 2575.

DORSET

TOPIC — Tandy Owners' Programme and Information Co-operative
Secretary
Fred Thorp
75 Bridport Road
Parkstone
Poole
Dorset.
Tel: 0202 730483.

Cosmac Users' Group
Peter Hibbs
54 Runneymede Avenue
Bournemouth
Dorset BH11 9SE.

DURHAM

North-east Pet Users' Group
Jim Cocallis
20 Worcester Road
Newton Hall Estate
Durham.
Tel: 0385 67045.

EAST ANGLIA

Anglia Computer User Group
Jan Rejzl
128 Templemere
Sprowston Road
Norwich NR3 4EQ.

Norwich and District BBC Microcomputer User Group
Paul Beverley
Room B12a
Norwich City College of Further and Higher Education
Ipswich Road
Norwich
Norfolk NR2 2LJ.
Tel: 0603 60011, ext. 233.

ESSEX

London and South-east Sharp MZ-80K User Group
Joe Seet
16 Elmhurst Drive
Hornchurch
Essex RM11 1PE.
Tel: 04024 42905.

TRS-80 User Group
Michael Dean
22 Roughtons
Galleywood
Chelmsford
Tel: 0245 76127.

UK101 User Group
Adrian Waters, 117 Haynes Rd
Hornchurch
Essex.
Tel: 494 0490.

Springfield Computer Club
Steve Cousins
1 Aldeburgh Way
Springfield, Chelmsford
Essex CM1 5PB.
Tel: 0245 50155.

EUROPEAN

Dainamic — European Users' Club of DAI personal computer
Heide 98
3171 Westmeerbeek
Belgium.

Nascom Brugergruppe
Asbjorn Lind
Sidevolden 23
DK 2730 Herlev
Denmark.
Tel: 02 91 7182.

GLOUCESTERSHIRE

Cheltenham Amateur Computer Club
M Pullin
45 Merestones Drive
The Park
Cheltenham GL50 2SU.
Tel: 0242 25617.

990 User Group
Chris Cadogan
21 Thistle Downs
Northway Farm, Tewkesbury.
Tel: 0684 293821, Ext. 310.

HAMPSHIRE

Independent Pet Users' Group
G A Parkin
Robert May's School
West Street, Odiham.
Tel: 025 671 2700.

(continued on next page)

(continued from previous page)

Southampton Amateur Computer Club
P G Dorey
Dept. of Physiology
The University
Southampton SO9 3TU
or Andy Low.
Tel: (0703) 555605, Ext. 34.

UCSD Pascal User Group
John Ash
Dicoll Data Systems Ltd
Bond Close
Kingsland Estate, Basingstoke.
Hampshire RG24 0QB.

HERTFORDSHIRE

Apple/ITT 2020 Users' Group
John A Sharp
20 The Glebe
Garston
Watford
Hertfordshire WD2 6LR.
Tel: Garston 75093.

CBM/Pet/Vic User Group
P N Mortiboy
2 Spurr's Close
Hitchin
Hertfordshire SG4 9QE.
Tel: 0462 54435.

The Harrow Computer Group
N P Butcher
16 St Peter's Close
Bushey Heath
Watford
Hertfordshire WD2 3LG.
Tel: 950 7068.

Harpenden Microcomputer Group
David M James
5 Ox Lane
Harpenden
Hertfordshire.
Tel: 05827 5366, evenings.

West Herts 80 Users' Group — TRS-80/Video Genie
Terry Bradbury
20 Spruce Way
St Albans
Hertfordshire.
Tel: 0727 73633.

INTERNATIONAL

International Association of Cromemco Users
PO Box 17658
Irvine, California 92713 U.S.A.

IRELAND

CPM/IRL — The Irish CP/M Users' Group
Doug Notley
Gardner House
Ballsbridge
Dublin 4.
Tel: 01 686411.

ISLE OF WIGHT

TRS-80 Users' Club
Mike Collins
3 Altofts Gardens
Ventnor
Isle of Wight.

KENT

Computer Users' Club
Tony Latham
72 Sidmouth Road
Welling
Kent DA16 1DS.

Independent Pet Users' Group South-east Region
164 Chesterfield Drive
Sevenoaks
Kent TN13 2EH.
Tel: Sevenoaks (0732) 53530.

Gillingham User Group
A Aylward
194 Balmoral Road
Gillingham.
Tel: 0634 56830.

Medway Amateur Computer and Robotics Organisation
Mrs C Webster
13 Ladywood Road
Cuxton, Rochester
Kent.
Tel: 0634 78517.

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Mike Marriott
Kent Micro Services
55 High Street
Maidstone
Kent.

Medway Atom Users' Group
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Chatham
Kent
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Tel: 29 71742.

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Martin Wren-Hilton
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Chorley Computer Club
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Lancashire.
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Tel: 061 228 6333, Ext. 372.

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Jill Olorenshaw
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Tel: 0533 22255.

LINCOLNSHIRE

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Tel: 0522 27347.

LONDON

Comp80 — Scientific Computer Users' Group
P L Roberts
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Tel: 01-540 3713.

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Croydon.
Tel: 01-653 3207.

Croydon Apple Users Group
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38 Box Ridge Avenue
Purley
Surrey.

Medical Micro Users' Group
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c/o Medicom
14 Broadway
London W13.
Tel: 01-579 5845.

National TRS-80 Users' Group
J S Wellsman
292 Caledonian Road
London N1.
Tel: 01-607 0157.

National ZX-80 Users' Club
Tim Hartnell
44-46 Earls Court Road
London W8 6EJ.

North London Hobby Computer Club
Robin Bradbeer
Dept. of Electronic and Communications Engineering
Polytechnic of North London
Holloway Road
London N7.
Tel: 01-607 2789.

Southgate Computer Club
Panos Koumi
33 Chandos Avenue
London N14
or Alan Toothill on
01-360 7014 (home) or
01-882 6111 Ext 2281 (work).

South-east London Microcomputer Club
Thames Polytechnic
Greens End
London SE18.
Tel: 01-852 4922 — Roger Kreitman
01-853 5829 — Peter Phillips.

MK-14 User Club
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8 Poolsford Road
NW9 6HP.
Tel: 01-200 6209
or 01-207 2000, Ext. 233.

OSI U.K. User Group
Richard Elen
12 Bennerley Road
London SW11 6DS.

Pet Users' Education Group
Dr Chris Smith
Dept. Physiology
Queen Elizabeth College
Campden Hill Road
W8 7AH.
Tel: 01-937 5411, Ext. 429.

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Tabassam Kayani
12 Calderon Road
London E11 4EU.
Tel: 01-556 5423.

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Abraham Moss Centre
Crescent Road
Manchester 8.

Manchester Computer Club
David Wade
28 Hazel Road
Altrincham
Cheshire
WA14 15L.
Tel: 061 941 2486.

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123 Roughwood Drive
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Merseyside L34 2QW.

(continued on page 191)

We don't need to tell you what the micro chip has done for computer hardware.

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(continued from page 188)

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Teddington
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Tel: 01-977 2346.
Richmond Computer Club
Bob Forster
18a The Barons
St Margaret's
Twickenham
Middlesex.
Tel: 01-892 1873.
West London Personal Computer Club
G J Brain
81 Rydal Crescent
Perivale
Middlesex.
Tel: 01-997 8986.

NORFOLK
East Anglia Computer User Group
Under East Anglia

NORTHAMPTON
Personal Computer Users' Club
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Mereway Upper School
Mereway
Northampton NN4 9BU.
Tel: 0604 63616.

NOTTINGHAMSHIRE
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17 Langbank Avenue
Rise Park
Nottingham NG5 5BU.
Nottingham Microcomputer Club
P McQuoney
28 Seaford Avenue
Wollaton
Nottingham.
Tel: 0602 751742.
TRS-80 and Video Genie Users' Group of Nottingham
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Beeston
Nottingham.
Tel: 0602 225165.
UK Apple Users' Group
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Tel: 0602 583254.

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Oxford University Microcomputer Society
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St John's College
Oxford
Tel: 0865 47671.
Oxfordshire Microcomputer Club
S C Bird
139 The Moors
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Oxford OX5 2AF.
Tel: 08675 6703.
Research Machines Users' Group
Tony Crowle
134 Howard Street
Oxford.

SCOTLAND
Central Scotland Computer Club
James G Lyon
78 Slamannan Road
Falkirk FK1 4NF.
Tel: Falkirk (0324) 22430.
Edinburgh ZX-80/81 Users' Group
Keith Mitchell
19 Meadowplace Road
Edinburgh EH12 7UJ.
Tel: 031-334 8483
031-661 3183 — John Palmer.
The Grampian Amateur Computer Society
M Basil
Orton Cottage
Burnside
Lumphanan
Kincardineshire
Grampian Region.
Tel: 033 983 284.
Scottish Amateur Computer Society
Alistair Macpherson
6 Curriehill
Castle Drive
Edinburgh 14.
Tel: 031 449 6658.
Ithaca Audio S-100 User Group
Strathclyde Computer Club
Dave Weaver 16 Etive Place
Condorrat
Cumberland
Near Glasgow G67 4JF.
Tel: 023 67 36570 or
I Barraclough
c/o S T V Cowcaddens
Glasgow.

SHROPSHIRE
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The White House
32 High Street
Leintwardine
Craven Arms
Salop.
Tel: 054 73 287.

SOMERSET
Ohio Scientific U.K. User Group
Tom Graves
19a West End Street
Somerset BA16 0LQ.
Tel: 0458 45359.

STAFFORDSHIRE
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Kidsgrove
Stoke-on-Trent
Staffordshire.
The Amateur Computer Club of North Staffordshire
Michael Turner
542 Lightwood Road
Lightwood
Stoke-on-Trent
ST3 7EH.
Tel: 0782 324639 evenings.
ZX-80/81 National Software Association
M J Rozier & C M Smith
15 Woodlands Road
Wombourne
Staffordshire WV5 0JZ.

SURREY
Forth Interest Group U.K.
H Dobson
c/o 38 Worsley Road
Frimley, Camberley
Surrey GU16 5AU.
Tel: Deepcut (02516) 6254.
ZX-80 Users' Club
David Blagden
PO Box 159
Kingston-Upon-Thames
Surrey KT2 5YQ.

SUSSEX
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7 Talbot Road
Littlehampton
West Sussex BN17 7BL.
Tel: 090 64 7607.
Brighton Hove and District Computer Club
Rod Phillippe
Hobbyist
3 The Broadway
Southwick
Brighton BN4 4ND.
Crawley Computer Club
John Fieldhouse
18 Seaford Road
Crawley
West Sussex.
Tel: 0293 543509.
Mid-Sussex Microcomputing Club
Bernard Langton
228 St Leonard's Road
Horsham
West Sussex RH13 6AU.
Tel: 0403 61156.
Southern Users' of Pet Association SUPA
Howard W Pilgrim
42 Compton Road
Brighton
Sussex BN1 5AN.
Tel: 0273 561982.

TYNE AND WEAR
Newcastle Personal Computer Society
John Bone 2 Claremont Place
Gateshead, Tyne and Wear
Tel: 770036 home, or
0632 781412, Ext. 236 work.
TRS-80 User Group
Dr S Tetlow 3 Highbury Close
Springwell, Gateshead
NE9 7PU.
Washington 462532.

WALES
Gwent Amateur Computer Club
Ian Hazell 50 Ringwood Hill
Newport, Gwent NPT 9EB.
Tel: 0633 277711.
National TI-58/59 Club
R M Murphy
Dept. of Electrical Engineering
University College Swansea
Swansea, South Wales.

WILTSHIRE
North Wiltshire Computer Club
Mathew Jones
Pinhills
Bowood
Calne, Wiltshire.

WEST MIDLANDS
Central Program Exchange
Mrs J Brown
Dept. of Computing and Mathematical Sciences
The Polytechnic
Wulfruna Street
Wolverhampton WV1 1LY.
Tel: 0902 27371 Ext: 56.
Amateur Computer Club
John Tracey 100 Booth Close
Brierley Hill
West Midlands DY6 8SP.
Tel: 0384 70097.
Birmingham 7/66 User Group
Sue Dunn
Tel: 021 707 7170.
Midland Amateur Computer Club
Roy Diamond
Tel: 0203 454061.
West Midlands RML User Group
Peter Smith BECC
Camphill Centre, Stafford Road
Birmingham B11 1AR.

WORCESTERSHIRE
Minicomputer Users in Secondary Education — MUSE
R Trigger, 48 Chadcote Way
Catshill, Bromsgrove
Worcestershire.
Worcester and District Computer Club
D J Stanton
Tel: 0905 22704.

YORKSHIRE
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P R Clark
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Leeds and District Branch of the British Computer Society
Dave J Sheppard
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Darlington Computing Club
Tel: 0325 67766.
Penine and District Computer Club
Douglas R Bryant
Tel: 0535 43007.
South Yorkshire Personal Computing Group
S P Gray
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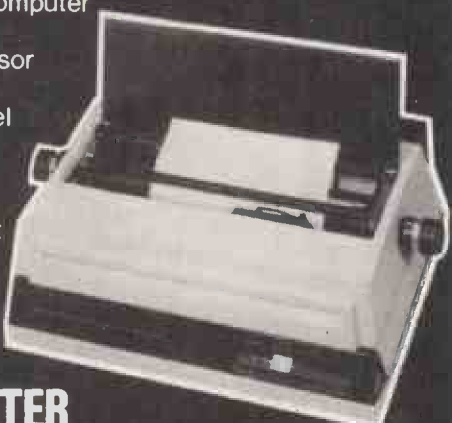

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Boris Allan appeals for more attention to programming principles and less on the merits or otherwise of individual languages or machines.

It's the pattern not the product

IN COMPUTING, never has so much rubbish been written about so much rubbish. The "this is the best, and only, programming language" or "this is the best, and only, computer" debate can only lead to suspicion of any grouping which claims allegiance to one machine or language. Magazines which cater for only one machine, or family of machines, are even more suspicious.

In the Tower of Hanoi problem — *Practical Computing*, December 1980 — three pegs are fastened to a stand. On one peg there are discs, with a hole in the centre of each. All are different sizes, with the largest disc at the bottom and the smallest disc at the top. The task is to move all the discs to another peg, one at a time, but in such a way that a larger disc is never placed on a smaller disc.

The machines with which the problem is solved are small and cheap, so that complex languages will be a waste of time. A large super-computer may be a billion times faster than a ZX-81 but no one could afford one. Look first at how the smallest disc moves, and then the next smallest, and so on to the largest.

Figure 1 shows what happens for three discs, and table 1 shows what happens in a rather more mathematical way. Disc 1, the smallest, always moves to the right; right of the right peg is the left peg, wrap round. Disc 2 always moves to the left, disc 3 always moves to the right, and logically disc 4 moves left, disc 5 moves right, and so forth.

Table 1 shows the discs' movement is very regular. Disc 1 moves every other time, disc 2 moves in a more complex but distinct pattern, and thus it continues. If the move number is expressed as a binary number, the form of the patternings emerges. The disc to move is the one for which the corresponding bit is set to one, with zeros to the right. To decide which disc to move all that is needed is to change the move number into a binary number and find the right-most unit or non-zero bit.

The programming problem can be saved by simulating binary arithmetic. It is the essence of computers that they use binary arithmetic, and the programs can use this characteristic. A whole number is stored on most computers in an exact form, and the exact form is as a series of bits, often 16 bits or two bytes. If the whole number is the move number then the move number is automatically stored by the computer in the form shown in column B of table 1.

In order to use this insight to the problem of working out which is the right-most non-zero bit, try the following statement out on as many computers as possible:

```
PRINT 2 AND 1, 3 AND 1
```

the answer will either be 0 1 when using Vic, Pet, and BBC computer among others or 1 1 for Apple, ZX-81, and Atom among others. By contrast

```
PRINT 2 & 1, 3 & 1
```

on the Atom provides the same answer as that for the Vic, etc.

Decimal differences

The difference between And and & on the Atom, is the difference between the two types of answer to the simple Print statement. The decimal number 2 is 10 in binary, and the decimal number 1 is 01 in binary, and so if you take each bit in turn

10 AND 01

is 00. Since 3 in binary is 11, then

11 AND 01

is 01. The Vic, Pet, BBC, and Atom using &, therefore perform what is called a bit-wise And, so that, for example, 255 And 128 is 128 since

1111 1111 AND 1000 0000

is 1000 0000.

It is easy to find whether the And, if it exists on your machine, performs a bit-wise And. If you execute

Print (1=1)

and if the answer is −1, then the compu-

(continued on next page)

Figure 1.

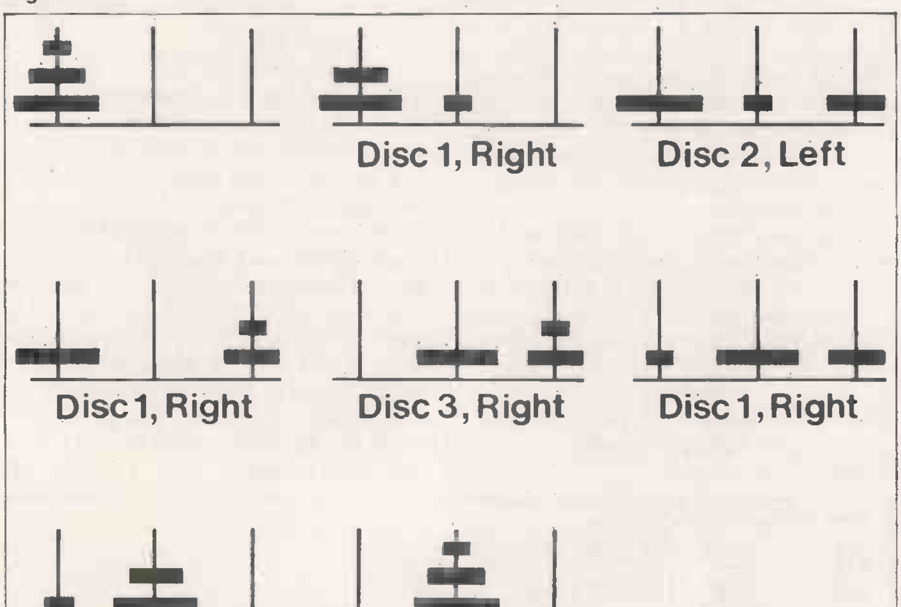

Table 1.

Move (denary) A	Move (binary) B	Disc to move C	Direction of move D
1	001	1	right
2	010	2	left
3	011	1	R
4	100	3	R
5	101	1	R
6	110	2	L
7	111	1	R

(continued from previous page)

ter does a bitwise And. If the answer to Print (1=1) is 1, then the And is a relational And, that is, the And can only be used to relate logical expressions.

And is used in this way on the Apple II, ZX-81, and Atom, though the Atom also has &. That the And is of this form is why the Apple and ZX-81 programs are of a different nature to the others. Sometimes it is useful for 1 to represent True, in cases like this the lack of a bitwise And is a drawback.

The bit-wise machines, apart from the Atom, consider −1 to be true, since −1 as a 16-bit binary number is

1111 1111 1111 1111

Vic listing.

```
10    REM TOWERS OF HANOI
20    REM LOGIC VERSION
30    REM
40    REM G J BORIS ALLAN, 1982
50    REM
60    INPUT "DISCS ";D
90    V=0
100   V=V+1 : I=1 : M=I
130   IF (M AND V)=M THEN 180
140   I=I+1 : IF I>D THEN 200
160   M=M+M : GOTO 130
180   PRINT "MOVE ";I;",  ";CHR$(ASC("L") +
      (I AND 1) * 6)
190   GOTO 100
200   END
```

Atom listing.

```
10    REM TOWERS OF HANOI
20    REM LOGIC VERSION
30    REM
40    REM G J BORIS ALLAN, 1982
50    REM
60    INPUT "DISCS "D
90    V=0
100   V=V+1 ; I=1 ; M=I
130   IF (M & V)=M GOTO 180
140   I=I+1 ; IF I>D GOTO 200
160   M=M+M ; GOTO 130
180   PRINT "MOVE  "I", "$(CH"L" + (I&1)*6)''
190   GOTO 100
200   END
```

BBC listing logical version.

```
10    REM TOWERS OF HANOI
20    REM LOGIC VERSION
30    REM
40    REM G J BORIS ALLAN, 1982
50    REM
60    INPUT "DISCS  "D
90    V=0
100   V=V+1 : I=1 : M=I
130   IF (M AND V)=M THEN 180
140   I=L+1 : IF I>D THEN 200
160   M=M+M : GOTO 130
180   PRINT "DISC "I",  "CHR$(ASC"L" + (I AND
       1)*6)
190   GOTO 100
200   END
```

ZX-81 listing.

```
10    REM TOWERS OF HANOI
20    REM DIVISION VERSION
30    REM
40    REM G J BORIS ALLAN,1982
50    REM
60    PRINT "DISCS ?";
70    INPUT D
80    PRINT D
90    LET V=0
100.  LET V=V+1
110   LET I=1
120   LET M=V
130   IF M/2<>INT (M/2) THEN GOTO 150
140   LET I=I+1
150   IF I>D THEN GOTO 200
160   LET M=M/2
170   GOTO 130
180   PRINT "DISC ";I;", ";CHR$ (CODE  "L"+
       (I/2<>INT  (I/2))*6)
190   GOTO 100
200   STOP
```

Apple listing

```
10    REM TOWERS OF HANOI
20    REM DIVISION VERSION
30    REM
40    REM G J BORIS ALLAN
50    REM
60    INPUT "DISCS ";D
90    V = 0
100   V = V + 1:I = 1:M = V
130   IF M / 2 <  >  INT (M / 2) THEN 180
140   I = I + 1: IF I > D THEN 200
160   M = M / 2: GOTO 130
180   PRINT "MOVE ";I;", "; CHR$ ( ASC ("L")
       + (I / 2 < > INT(I / 2)) * 6)
190   GOTO 100
200   END
```

or each bit is true. The difference in the types of Basic is mirrored in Pascal which cannot easily manipulate bits, compared to the superior language Algol 68 in which bit manipulation is simplicity itself.

The first listing for the Tower of Hanoi is for a Vic, though it would be equally true for a Pet. If input and output statements are ignored, there are about eight essential statements, lines 90 and 200 are not really needed. The line numbers are of variable interval to correspond with the ZX-81 program given later.

Valuable lines

Line 60 merely asks for the number of discs to be used, and the program proper starts at line 90. The variable V contains the move number, and at line 90 it is set to zero, since this line is not needed and is only executed once in the program.

At line 100, V is incremented by 1, and I, the disc marker, is set initially to 1, as is M, the mask, that is, the variable used to find the right-most non-zero digit.

At line 130 is a conditional statement

(M AND V)=M

which is in two parts. The value of M, line 160, is doubled at each occasion the program comes to line 130, that is to say M takes the values 1, 2, 4, 8, 16, 32, which in binary is 0001, 0010, 0100, 1000. If V = 12, in binary this is 1100; and when M = 0001, M And V is 0000; when M = 0010, M And V is 0000; but when M = 0100, M And V is 0100, and so when the rightmost 1 is reached M and V = M. As I is incremented in line 140, then when the conditional in 130 is true and a jump has been made to line 180, disc number I must be moved.

If the disc has an odd number it is moved right, and to the left if even. Line 180 uses this information to provide one Print statement for both cases: the result of I and 1 is equal to 1 if I is odd, and if I is even the result is O. When I is even,

CHR$(ASC("L")

which is L, is printed; and when I is odd,

CHR$(ASC("L")+6)

which is R, is printed.

At line 130, if the conditional is untrue, control passes to line 140, at which I is incremented, and if I is now greater than the number of discs then it exits, this line could be

IF I>D THEN END

Otherwise M is doubled, line 160, and control returns to line 130.

The listings for the Atom and the BBC machine follow the pattern for the Vic, with slight differences but the listing for the ZX-81 and Apple is dramatically different. Both the ZX-81 and the Apple do not use bitwise comparisons, and so there have to be changes The programs for the Apple and the ZX-81 are very similar to each other. The line numbers for the ZX-81 program, in 1K, correspond to the line numbers in the other listings, with the proviso that there is only one statement per line allowable on the ZX-81.

Divided solution

The program is called the Division Version because of the way it tries to emulate the bit-wise comparisons of the other programs. The main differences are that M is made equal to the move number V in line 120, and it is discovered in line 130 if M is odd. If M is even, it is halved in line 160, control is the same as other programs. In line 180

(I/2<> INT(I/2))

is a check to see if I is odd or even. Even those who prefer the method of bit-wise comparison to the division method will find the ZX-81 and Apple programs very neat, and very short.

The perpetrators of rubbish frequently avoid Goto; and use If-Then-Else or Repeat-Until instead. In this program Until does not appear, If is avoided, and only Goto is used. The final program, the result of this attempt, will solve the Towers of Hanoi problem using Goto as the only means of control. The program is called the Illogical Version though it is, in fact, quite logical.

BBC listing illogical version.

```
10    REM TOWERS OF HANOI
20    REM ILLOGICAL VERSION
30    REM
40    REM G J BORIS ALLAN, 1982
50    REM
60    INPUT "DISCS "D
90    V=0
100   V=V+1 : I=1 : M=1
130   GOTO ((M AND V )<>M)*40 + 180
140   I=I+1 : GOTO (I<=D)*40 + 200
160   M=M+M : GOTO 130
180   PRINT "DISC "I", "CHR$(ASC"L"+(I AND 1
       )*6)
190   GOTO 100
200   END
```

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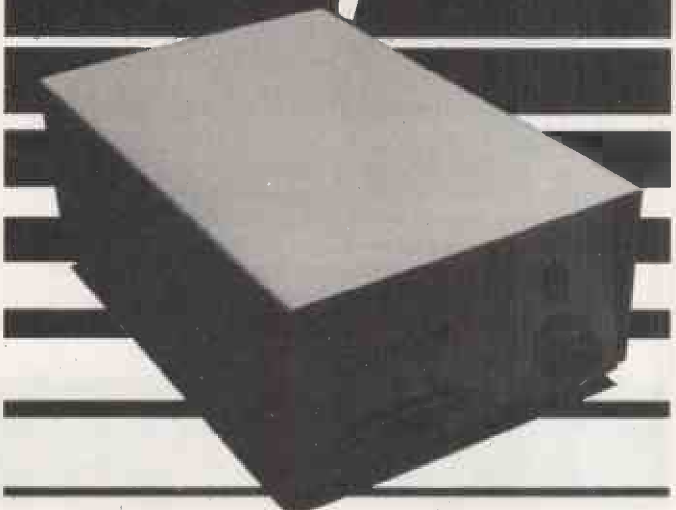

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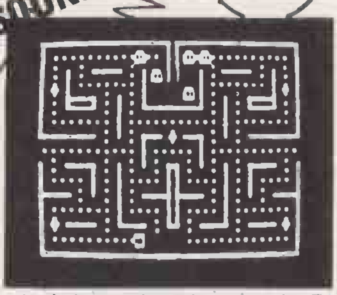

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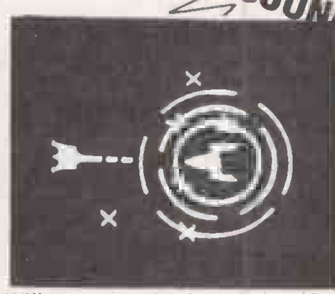

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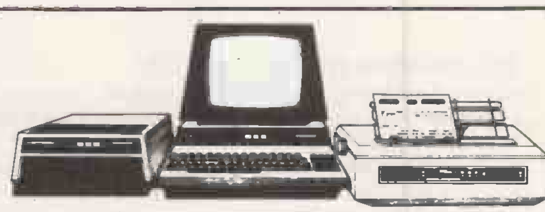

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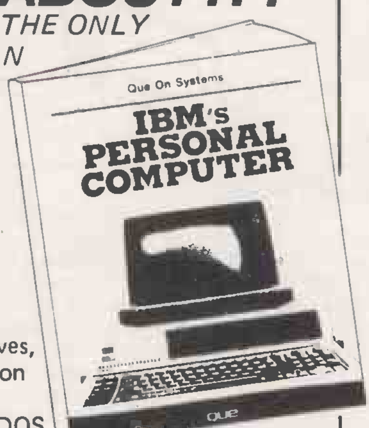

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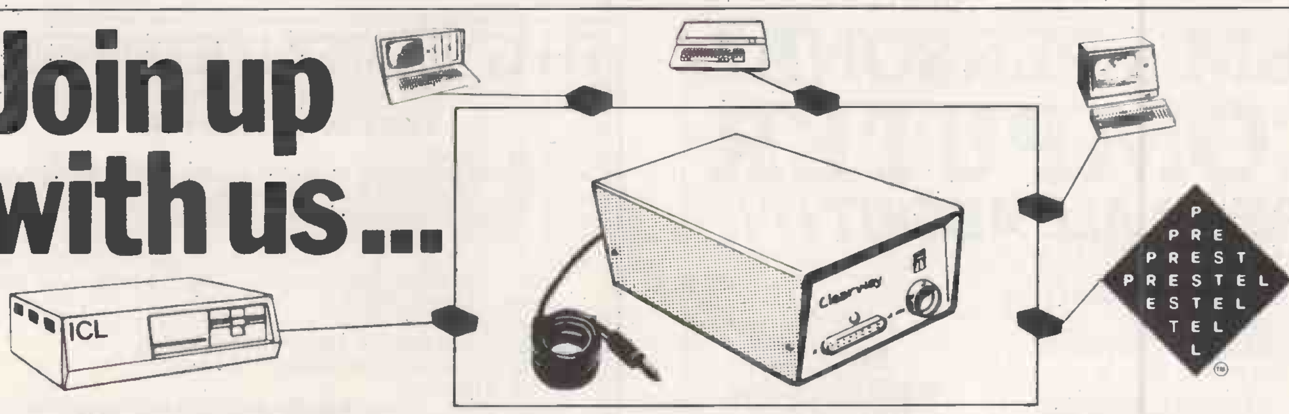

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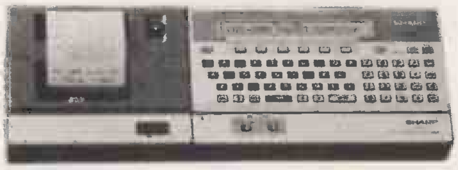

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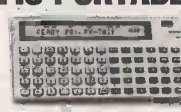

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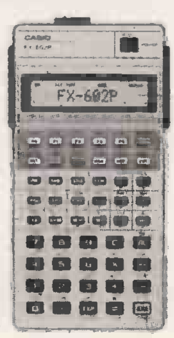

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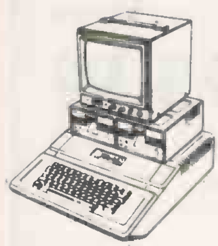

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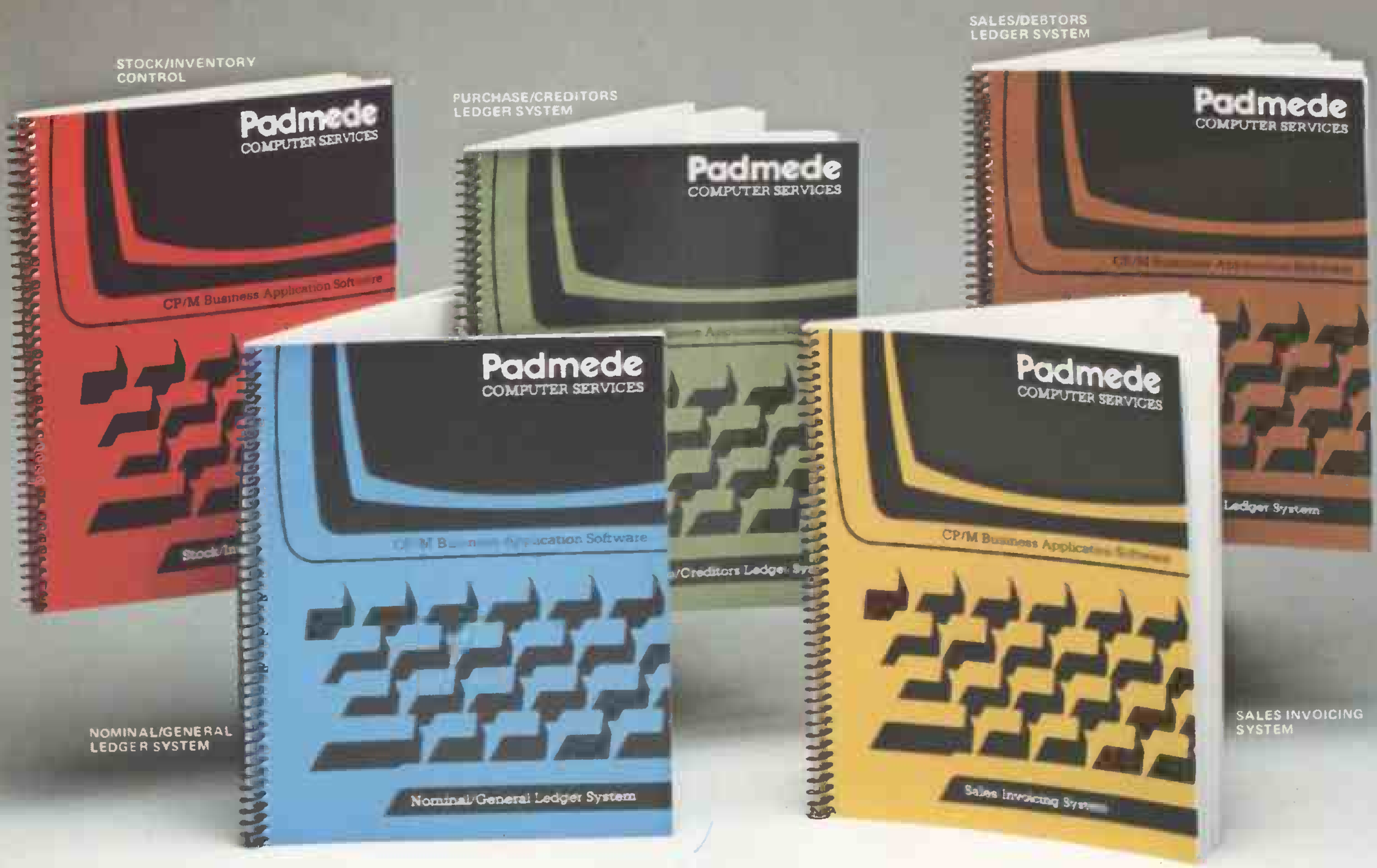

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