Practical Computing

80p August 1983

Volume 6 Issue 8

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Every effort is made to check articles and listings but *PC* cannot guarantee that programs will run and can accept no responsibility for any errors.

The death of 1,000 cuts

YOU MIGHT think that in a booming industry, with products in short supply, manufacturers would be thinking about putting up their prices. Law of supply and demand, right? In the microcomputing industry, however, we are in the middle of a price war of unprecedented proportions.

Four major manufacturers are involved: Sinclair, Commodore, Atari and Texas Instruments. They are, between them, already responsible for the vast majority of world microcomputer sales — not by value, perhaps, but by volume.

A glance at the prices of these machines shows why. The 16K Atari 400 and 16K TI-99/4a are now around £150. The Commodore 64 and Atari 800, which are both comparable in power and facilities to the Acorn BBC Micro, are a touch under £300. In the pocket-money market, both the 16K Sinclair Spectrum and Vic-20 can be bought for under £100 — allowing for a package deal on the Vic.

Current American prices do not show the price-cutting storm subsiding. The American package-deal price puts the Vic-20 at under $100 — around £65. Texas Instruments is giving a $100 "rebate" or money-back offer on the TI-99/4a which brings the price down to $159.95 — around £100.

As in the U.K. so in the U.S. The Sinclair micros are undercutting everything. With a $15 rebate, the price of a Timex 1000 — known here as the ZX-81 — is only $44.95, which at today's exchange rate is only £29.

How can a machine for which Texas once wanted £1,000 now cost $150? The answer is only partly to do with volume. As a veteran of the pocket-calculator wars, Texas knows it has to stay in the market. The name of the game is market share.

Other factors are, of course, involved. Most of the companies have new machines on the way. Commodore always has several, and Atari is about to launch four new micros. Even the current models, including the 99/4a and Commodore 64, are being heavily redesigned to use fewer chips, which will enable them to be made even cheaper.

Then there are numerous new machines lining up for the Christmas market. Many will offer 16-bit processors, including the powerful Motorola 68000. Last but not least, the two major microcomputer manufacturers — by value if not by volume — are threatening to launch new machines. Apple has a "mini Lisa", called the Macintosh, currently out with software houses. IBM is rumoured to be about to enter the small-micro market with the Peanut.

So far none of these developments has had much significance for the serious business market. The manufacturers mentioned have not reduced the prices of their peripherals and software by comparable amounts. Maybe you could expand, say, a Vic-20 or TI-99/4a to the capability of an Osborne 2 or Morrow Microdecision, but if you cost the exercise you will find them poor value in comparison. In many cases, too, neither the peripherals nor the business software exists.

But this could change. Forthcoming Atari, Commodore and even Sinclair micros could soon be offering business capabilities, including CP/M, at close to home-micro prices. Both IBM and Apple have the manufacturing capability and the high profit margins which would enable them to engage in a price war. Of course they don't want to, but they may not have a choice.

Meanwhile, the Japnaese are still waiting in the wings. The price war is not ending, it is just starting. Next it is likely to move from the home to the business market. A lot of companies are already lined up to die the death of a thousand price-cuts.

5 Years ago...

NEW FLOPPY SYSTEMS

Research Machines of Oxford has introduced new floppy disc systems for its 380Z computer.

A mini-floppy system is offered with one or two drives, each drive of 70K byte capacity. Also available is a dual double-sided, standard drive system with a capacity of 500K bytes per drive giving a total of one megabyte of on-line storage; this system can produce IBM 3740 compatible discs.

At a later date a new disc controller card will be offered which will allow existing standard drive users to upgrade to IBM standard double density recording, doubling the capacity to one megabyte per drive.

BASF drives are used throughout and the prices of both the mini and standard disc systems include the Digital Research CP/M disc operating system which is rapidly becoming the industry standard for microcomputers.

The price of the 380Z with 32K RAM is £1,158; the dual mini-floppy disc system, MDS-2, is £895; and the dual standard system, FDS-2 is £1,695.

Practical Computing, Volume 1 Issue 3.

Software standards

THE FIELD OF SOFTWARE and the number of people who write and sell it grows by leaps and bounds. Inevitably there will be those whose level of service leaves much to be desired, and many will fail and leave the scene.

In the meanwhile the prospective purchaser falls victim. I'm sure thoughts similar to mine have already appeared in your columns. However, I think it worthwhile suggesting to software dealers three criteria required by any prospective purchaser of a package:

- That It is received promptly after being ordered.
- That it runs trouble-free when received and also meets advertised specifications and facilities.
- That it is accompanied by documentation which is accurate, clear and comprehensive. Brevity is not a prerequisite.

Am I unfortunate? I have a Sharp MZ-80B, previously I had a K, and to date I have never had all three of the above. Rarely have I had any two of them.

I have communicated with the U.K. headquarters of the Japanese manufacturer and have received no reply to two of the three letters about documentation and manuals. I have documentation and tapes outstanding from Sharp's largest international dealer from packages bought nine months ago, and cannot get any sense out of them. I have purchased packages from two Sharp software specialists who advertise in your columns, and have never had the above services. Indeed, I see a package still for sale which I returned because it does not meet the advertised specification.

Frequently I get no documentation. Often the documentaiton sent is for another machine or is incorrect or inadequate. How long shall we have to suffer such poor service? Or is this merely the signs of a growing infant, to have to stick with until it becomes a little more sophisticated and aware of what its market requiers?

Needless to say I have no problems with my own software but unfortunately my level of expertise does not allow me to do without some of the packages available on the market. Am I expecting too much? Do other readers have the same problem? And what can be done about it?

G C Heaviside,
Bishops Itchington,
Leamington Spa.

Disabled aids

WE ARE IN the process of establishing the British Database on Research into Aids for the Disabled. The emphasis of the database is on research into aids, design of prototypes and one-offs, and at present we are collecting information on projects. We think the database will be of interest to you and your readers as potential users and/or contributors.

Jane Whiteley,
Handicapped Persons Research Unit,
Newcastle upon Tyne Polytechnic
1 Coach Lane,
Coach Lane Campus,
Newcastle upon Tyne
NE7 7TW.

Or and And

ONE OF THE limitations of the PFS database is that when retrieving forms the user has only logical And at his or her disposal. At least the manual does not give any hint that there was any possibility to use logical Or in searching specifications.

Suppose that you want to retrieve all the forms which have a given word — Pascal in this example — either in field 2, or in field 3, or in field 4. The problem is that the keyword Pascal may occur in all the fields 2 to 4 or only one or two of them. If you have only logical And at your disposal, the search will retrieve either a part of the forms you want or some forms several times. But there is a way to have logical Or and the procedure is as follows:

- Make an extra back-up of the data diskette
- From menu choose 6, Remove
- Make the following retrieve spec:
  Item 2: / .. Pascal ..
  Item 3: / ..Pascal..
  Item 4: / .. Pascal ..

in PFS "/" means "not".

After pressing Ctrl-C and waiting for a while you will have a diskette with only forms which have the word Pascal as a part of either field, or of field 3, or of field 4. This principle can be used with any database which does not have logical Or as a feature but which has a Not.

Pauli Heikkinen,
Liisank,
Pori 10,
Finland.

Reserved words?

THE APRIL edition of *Practical Computing* concerning languages omitted the only language known to all computer users: Profanity.

R J Dowling,
King's Lynn,
Norfolk.

If-Then-Else

I MUST CONGRATULATE you on the high standard of your languages section in the April issue, but I see the Pascal section has come under fire from Mr John Robinson, Feedback, May. John is not completely correct. Dr Allan says the statement

```
IF X = Y THEN
IF W = Z THEN A : = 1
ELSE B : = 1
```

has two possible meanings. The Else statement could correspond with either If, but then the syntax diagrams of Pascal state that an Else always refers to the last If. So in fact there is no ambiguity.

John Robinson implies that Dr Allan does not appreciate this fact, but page 119 has a syntax diagram of this compound If statement which clearly shows which If the Else refers to. John's code for version one is incorrect. Try it if you don't believe me; his statement is

```
IF X = Y THEN
IF W = Z THEN A : = 1
ELSE B : = 1
```

It is elementary knowledge that the semicolon is the Pascal statement terminator, so the semicolon after A := 1 terminates both If statements since neither is a compound statement, no Begin and End. Therefore the Else has no If to correspond to, because the If statements are now terminated, and so will cause an error in compilation.

One way to code version 1 is to make the second If a compound statement forcing the Else to refer to the first If:

```
IF X = Y THEN
  BEGIN
        IF W = Z THEN A : = 1
  END
ELSE B : = 1
```

Once again, well done on a great magazine.

David Miller,
London N3.

IF THE ELSE is to be associated with the first If, then alternatively the If statement could be rewritten as

```
IF X < >Y
THEN B : = 1
ELSE IF W = Z
THEN A : = 1;
```

I think this is a better solution. It is certainly an improvement on Mr Robinson's solution — it will compile.

Neil Jones,
Levenshulme,
Manchester.

Sticking up for Boris

M S JACKSON in the January 1983 issue is busy knocking Dr Allen's Tower of Hanoi program. I particularly liked the way in which Dr Allen gives a direct link between the move number and the required move — far nicer than the messy recursive method. Admittedly, I might be impressed by the fact that it runs easily and simply under Basic.

With proper structuring and comments, and a hi-res display the entire solution expands into a program occupying less than 2K on an RML-380Z. Mr Jackson makes the point that

(continued on next page)

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.

(continued from previous page)

Dr Allen's solution uses "bit twiddling" methods which is, to an extent, justified. However, Dr Allen did show how the same thing could be achieved fairly simply by repeated division by two. This method could work on any future computer, even if it functioned internally in decimal.

Next, Carl Zetie's letter in the same issue. In it, he affirms his belief that the trivial Basic program

```
10 A = 1
```

is correct. He correctly states that Sinclair Basic and Atom Basic are non-standard, and hence it does not matter if his program does not work under those versions of Basic. The implication is that, to be correct, a program must be written in a standard version of Basic, and the standard Basic in the U.K. is Microsoft.

I agreed with him on that line of thought, but taking the next logical step, he should have written his program in standard Microsoft Basic. The Microsoft assignment statement is Let. Thus, his line 10 should read

```
10 LET A = 1
```

Is this program correct now? No, a standard Microsoft program should have an End statement as the last line of the main program. Thus, there should be a line:

```
20 END
```

What I would like to ask Dr Allen is, given the alterations he and I both made to Mr Zetie's program, does he think that the altered form is correct now?

Dr Allen really cannot remain unscathed after Carl Zetie's rejection of mathematical induction, MI, in the May 1983 issue. Any mathematician should know that if P(n) is a proposition operating over some range of the integers, then if P is true for the first value of the range and P being true for n k implies P is true for n k 1, then P(n) is true for all n in the range. This is in a very real sense a complete enumeration of instances.

The fundamental difference between MI and scientific induction, SI, is that MI only concerns abstract mathematical propositions such as does $1+2+3+4+5+\ldots+n$ equal $n(n+1)/2$ for all natural, positive integer, n? SI concerns real events, such as the sun has always risen before, therefore it will rise today, tomorrow and so on.

While SI may have been discredited and invalidated, MI remains an extremely useful abstract mathematical technique.

In the same issue, Carl Zetie contentedly blurbled on about axioms and what is obvious. He claims that $1+1 = 2$ is not obvious, pointing out that 1 XOr 1 is 0. To him I issue a challenge: find a small group of normal, not pedantic, people and ask them what they think 1+1 is. If he finds any who naturally think in terms of XOr when + is mentioned, he has found a very strange bunch of people.

I suggest to him that when + is mentioned, the natural meaning is the addition of two elements taken from the set of real or integer numbers, not XOr.

On now to Euclidean geometry — the geometry of planes. Euclid's final axiom is a truism in a Euclidean space. Certainly in a non-Euclidean space, such as the surface of the Earth, any of the Euclidean axioms may fail. Thus Carl Zetie's comment that "what Boris Allen asserts to be a self-evident truth is, in fact, sometimes false" is extremely misleading, since it implies that Boris Allen has blundered. Yes his statement is correct in Euclidean geometries, which was all he ever said.

Finally, however, Dr Allen was extremely naughty in one section of the article Mr Zetie was attacking, in it he asks "does 1 man + 1 woman = 1 child?" This is unforgiveable coming from anyone who has any mathematical background — a number is totally dimensionless and abstract. To talk about 1 man + 1 woman is absolutely meaningless in mathematics. It is as bad as saying that a kilogram is the same as a litre — the units are completely different and incompatible, from a mathematical viewpoint.

Duncan White,
Little Chalfont,
Buckinghamshire.

● **On that last point, we suspect Dr Allen of attempting humour though his arithmetic remains incorrect: 1 man + 1 woman = 2 and one to carry, as anyone knows.**

Induction

IN HIS REPLY to my letter in the May issue of *Practical Computing*, Boris Allan challenges me to give a complete enumeration of an example of mathematical induction. I propose to do so, though I suspect that Dr Allan may not like the method.

First, take the so-called induction axiom, due to Peano: "Any property belonging to zero, and also to the immediate successor of every number that has the property belongs to all numbers." "Number" here means positive integer.

Now Dr Allan may wish to reject this axiom, but if he does so he is no longer dealing with the same concept of numbers as the rest of us, as this is one of the axioms that defines the arithmetic of numbers.

Secondly, a "complete enumeration" simply means verifying the assertion for every single case. Scientific induction cannot do this because some cases lie in the future — we cannot be certain the sun will rise tomorrow until it actually does so.

Mathematical induction does this by showing that the property holds in one particular case such as zero, and that if it holds for one number, k, it holds for k + 1. The induction axiom then allows us to deduce that it holds for all numbers, that is it is completely enumerated.

Suppose we wish to prove that the sum of the first k + 1 integers is given by the formula

$$\sum_{n=1}^{k+1} n = \tfrac{1}{2}(k+1)(k+2)$$

Obviously, when k = 0 the sum is just 1 so the property holds. Now suppose that p is some number with the property:

$$\sum_{n=1}^{p+1} n = \tfrac{1}{2}(p+1)(p+2)$$

We wish to show that the property is as necessary consequence true for its successor, p + 1, so that:

$$\sum_{n=1}^{p+2} n = \tfrac{1}{2}((p+1)+1)((p+1)+2)$$

$$= \tfrac{1}{2}(p+2)(p+3)$$

That is, the same formula with p + 1 in place of p. To prove this we observe that:

$$\sum_{n=1}^{p+2} n = \sum_{n=1}^{p+1} n + (p+2)$$

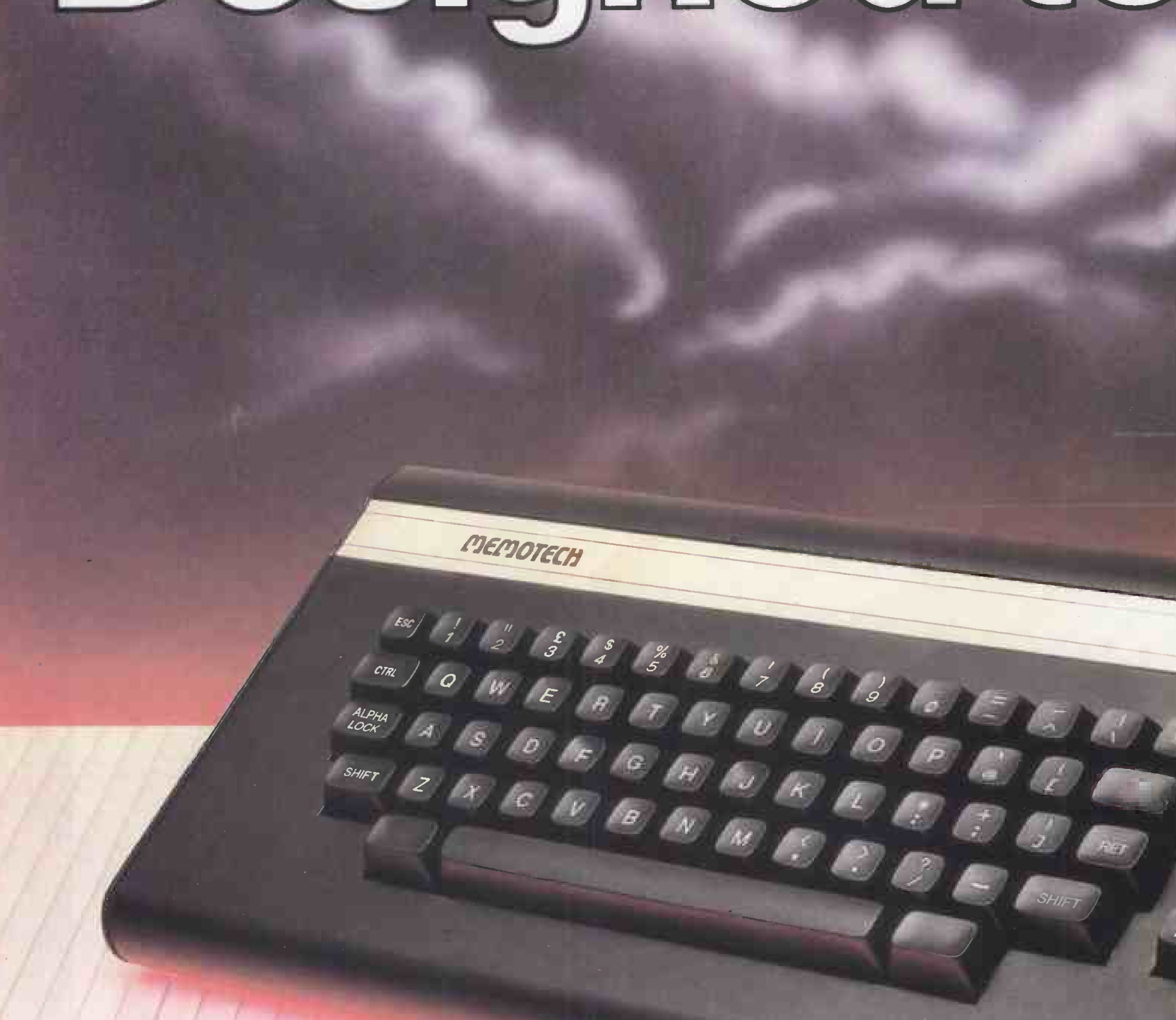
$$= \tfrac{1}{2}(p+1)(p+2) + (p+2)$$
$$= \tfrac{1}{2}(p^2+3p+2) + (p+2)$$
$$= \tfrac{1}{2}(p^2+5p+6)$$
$$= \tfrac{1}{2}(p+2)(p+3)$$

as required.

Hence, by the induction axiom, the property holds for all numbers; we have completely enumerated an example of mathematical induction. I trust this satisfies Boris Allan.

(continued on page 13)

Designed to



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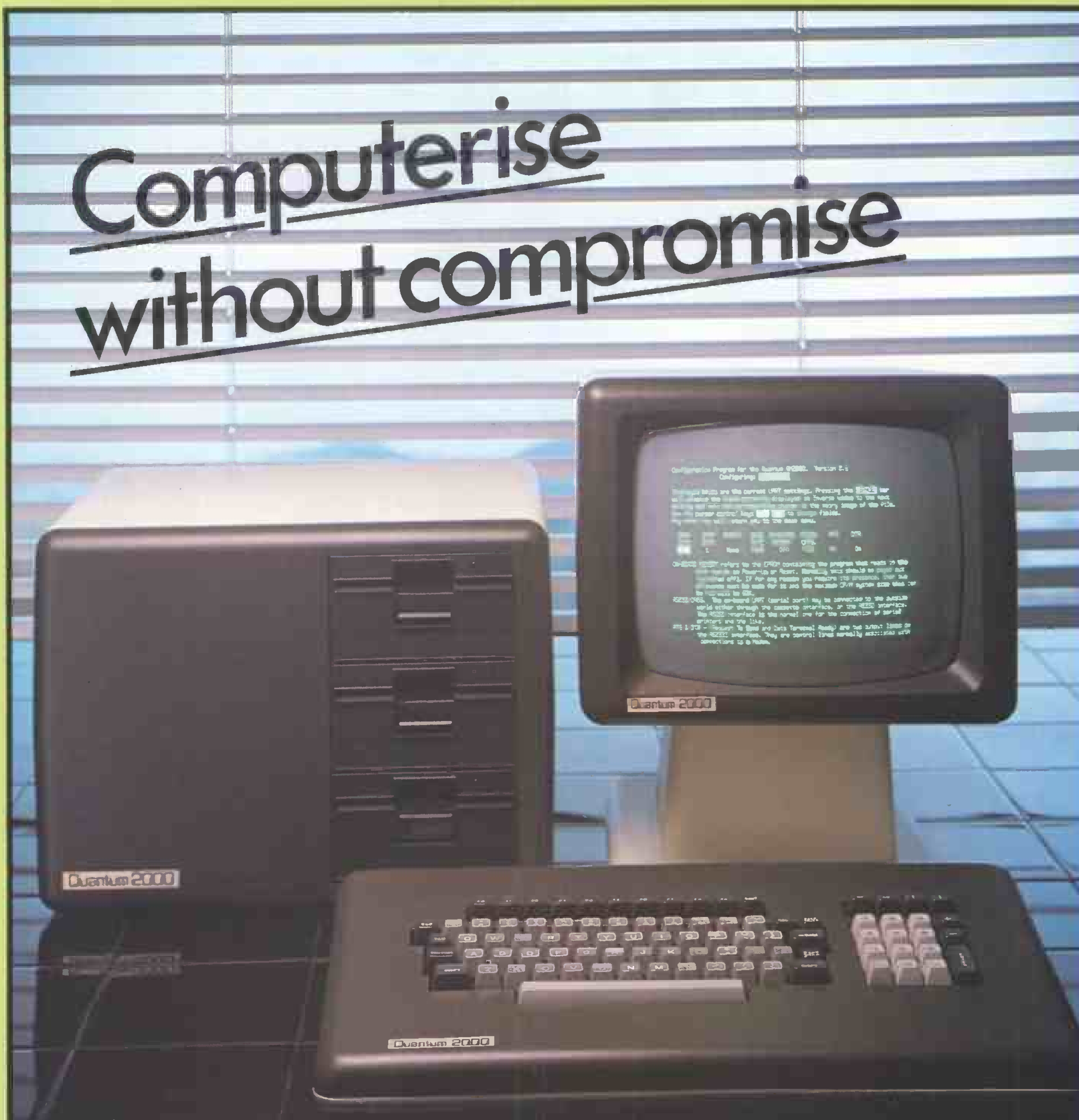
Hardware

As standard – 32k of user RAM expandable to 512k plus 16k of dedicated video RAM. Sixteen colours, 40 column text, 256 × 192 high resolution graphics with all sixteen colours available and easily moveable user defined graphics (Sprites) combine to make effective screen displays quick and simple to achieve. Standard outputs are centronics printer



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(continued from page 8)

On the question of Gödel's proof, Gödel proved that: if axiomatic set theory is consistent, there exist theorems which can be neither proved nor disproved; and there is no constructive procedure which will prove axiomatic set theory to be consistent.

How Dr Allan construes this to mean that no program can ever be proved correct is beyond me. Presumably he believes that, as a corollary, no mathematical theorem can ever be proved correct, including Gödel's theorem.

Finally, the "Boris bashing" completed, may I thank K M Helme — May issue — for clearing up a point that had confused me as well as him. The missing step was in my original letter, but seems to have got lost somewhere between posting and printing.

Carl Zetie,
Cambridge.

● **Boris Allan replies:**
Carl and Boris were stranded on a desert island. They found a crate of baked beans. Boris suggested that they try to open the cans by battering the cans with rocks; he failed. Carl solved the problem quite simply: he said, "imagine one can opener."

I ask Carl Zetie to enumerate an inductive argument, and he cannot go through every example because he will not live that long. To prove enumerability he therefore assumes what he has to prove, that is he uses Peano's axiom of induction.

If we use Peano's axiom of cosmology — that is, the sun rose on the first day and the sun rose the day following every day that the sun rose, so *therefore* the sun will rise every day — then we have no problem with scientific induction.

Mr Zetie has not completely enumerated; he has assumed a rule. The concept of numbers, I would point out, existed long before mathematicians.

● **This correspondence is now closed.**

Unfair criticism

THANK YOU for your write-up in the June issue of your magazine, page 24, outlining the wide range of our application software. However, your assertion that "Superstar is really just a good way of running some of Bromley's software" is, I think, misleading to your readers.

I would be pleased if you could point out to your readers that any CP/M compatible software can be run on the Superstar. Bromcom customers who have chosen to buy the Superstar and to use their own CP/M software include Philips, Marconi and Mount Vernon Hospital, Middlesex.

B Bartlett,
Bromcom,
Bromley,
Kent.

Calculating pi

IN THE Feedback column in May's issue S Mehew cites my March letter, but he is discussing a different topic. The topic of my letter was rational fractions which approximate to π.

The topic of his letter was getting values of π from an Apple II using as few keystrokes as possible. Only in this context can a single division be regarded as cumbersome — his word — compared with an evaluation of the inverse tangent.

R A Fairthorne,
Farnborough,
Hampshire.

APL neglected

IN RECENT ISSUES you have been pointing out the availability of different languages on micros. Could I point out that a reasonably cheap version of APL is available for the TRS-80 model 1 and 3 microcomputers?

APL-80 is available from Microcomputer Applications and costs just over £10 for cassette, or just over £30 for disc. The version is a substantial subset of APL and gets over the need for a special keyboard. It was written by Phelps Gates and offers insight into the language at a reasonable price.

A more comprehensive version of APL is available for the Model 3. It costs $295 and can be obtained from STSC Inc., 2115 East Jefferson Street, Rockville, Md 20852. This version contains ROMs for generating the full APL character set.

APL is also available for the ZX-81 at a cost of $295 from Telecompute Integrated Systems of 251 Spadina Avenue, Toronto, Ontario, Canada, M5T 2E2. I understand that the price includes a 64K memory expansion and a 16K APL interpreter.

Details of the product were given in the June 1982 issue of the U.K. APL User Group Newsletter: "Pressure sensitive APL overlays cover the membrane keyboard. The package required to place APL on the ZX-81 includes a 64K and a 16K expansion memory and a 16K APL interpreter. The memory, called Tispac-64, sells for $175 if purchased alone.

The interpreter, called APL-Powerpac, is priced at $295, including Tispac-64 and the APL interpreter."

I don't know the current exchange rate, but it doesn't sound too bad. Most APL users do appear to belong to big companies. It would be nice for there to be a few more lesser mortals running it on micros. Anyone interested in APL can of course join the U.K. APL User Group by contacting Les Hollingbery, Membership Secretary, 9 Koh-I-Noor Avenue, Bushey, Hertfordshire WD2 3EJ.

I am sure that Les wouldn't mind a plug and I can guarantee that anyone writing to him will receive a friendly reply. APL does appear to be neglected because of its lack of cheap availability, but it is an incredible language to use.

Norman Bailey,
Bracebridge Heath,
Lincolnshire.

Stop ignoring Sharp

THERE IS UNDENIABLY some truth in the view that the MZ-80K and its marginally up-market version the MZ-80A were introduced too late to make serious inroads into the popularity of their close cousin the Pet. Nevertheless, some of the blame for the apparent lack of interest in these excellent Japanese machines can be laid firmly at the feet of the computing press.

In the article Music Micro Please in the June issue Bill Bennett deals with the sound-generating and specifically music-making capabilities of a wide range of current micros. He includes the ZX-81, which he himself says is normally "as silent as the grave", but overlooks the Sharp MZ-80K and A, both of which can make music in a rather limited but nevertheless easy-to-use way.

It is true that the Sharps have only a single channel, and that only three octaves are available using the Music command. But what could be easier than setting the Tempo, to a value of 1 to 7, and then employing the command Music to play a string made up of the names of the notes, A to G with R for rest? A suffix number could indicate their length, 0 to 9, covering shorter than a demi-semi quaver up via various dotted notes to a breve, and a prefix character would indicate which of the three octaves they are in? And these strings, like any others, can be subjected to all the normal string manipulations.

Moreover, Poking the relevant locations, 4513, 4514, with a value from 1 to 255 and turning on the sound generator chip with USR(68) produces a continuous background noise variable in pitch over about six octaves even while the program is busy doing something else.

J P L Hooper,
Colchester,
Essex.

Bad handling

I AM GRATIFIED to note that your review of Apple Writer II, February 1983 issue, condemns the appalling cursor handling. I was beginning to wonder if I was the only person who had noticed. We use Apple Writer II, which I have modified for a Vision-80 card, and we actually like it.

In the course of modification I located and fixed the cursor handling by taking advantage of the fact that Apple Writer makes no use of 4K of bank-switched RAM on our 64K system. That I should have had to get involved in the grubby details of the machine code, including the disc copy-protection scheme, to fix this fundamental defect in the user interface is very sad. That the problem is repeated on the Apple Writer III, supposedly a full business word processor, and the New Apple Writer II for the Apple IIe is even sadder.

Incidentally, your reviewer's comment that the cursor vertical movement is arbitrary is wrong — it moves up and down lines by exactly 80 text characters, entirely oblivious to the word wrapping that is going on on the screen.

M J A Hamel
Dunedin,
New Zealand.

Four new Ataris announced in U.S.

ATARI PREVIEWED four new machines at the Consumer Electronics Show in Chicago in June. The most important thing about them is that they are software compatible with the existing 400/800 models, but all sport extra facilities and smart new cases.

The 600XL is the bottom of the new range, and features a proper keyboard and 16K of RAM for $199. A 64K upgrade is on offer. For a change, the Basic is built in.

The 800XL will replace the current 800. Apart from the case, the major differences are that the XL has 64K built in, and only one cartridge slot.

The 1400XL and 1400XLD are replacements for the 1200, which will not now reach the U.K. They are deluxe models with 64K of RAM plus built-in speech synthesis, Basic and V-24 Modem interface. In addition the XLD has a single disc drive which, under the upgraded DOS 3, offers 127K of storage per side, 254K in all. The XLD casing has room for a second drive to be inserted as an upgrade.

New accessories include a track-ball, "professional" joysticks, remote-control joysticks and light-pen, with a touch tablet to follow. There are also the 1010 cassette deck, 1020 printer/plotter, 1025 dot-matrix printer, 1027 letter-quality printer and 1050 double-density disc drive. Instead of the peripheral box Atari will offer a new expansion system providing eight expansion slots, two RS-232 and a Centronics interface.

Finally, for CP/M there is the Atari CP/M Add-On. It has a Z-80 running at 4MHz plus 64K of RAM, and at under $400 could well offer the cheapest way of running CP/M. Certainly it will undercut the current ATR-8000 CP/M maker for the Atari. As it runs on the serial interface bus, the CP/M Add-On will run with any Atari, including the current 400 model. Also, Atari will actively be promoting the conversion of standard CP/M software to its own disc format.

The new products will reach American shops between August and Christmas, but their appearance in the U.K. will have to wait for conversion to Pal television. The launch has two interesting aspects. First, unlike many firms, Atari has decided to keep faith with existing users, instead of making their machines redundant. By offering Apple-style expansion slots the company has increased the flexibility of both new and existing products. Second, Atari has not launched a new touch-keyboard machine to compete at the bottom end of the market, where it has sold some 10,000,000 video games machines.

For further information contact Atari (U.K.) Ltd, Atari House, Railway Terrace, Slough, Berkshire SL2 5BZ. Telephone: (0753) 33344.

Lynx expanded to 96K

A 96K VERSION of the Camputers Lynx made its first appearance at the Earls Court Computer Fair and is now available from the existing Camputers dealer network. Retailing at £299 including VAT the machine gives Basic programmers 37K to play with, and an extra 24K to machine-code programmers.

There is more to the machine than extra RAM alone. The 96K Lynx also includes a larger 20K ROM, which is 4K bigger than that included with the 48K Lynx. Extra commands provided in the ROM include a number of pre-formatted sound effects and drivers for both parallel and serial printers. There are also commands to draw circles, and others that allow programmers to open up that 24K of machine-code RAM to use as a data store for Basic programs.

Existing Lynx users will be able to upgrade their machine for £89.95 by going through their dealer, who will send it back to Camputers for alteration. Camputers can be found at 33a Bridge Street, Cambridge CA3 4AB. Telephone: (0223) 315063.

The smallest possible disc system for the BBC Micro is based on 3in. Hitachi drive units. Cased in rigid steel, the drives come in single or double versions which cost £225 and £399 respectively. Included in that price are the relevant cables, manuals, disc utilities and EPROM as well as free discs. The discs are double sided, the "B-side" being accessed by flipping it over. Each side can hold 100K. The disc itself is completely enclosed in a plastic case, so it is secure. For details contact Advanced Memory Services Ltd, Woodside Technology Centre, Green Lane, Appleton, Warrington. Telephone: (0925) 62682.

Unix in the Club

THE CIFER CLUB is a new Winchester hard-disc based micro that is available in both eight- and 16-bit versions. The 16-bit version uses the powerful Motorola MC-68000 microprocessor running at 8MHz. On the same board is a minimum of 256K of user RAM, together with memory management. The operating system used by the machine is Unix, which is rapidly gaining ground among 16-bit micros, especially those using the 68000.

The 16-bit board is available as an option for existing Cifer micro users, and as such costs £995. Adding it to the system does not render existing CP/M software obsolete as the upgraded machine retains the Z-80 board as an I/O processor. This function can be switched off to reveal an ordinary CP/M micro. The Club, together with Unix, costs around £4,400. Details from Cifer Systems Ltd, Avro Way, Bowerhill, Melksham, Wiltshire SN12 6TP. Telephone: (0225) 706361.

Oric picks a printer

ORIC PRODUCTS INTERNATIONAL has chosen a printer/plotter unit as the first peripheral to wear the Oric badge. The Oric printer plugs directly into the expansion port on either the 16K or 48K Oric. It requires no accessories other than the connecting lead which is supplied with it.

The Oric Colour Printer was shown for the first time at the Earls Court Computer Fair in London, and is currently available at Oric retail outlets nationwide. Also available at these outlets will be supplies of the plain paper rolls the device uses, as well as the miniature ball-point pens.

Four colours are available on the printer — black, blue, red and green — which can be selected without any manual interference from the user. A standard Centronics interface means that the printer can be connected to a wide range of other microcomputers as well as the Oric 1.

The Oric printer retails for £169.95 and comes complete with a comprehensive manual which includes a number of example programs.

(More news on next page)

Jupiter Ace now has 19K RAM

THE JUPITER ACE is now the Jupiter Ace 16+. The standard memory size of the only micro to use Forth as its native language has been boosted to 19K. The standard 3K of the original Ace has been augmented by a 16K RAM pack but the asking price for the micro is still £89.95.

The Ace 16+ is an ideal machine for users interested in control applications. To demonstrate this fact, the Jupiter Cantab stand at the Earls Court Computer Fair had a robot controlled by an Ace.

Jupiter Cantab has recently moved to a new suite of offices at Cheshunt Building, Bateman Street, Cambridge CB2 1LZ. Telephone: (0223) 313479.

NEC portable

IN JAPAN the Nippon Electric Company, NEC, has launched the PC-8021 portable micro. It appears to be almost identical to the Tandy Model 100 — reviewed on page 96 of this issue — and also features Microsoft software.

One difference is that the 16K of CMOS RAM in the NEC micro can be expanded to 64K internally. A number of other Japanese companies are rumoured to be about to enter this competitive field, which should result in prices coming down.

Contact NEC Business Systems, NEC House, 164/66 Drummond Street, London NW1 3HP. Telephone: 01-388 6100.

Process control with the BBC

BEEB-EX is an expansion system for the BBC Micro which will be of interest to those users not prepared to wait for the Tube. It is an interface card which attaches via a 34-way cable to the 1MHz bus port on the bottom of the micro. It allows BBC users access to the Cube range of Eurocards produced by Control Universal, of which there are over 300.

This system can be applied in the field of industrial control: users can develop controlling software using the BBC Micro and the relevant board. Once it is fully debugged it can then be blown to PROM and incorporated in a stand-alone system. The BBC Micro is too big and bulky for this kind of application, but a version of BBC Basic on a Eurocard is currently under development.

There are two versions of the Beeb-ex. One is a stand-alone unit which holds up to four Eurocards and costs £49. The second is designed for bigger applications: it is a rack-mounted system consisting of an interface costing £41 and rack from £72.

Also available from Control Universal Ltd, supplier of the Beeb-ex and Cube cards, is the Cube modular computer system. This Eurorack computer leaves the user with infinite flexibility: it offers a choice of 6502 or 6809 processors in a number of configurations and is also compatible with Acorn Eurocards.

Control Universal can be found at Unit 2, Andersons Court, Newnham Road, Cambridge CB3 9EZ. Telephone: (0223) 358757.

Texas to go protectionist

TEXAS INSTRUMENTS plans to doctor the TI-99/4 machine in such a way that it will only run cartridge software if the cartridge contains a special chip. This will mean that TI — which makes the chip and steadfastly refuses to let anyone else make it — is the only company able to provide cartridge software for the machine.

Anyone else planning to release software for the TI-99/4 will have to go through TI. Authors will only receive a royalty. It seems that the 99/4 is being sold so cheaply that TI has had to look elsewhere to make a profit from the machine. After reporting a 77 percent drop in profits for the first quarter of 1983, TI is predicting a $100,000,000 loss in the second quarter.

In many ways the move to protect its software represents an own goal by TI. A number of software houses have responded by pulling out of producing 99/4 software — and we all know that software sells micros.


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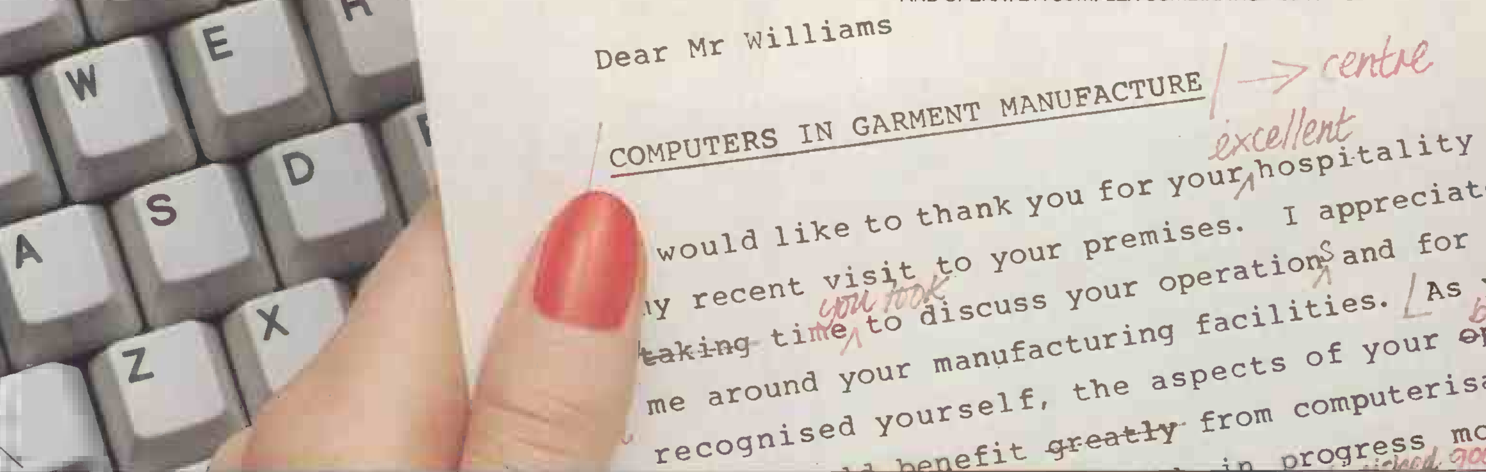

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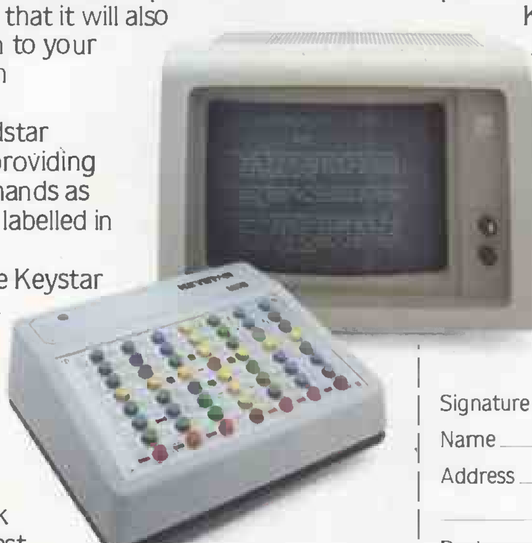

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Another source of DEC discs

USERS OF the Digital Equipment Corporation Rainbow 100 are now freed from having to buy their blank floppy discs through DEC. The Rainbow's CP/M-86/80 operating system requires specially pre-formatted discs.

Key Computer Centres has produced a format utility so that any normal 5.25in. floppy disc can be used. The utility is available from most authorised DEC dealers or from Key Computer Centres Ltd, Enterprise House, Terrace Road, Walton-on-Thames, Surrey. Telephone: (093232) 42777.

6502 assembler for beginners

THE DR WATSON beginners' assembly-language course consists of a tape containing a 6502/6510 assembler and a step-by-step book full of exercises. This seems a good approach as the book is written to suit the assembler, leaving the beginner with only the intricacies of the 6502 instruction set to worry about.

The tape/book package costs £14.95 and is available at the moment for the Commodore Vic-20, Commodore 64 and Pet 2,3,4 and 8000 series. Contact Honeyfold Software Ltd, Standfast House, Bath Place, High Street, Barnet, Hertfordshire. Telephone: 01-441 4130.

Vic-20 teaching games

ASK, a specialist company writing educational games for the three to 12 age group, now has 10 titles available for the Vic-20. Shape Up, for instance, is designed for very young children as a preliminary to learning the shapes of the numbers and letters. The child matches shapes to build houses and tries to catch a shape burglar. Other programs adopt a similar approach to build up literacy and numeracy.

Ask programs cost £8.95 from High Street retailers or £9.50 by mail order from Ask. They generally require 8K or 16K RAM extensions. Details from Ask, London House, 68 Upper Richmond Road, London SW15 2RP. Telephone:01-874 6046.

Smalltalk out at last

SMALLTALK is at last available in the U.K. The Smalltalk programming language is the inspiration behind the current wave of systems which use a mouse, such as Apple's Lisa, Visicorp's VisiOn and Microsoft's mouse.

The Smalltalk PC system written by Chris Macie of Software Systems runs on expanded Apple II or IIe systems or Apple look-alikes like the Basis 108. It requires at least 256K of RAM plus a mouse to run. Smalltalk PC is a cut-down version of Smalltalk designed to run on relatively low-cost set-ups. It sacrifices most of Smalltalk's graphics features, but preserves the concept of multiple windows and implements most of the language.

Smalltalk is an immensely ambitious system developed over the last dozen years at Xerox's Palo Alto Research Centre, running on large Xerox minicomputers. Up to now it has not been publicly available, but Xerox has had co-operation from other manufacturers such as DEC, Hewlett-Packard and Apple in implementing research versions. An unreleased Lisa Smalltalk is known to exist already.

Smalltalk PC has been developed independently of Xerox, but relations between Chris Macie and Xerox seem to be amicable. Getting even a cut-down version of Smalltalk on to an eight-bit machine is an achievement in itself.

Xerox itself is now licensing what it calls the "virtual image" to hardware manufacturers. This is Smalltalk-80 written in a machine-independent intermediate code, actually the lowest level of Smalltalk. Hardware manufacturers then have to go off and write the "virtual machine" — an interpreter to run the code. Having done so they will be able to offer users the full-scale Smalltalk-80 system. The minimum hardware this is likely to run on is an 8066 or 6800-based system with at least 0.5Mbyte of RAM and fully bit-mapped high resolution graphics.

The user interface is the most innovative feature of Smalltalk, but a major design goal has been to provide an interactive envrionment ideal for program development. Smalltalk is therefore likely to be of long-term commercial interest to companies looking for a fast way of producing prototype systems that can be progressively refined.

Smalltalk PC for the Apple is priced at £495, with the mouse and interface costing £275, from Asolve Ltd, 12-14 Church Street, Basingstoke, Hampshire RG21 1HQ. Telephone: (0256) 795746. Smalltalk PC is also available now running on the Basis 108. Details from BCD Systems Ltd, 21 Mount Ephraim Road, Tunbridge Wells, Kent. Telephone: (0892) 45266. Smalltalk PC for the IBM PC is expected soon.

Addison-Wesley has launched a series of books on Smalltalk just as Xerox has finalised arrangements for licensing the product for use on other manufacturers' hardware. *Smalltalk 80: the Language and its Implementation* by Adele Goldberg and Dave Robson is in the shops now — try Dillons University Bookshop in Malet Street, London WC1 if you have trouble getting hold of it. The book costs £24.95 and is available in hardback only.

Addison-Wesley plans to bring out more books this year on the subject. The Smalltalk user interface has inspired the modish mouse-and-high-resolution-graphics approach of the Apple Lisa, VisiOn and the latest Microsoft offerings. *Smalltalk 80: Creating a User Interface and Graphics Applications* deals with this aspect of Smalltalk in depth.

Smalltalk does away with the distinction between language and operating system, so the process of developing programs in Smalltalk is a novel experience for most programmers. The book *Smalltalk 80: the Integrated Programming Environment* should create great interest among the software writing community when it appears.

Standard software is the aim

MICROSOFT HAS reached agreement with a number of Japanese and American computer manufacturers on a software standard for low-cost home computers. Called MSX, the standard has immense implications for a market characterised by a multiplicity of different machines all running entirely incompatible software.

The standard is in the form of documentation describing what hardware environment manufacturers have to provide to run MSX software. An MSX machine must be based around the Z-80 eight-bit processor and the Texas Instruments 9918 video controller. The standard specifies other I/O features in detail, including the joystick, cassette and ROM-cartridge interfaces, and the music features to be supported. Microsoft will be licensing a 32K ROM for this standard MSX machine based on Microsoft's Advanced Basic.

Manufacturers gain by getting access to this essential system software more quickly, and their customers should gain access to a much larger base of software packages. Manufacturers are free to add machine-specific enhancements to the MSX core and can obviously lay out their circuits as they choose. Microsoft avoids the tedium of having to churn out inumerable variations on the same theme.

Manufacturers working with Microsoft on MSX include NEC, Sony, Matsushita Panasonic, General Instruments and Spectravideo. MSX is primarily intended for machines that will be sold into the Japanese home market, hence its conservatism, but Microsoft is keen to reach agreement of this kind for other sections of the micro market. Microsoft is at present actively engaged in discussions with U.K. and European manufacturers and software writers to see if a similar arrangement can be worked out for Europe.

(More news on page 23)

Languages for Apple Lisa

APPLE HAS ANNOUNCED Pascal, Cobol and Basic for the Lisa, with C and Fortran to follow. The languages come with a range of tools for software developers which together make up what Apple calls the Lisa Workshop.

Lisa Pascal resembles the UCSD Pascal used on the Apple II and III sufficiently closely to enable existing code to be ported across to the Lisa quite simply, and it also conforms to the ISO standard. It has been extended to allow use of the Lisa mouse, and can be used with Quickdraw, a powerful graphics utility which is part of the workshop. Pascal costs £480.

Lisa Basic resembles DEC Basic Plus, and costs £240. Lisa Cobol is a level 2 Cobol developed by U.K. software house Micro Focus. It costs £800.

These three languages will all be available when volume deliveries of the machine commence. The prices all include the software-development workshop, with its mouse-controlled text editor, 68000 assembler and various other debugging and development tools.

To write applications which use the mouse and the Lisa's 364-by-720 dot screen to full advantage, with multiple windows and so on, you will need to use Pascal for the time being. The Basic and Cobol are more limited in this respect, and do not support Quickdraw.

Already several U.K. software houses, including Vlasak and Eurobeta, have transferred commercial accounting software written in Pascal across from the Apple II and III on to the Lisa, and then used the workshop utilities including Quickdraw to rewrite the user interface.

Quickdraw's 40,000 lines of 68000 assembly code provide the software developer with fast routines to handle window management, multiple type founts and the other features of the Lisa graphics interface. Lisa Pascal with Quickdraw was used to develop the 2Mbyte of office management software which comes with the standard Lisa system, reviewed on page 92 of this issue.

Further details from Apple Computer (U.K.) Ltd, Eastman Way, Hemel Hempstead, Hertfordshire HP2 7HQ. Telephone: (0442) 60244.

Software deal with record company

K-TEL and DK'Tronics signed a deal worth £150,000 at the Midland Computer Fair. The deal will commit the large record company, better known for its 20 Greatest Hits compilations than for computer software, to market, 75,000 cassettes supplied by the Essex-based microcomputer company.

The deal highlights the similarity between the micro software market and the record industry. Both deal with a form of software that requires hardware for its operation, and both sell to a predominantly young audience.

That K-Tel knows how to sell to this market is beyond doubt. In the run-up to the busy Christmas selling period you can expect to see a high-powered TV advertising campaign extolling the virtues of certain Spectrum software packages being distributed by the K-Tel organisation.

There is one other similarity between the two markets. They are both haunted by piracy. K-Tel will really score here since it already has a well-oiled legal department specialising in this type of case.

Virgin Games, part of the Virgin Records empire, is another software company to enter the market from the music business. It is looking for exclusive deals to market other people's software under the Virgin label. K-Tel is acting as a distribution company only, with software houses keeping control of the packaging, etc. This appears to be the better strategy, as most software houses seem reluctant to jump to the Virgin bait.

DK'Tronics is run by Managing Dirctor David Heelas and Marketing Director Peter Brownlie, who sees the micro software industry as being similar to the rock-and-roll music business in the 1950s. He likens David Heelas, the programmer, to Eddie Cochran and says he is now looking for the new Paul McCartney.

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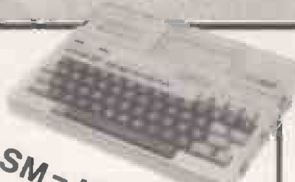

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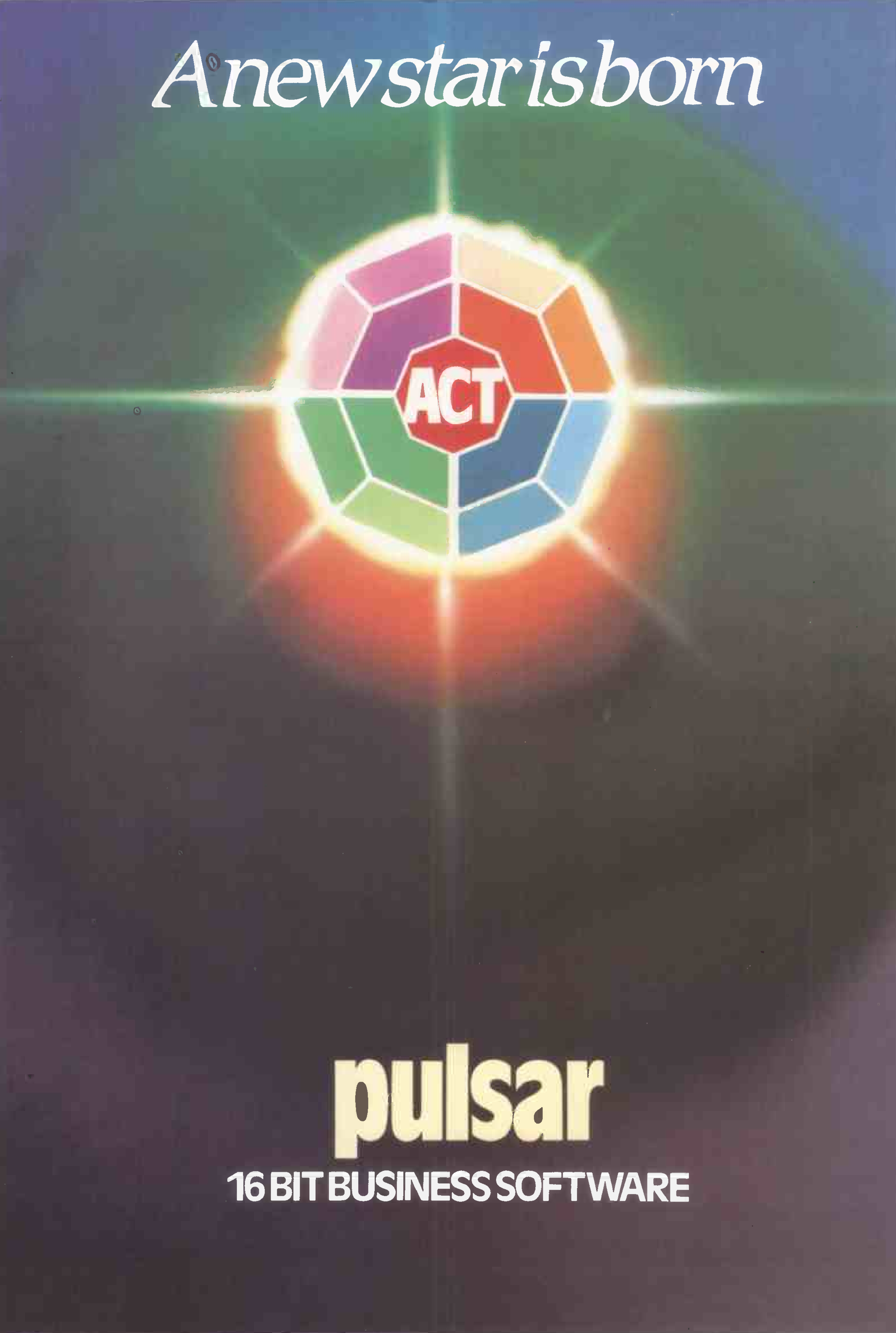
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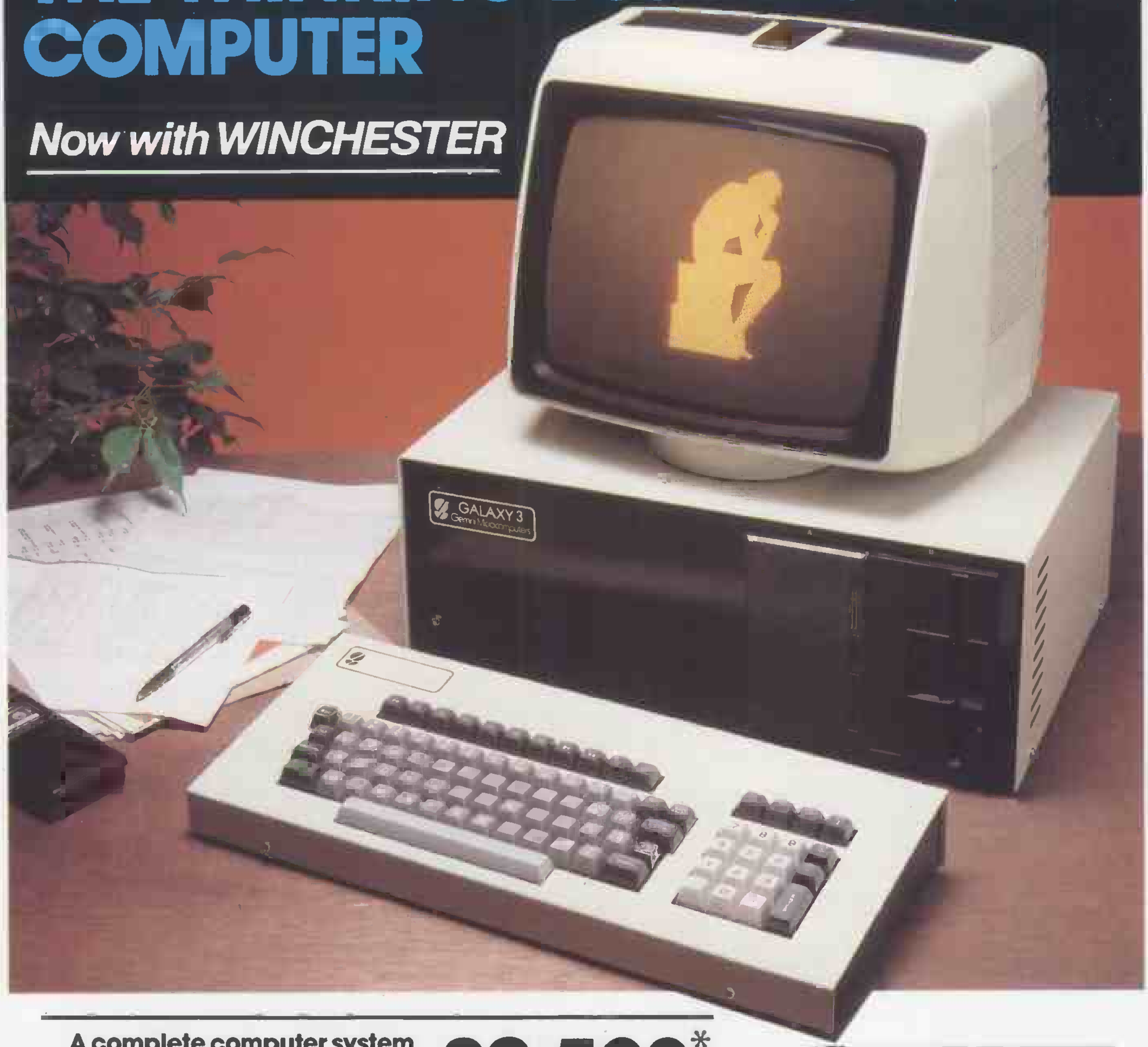

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The new Galaxy 3 has been built to comply with the most widely accepted industry standards, so the business user can make effective use of the largest range of hardware and software options. It uses the world's best selling micro processor, the Z80A, and is based on industry standard 80BUS Boards. Interfaces include both parallel printer interfaces and RS232, enabling the user to immediately connect a wide range of compatible hardware, even to the extent of building up his own networking system.

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> "The fundamental premise of a revolution is that the existing social structure has become incapable of solving the urgent problems of development of the nation."
> Leon Trotsky
>
> "Every revolution evaporates, leaving behind only the slime of a new bureaucracy."
> Franz Kafka

Even unto the fifth generation

Boris Allan ponders the future of computing.

TO A PEASANT in Tanzania, and for many city dwellers, a bicycle is far more useful than a Concorde. Perhaps it is fitting that the polemic of the IT82 booklet referred uncritically to Concorde; we are told IT is a revolution, and Concorde was planned in a Britain that was to be forged in the white heat of another revolution. Do the seers of IT promise another Concorde? One hopes not.

When I refer to IT, I refer to the revolutionary ideology which, as Trotsky noted, feels that our existing society is incapable of solving the nation's problems. When I refer to Information Technology, I mean the idea that there are assorted aspects of technology which can usefully be classed together — for example, computers, VTRs, and word processors. By information technology without the capitals, I mean the individual aspects, computers, etc. It is crucial to distinguish between these levels because the move now has been very much from information technologies to IT revolutions. That computers are useful does not mean that the ideology of IT is going to solve any problems.

We know that the fifth-generation computers are on the way and that the Japanese are beginning to spend, spend, spend to produce this new breed of machines. I have not been able to find a convincing explanation or definition of what is, or will be, the fifth generation. But this does not stop conferences being organised to discuss the subject.

In my search for enlightenment I decided to find out what was the definition of the fourth generation, and so I went to the second edition of the *Penguin Dictionary of Computers*. In 1977, when it was published, there was no fourth generation, but there was a third generation: "Machines built with integrated circuits. Related to first generation and second generation".

In 1977 the coming of large-scale integrated circuits was easy to predict, in fact it was happening then; obviously the compilers of the dictionary felt, sensibly, that it was going to come — but why bother to include it? The fifth generation is of a different order of things entirely: the fifth generation is not to be a hardware-led revolution, but a software-led revolution. The revolution will come with the nature of the software, the expert systems, but although with hardware one can gauge the rate of future advance with a reasonable certainty over the very short term, software is much less malleable.

Sir Leon Bagrit in *The Age of Atuomation*, the 1964 Reith Lectures, wrote: "I believe that within 25 years, automation will have made the old concept of charity obsolete. We may eventually reach a stage where the work to be done will need perhaps only a third of the population to provide fully for everyone, and still leave plenty in hand . . . ".

Together with the fifth generation — not yet with us, remember — we have a new occupation, the knowledge engineers. One of the original knowledge engineers was Aristotle, who developed apodictic logic. A more recent knowledge engineer, Karl Popper, made some apposite comments upon the development of all knowledge in *Poverty of Historicism*, published in 1961.

Let us first consider though what is being propounded by the ideologists: very little of any real substance. Japan is reputedly spending £250 million over 10 years to develop something, though exactly what is not certain — the all-talking, all-dancing computer perhaps. Hitachi allegedly has a prototype which can translate grammar-school English into Japanese with 60 percent accuracy, something AI experts were predicting in 1963 would happen shortly. Japan could be wasting a great deal of money, though as with the moon shots there might be technological spin-offs. They might have happened more cheaply through normal channels but the normal channels have been choked by emphasis on the moon shot or the fifth-generation project.

Popper, the knowledge engineer, noted that the course of history is strongly influenced by the growth of human knowledge and thus scientific knowledge. He also noted that we cannot predict, by rational or scientific methods, the future growth of our knowledge.

The latter assertion he had proved by logical means, and the result was "We cannot, therefore, predict the future course of human history". The logical proof is only outlined by Popper, but runs "no scientific predictor . . . can possibly predict, by scientific methods, its own future results". In general terms this reduces to the argument that if there is such a thing as growing human knowledge, then we cannot anticipate today what we shall know only tomorrow.

The logical proof used by Popper is elsewhere revealed as based on Gödel's theorem, as are some of the arguments about the limitations of expert systems. For example, there is a qualitative difference between protecting a warship against Exocet by an expert system, and an intelligent computer using an expert system.

In essence — and as I write this I know others will disagree — Gödel's theorem states that in any system which is complex enought to describe itself the system is incomplete, and there are things which one can do in the system whose meaning is uncertain. Popper uses Gödel's theorem in this way: a scientific predictor is a system sufficiently complex to refer to itself, but the meaning of the statement "in two years I predict that I will predict X" is very uncertain.

There is an argument of long standing which uses supposed consequences of Gödel's theorem to claim that the human is irreconcilably different from the machine. The human has free will because the human can realise that there are things which are inherently meaningless, the human has a concept of meaninglessness.

It would seem that a reassessment of the nature of the IT predictions, and the direction of work to produce the fifth generation — a notion I find inherently strange — needs to start from a study of knowledge engineering in a wider sense. Perhaps philosophers such as Gödel and Popper have insights to offer to the new knowledge engineers. With the formation of IT committees, and committees to study the fifth generation — for example, the Alvey Committee — I begin to suspect that Kafka's prediction might be the most accurate.

Perhaps Japan will be wasting so much money that we will benefit. Can anybody tell me what is the sixth generation?

Computer Fair 83

The Earls Court Fair broke attendance records again this year. Bill Bennett reports on the new products which drew the crowds.

NEARLY 48,000 visitors made the Earls Court Computer Fair the biggest-ever microcomputing show this side of the Atlantic.

There was something for everyone at the Fair whether they were business users looking for software and hardware, serious enthusiasts wanting to expand, upgrade or add to their existing systems, home users looking for the latest games software to run on their machines, or beginners out to buy their first micro.

Among the machines on show for the first time was the Memotech MTX-500 and its closely related cousin the orchid. In many ways the MTX-500 micro was the star of the show. Memotech did not take any orders, but was content simply to let the public look and lick their lips. However, the response to both machines was strong, with dealers from all over the world queueing up to take a slice of the Memotech action.

Tipped by many as a replacement for the BBC Micro, the MTX-500 is based on a Z-80A running at 4MHz. It comes complete with 32K RAM, expandable up to 512K and 16K of dedicated video RAM. Basic and a dissassembler/assembler come as standard, as does Logo and a new educational language called Noddy. Pascal is available on a plug-in ROM. The keyboard is everything you could want.

The Orchid is the MTX-500's more powerful relative. It is a fully fledged business system that offers hard discs, a Z-80B running at 6MHz and a number of other features, including colour graphics. It is the fastest machine around, and claims to knock spots off the Olivetti in the benchmark stakes.

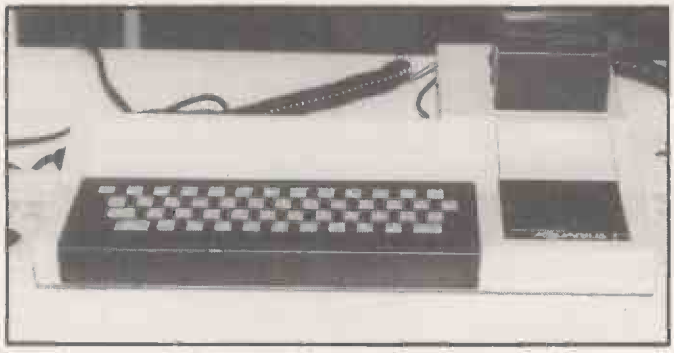
Also on show for the first time at the Computer Fair was the Mattel Aquarius, a beginners' micro which is bought unit by unit in a manner familiar to hi-fi ethusiasts. For many visitors the show also provided the first glimpse of the Commodore 64, the Laser 200 — previously known as the Texet — the Comex, the Sord M-5 and the 96K Lynx.

Business users visiting the Encotel stand will have noticed Otrona, a ruggedised portable for the user on the move. The machine costs around £2,400 with WordStar and other worthy CP/M packages thrown in. Also visible was *Practical Computing's* ex-editor Peter Laurie showing off a tasteful NCR Decision Mate V micro running the Southdata Superfile package.

Printer distributor Appropriate Technology had the Flowwriter range on display, and Canon's colour ink-jet printer was to be seen on the Canon stand. KGB micros was showing an impressive CAD system based on the ACT Sirius micro, together with a number of other software packages. Coloured floppy discs to brighten up the office were to be found at the Counting House stand.

Home-computer software was being sold in vast quantities from numerous stands. All the big names were there, including Imagine, Quicksilva, Bug-Byte and DK'Tronics, together with some of the rising stars such as Addictive Games, Salamander and AP Software. Many of them could be found deep in the haunts of the Sinclair Village.

My favourite item was a super soccer game that was running on a Commodore 64 — its graphics are like nothing seen before on this machine.



Above: The Mattel Aquarius made its first U.K. exhibition appearance by courtesy of Silica Shop.
Below left: "Take me to your leader . . . "
Below right: . . . and here he is, PC's publisher Chris Hipwell clearly enjoying a spell on our stand.

Staff of Computer Fair sponsor *Practical Computing* prepare to welcome visitors.

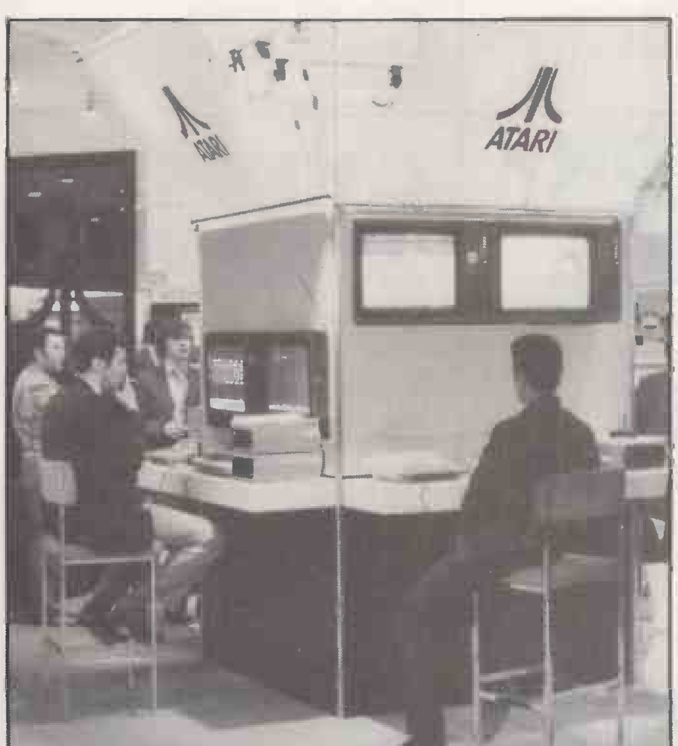
Above: Claudia Bayr sports a Micro Management T-shirt. Below: Stephen Vickers' Ace running a Cyber robot arm.

Unfortunately the staff on the Chromasonic stand displaying the game were unable to sell it. Susan Ben-David was doing a roaring trade in selling books. They were not the conventional computer handbooks but Adventure game stories. Does the advent of this novel medium spell the end of the computer?

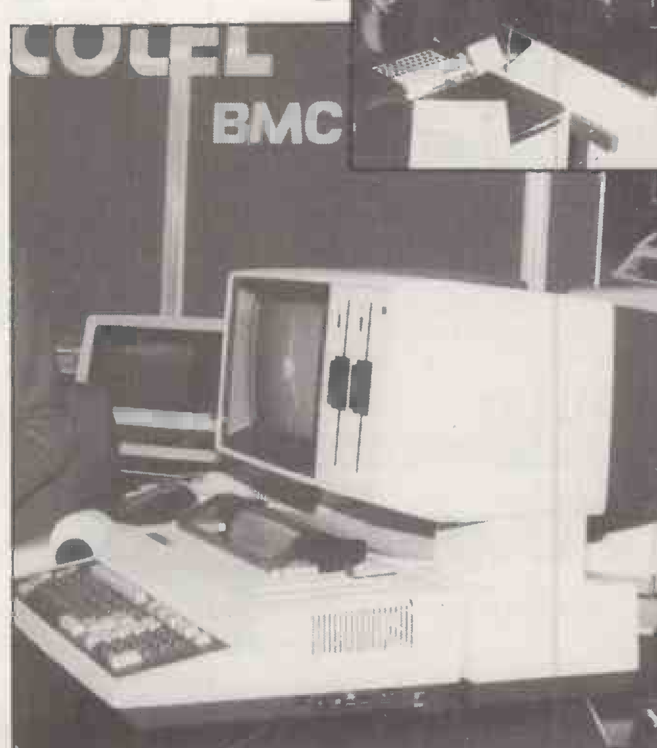
Robots seemed to be quite popular at the Computer Fair. There were robots on stands and robots handing out promotional material. There were even robots that would talk to you. To prove the virtues of Forth, the Jupiter Cantab stand was dominated by a Cyber robot arm controlled by a Jupiter Ace micro.

Elsewhere, robot rodents were battling it out in the Micromouse competition. Overall victor was Alan Dibley who trained T4, the fastest mouse on the day. He won £1,000 and a piece of brass cheese donated by Micro Management. Next came a mouse named Knownaim, managed and trained by Dave Woodfield. Third prize went to seasoned campaigner Sterling Mouse from the Nick Smith stable.

Next year's Earls Court show will be bigger and better. And if you can't wait until then there is always the Northern Computer Fair to be staged in Manchester on November 24-26.



"No one beats Atari at their own games" — says Atari.



Encotel's BMC if800 business microcomputer.

Second front for Zilog

WITH SMOKE from the eight-bit battlefield now clearing, and the heroic deeds of the Z-80 and the 6502 now little more than ancient history to the chip designers, it is fascinating to observe how the next big battle is being stage managed by the semiconductor giants — the battle for 16 bits.

In the beginning there was the Texas 9900, a creditable first in 16-bit processors. But it was ahead of its time, with consequent deficiencies which have kept it on the sidelines, despite several efforts at modernisation. Perhaps the new 99000 family will fare better, though it is generally agreed that the three main armies to watch are those of Intel, Motorola and Zilog, all successful veterans of the eight-bit crusades.

Intel got in first with its not very lovely 8086, closely followed by Zilog with the powerful Z-8000, and then Motorola with its almost divinely inspired 68000. Of the three, the Intel device is streets ahead of the others in terms of sales, and the Z-8000 comes a poor third. Of course, the sales battle is still in full swing and the final outcome not yet decided, but already it is possible to see the sort of features which have contributed most to success, and they are not what many of us might have anticipated a few years ago when the battle had just been joined.

The 8086 is not elegant or even very powerful when compared with the other contenders, but it does have the advantages of being first; a 100 percent compatible eight-bit bus version, the 8088; a powerful peripheral chip family; and a measure of compatibility with the eight-bit 8080 family.

The 68000 is potentially a much better design than the 8086 but at the moment it lacks the advantages of an eight-bit bus version or a comprehensive family of peripheral circuits, although these things are certainly planned. Since there never was a large software base for earlier Motorola eight-bit processors like the 6800, there was no real advantage in giving the 68000 a compatible instruction set, so it wasn't given one. The 68000 may yet end up victorious, thanks to its raw power and its elegance, but the Intel bandwagon will take a lot of stopping — just look at what the IBM PC, the ACT Sirius and a host of other 16-bit personal computers are using.

We all expected a lot from Zilog, after its amazing success with the Z-80. The Z-8000 certainly looked good at first with its neat architecture and 16Mbyte addressing range — so good, in fact, that I would have put money on it. Unfortunately Zilog neglected two important features. As the battle unfolded, it became obvious that these were near fatal omissions. First, Zilog ignored its huge existing Z-80 user base and did not make the Z-8000 software compatible. Old Z-80 users now had nothing to gain by staying with Zilog, and shopped around for the best 16-bit processor they could find. A lot of them found the 8086 — which does have a degree of compatibility with Z-80 code — and still more found the 68000.

Secondly, Zilog did not provide an eight-bit bus version of the Z-8000, and since more 8088s are sold than 8086s, thanks to the lower system and memory costs, this too was a bad mistake.

by Ray Coles

The Z-8000 is not a complete failure by any means — it has attracted sufficient support to remain viable for years to come — but neither can it ever be the rip-roaring success that Zilog desired. In typical, dashing style, Zilog has now apparently realised its mistake and, rather than sulking or applying hasty fixes to the Z-8000 family, has done the unthinkable and is about to introduce the brand-new Z-800 family of 16-bit processors. They have all the earlier omissions corrected and lots of new features added.

By opening this second front on the 16-bit battlefield Zilog is attempting a bold outflanking manoeuvre which just might gain it the initiative. Certainly the specifications of the new family seem to make it peculiarly well suited to meet the emerging needs of the 16-bit market which can now be seen in sharper focus.

The launch announcement of the new family stresses compatibility with the Z-80 and, rather craftily, does not speak of competition with the Z-8000 and other 16-bit processors. The Z-800 processors will run Z-80 code directly, and can even use the CP/M 80 operating system to gain access to the huge amounts of CP/M software already available to many potential users. All the other 16-bit processors can run the new 16-bit versions of CP/M, such as CP/M 86, but this does not allow them to run eight-bit software.

There are four processors in the Z-800 family at present. The Z-8108 and the Z-8208 are eight-bit bus versions compatible with Z-80 hardware. The Z-8116 and the Z-8216 are 16-bit bus versions compatible with Z-8000 hardware. All four processors operate using 16-bit buses internally, and all of them have the same basic architecture and compatibility with Z-80 code.

The common architecture of the new family is based on the old Z-80 model but with the addition of an extra stack pointer and a number of new hardware facilities which include a 256-byte fast cache memory, a memory management unit, an on-chip clock oscillator, and four 16-bit counter-timers. The Z-8108 and Z-8116 are housed in 48-pin packages and can address 512K using a 19-bit address bus. The Z-8208 and Z-8216 use a 64-pin package and can address a full 16Mbyte using a 24-bit address bus.

The Z-8208 and Z-8216 also have extra on-chip facilities which put them in a class of their own and make them, literally, systems-on-a-chip. In addition to the standard Z-800 features, these two powerful processors have four-channel DMA controller and a full duplex asynchronous serial port capable of operation at up to 2Mbits per second.

On the software side, the Z-800 family has a considerably expanded instruction repertoire to enable it to compete with the other 16-bit processors. The two stack pointers provide for a System and a User mode, in true 16-bit fashion, and the IX and IY index registers have been made byte-addressable.

Add to that a new chip-fabrication process which promises to realise clock speeds of up to 25MHz, and you get a powerful 16-bit processor which can probably compete on equal terms with the 8086 and 68000 families while retaining full compatibility with the preceding eight-bit generation. It's a pity Zilog did not introduce the Z-800 earlier, instead of the Z-8000. If it had done so, Zilog's sales figures would have been very different.

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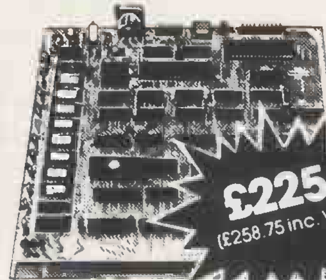

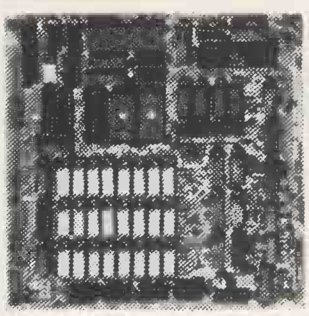

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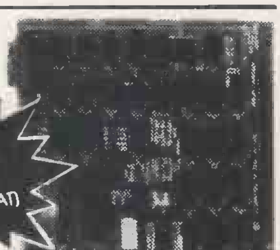

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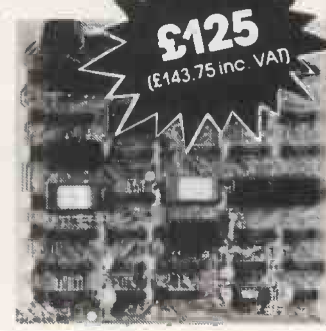

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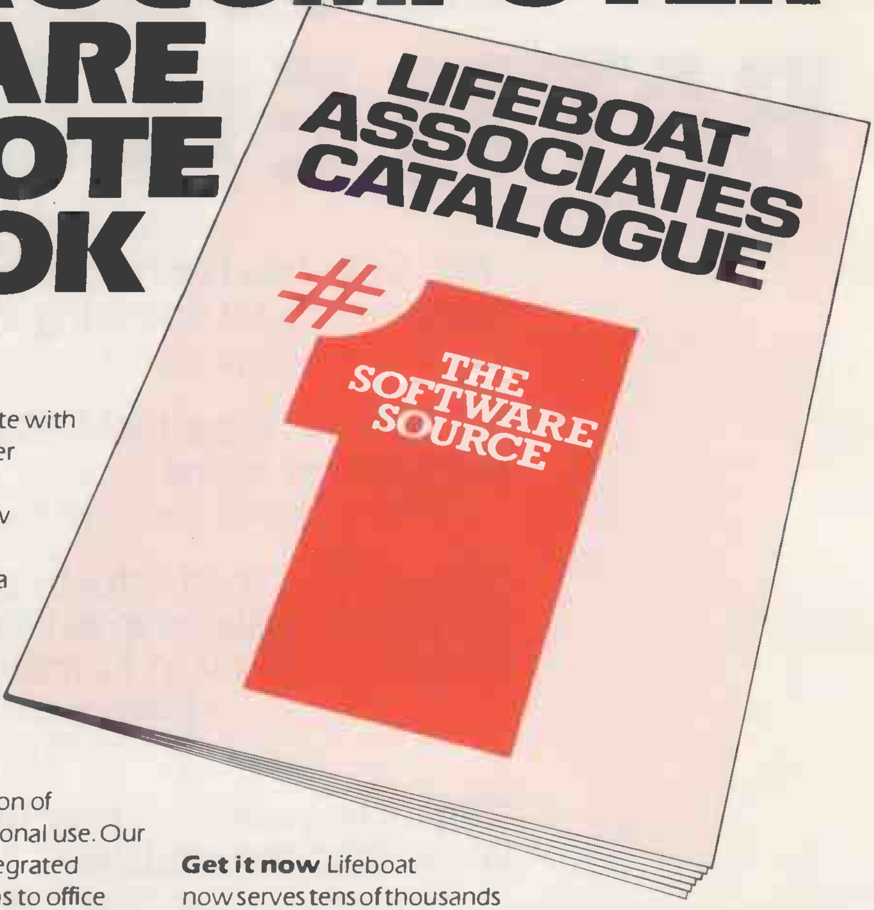

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Our spreadsheet sys
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But which system should you buy? Surely no one system can meet the needs of all businesses?

Fortunately Comshare is not like most companies. We see the need for different systems to suit different people.

NEW USERS START HERE

PlannerCalc at £85.00* is now accepted as the first choice for people new to financial planning.

Designed for 8-bit micros, it boasts the kind of features that you'd expect to pay twice as much for. (Buy PlannerCalc's nearest rival and you'll have to.)

Unlike all other 'calc' products it allows you to enter calculations in a language you understand. Plain English.

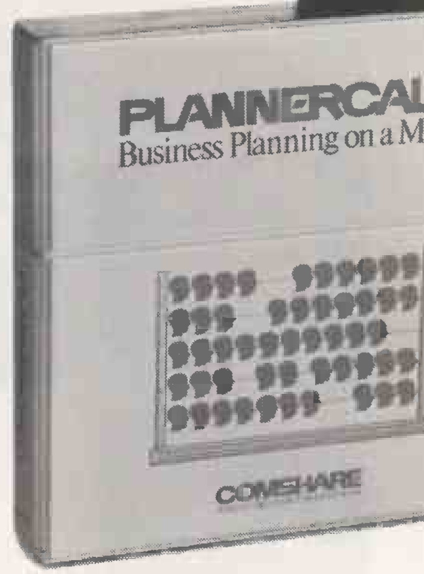
For example:

```
LINE 1  SALES=100,150,175,210
LINE 2  EXPENSES=GROW 70 BY 15% FOR 4
LINE 3  NET=SALES−EXPENSES
LINE 4  CSALES=CUM SALES
COLUMN 5 YEAR=SUM OF COL 1 THRU COL 4
```

So it's much easier to use.

It uses the popular "spreadsheet" approach with a window that can be rolled in all directions.

Which means you can enter new figures and rules and immediately see their effect on everything else in the model.



It comes with the best manual on the market and it's suitable for most micros with a ™CP/M 2.2 operating system, 64K of memory, giving at least 900 cells, minimum screen width of 80 characters and 2 floppy disc drives.

MUCH MORE POWER, NOT MUCH MORE MONEY

MasterPlanner is the most powerful spreadsheet system currently available with its increased matrix size, 2000-3000 cells on most 64K micros. (But at £245* it certainly isn't the most expensive.)

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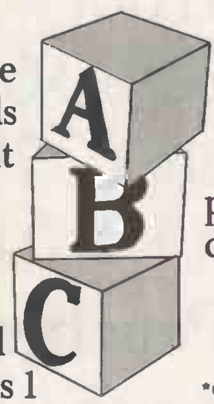
plan. Data transfer to word processing and other systems lets you incorporate figures in reports and output to a data base. It also has extensive formatting facilities which means you can produce reports that wouldn't look out of place in the board room.

It can store up to 25 standard reports to run when you need them. It's got full WHAT IF? analysis and direct editing of both spreadsheet and logic display.

JUST AS EASY TO USE

All this increased power doesn't mean you'll need a degree in advanced computing to understand MasterPlanner.



It works on exactly the same system as PlannerCalc and models written on PlannerCalc run without modification on MasterPlanner.

16 BIT VERSION

A new version of MasterPlanner has been specifically designed for the 16 bit micros like the Sirius 1 under ™CP/M-86 or the IBM personal using either CP/M-86 or ™MS DOS 1.1. With a vast matrix size of over 7000 cells on 128K and even more with larger memory, you'll at last be able to make the most of your micro.

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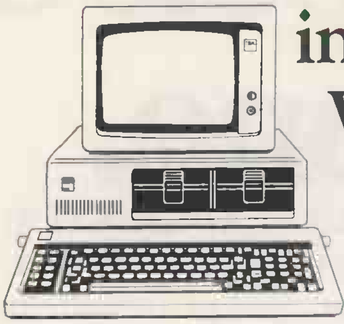

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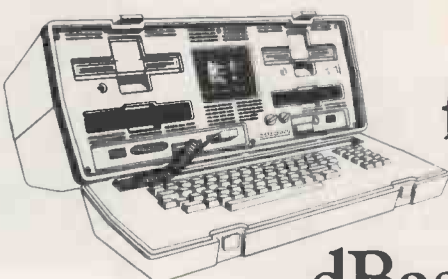

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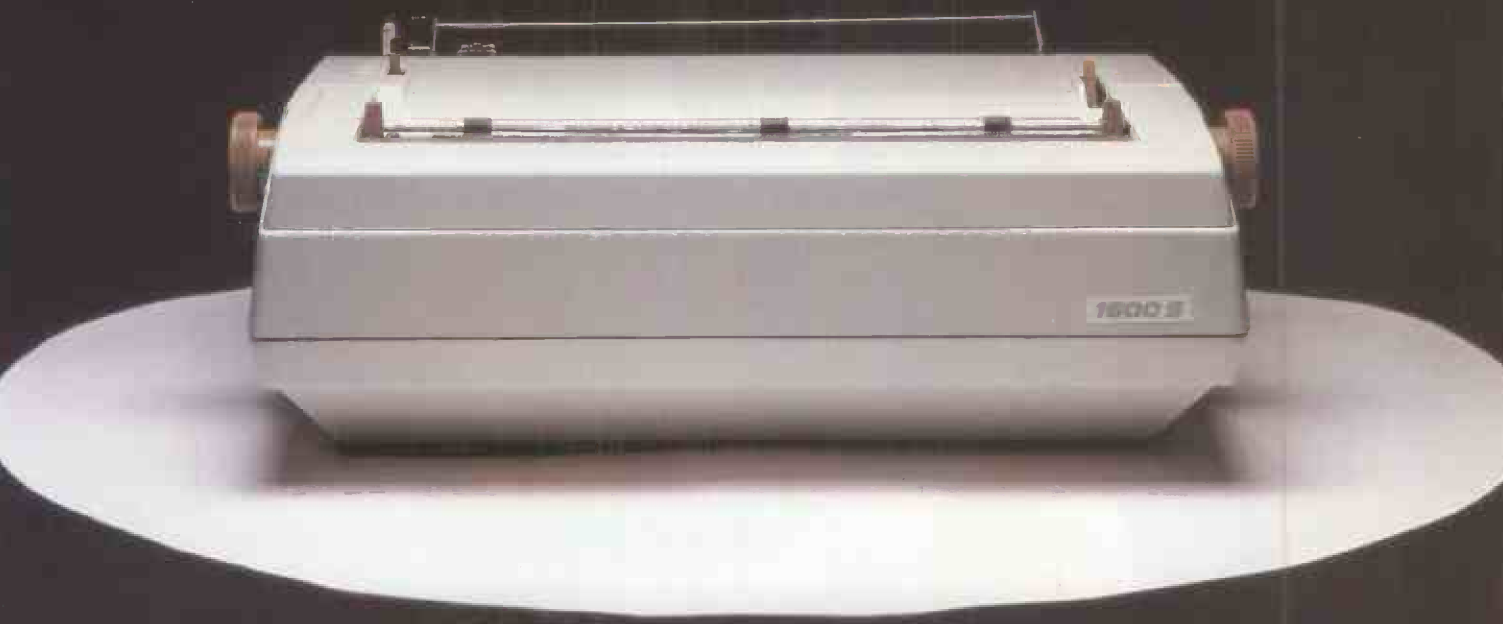

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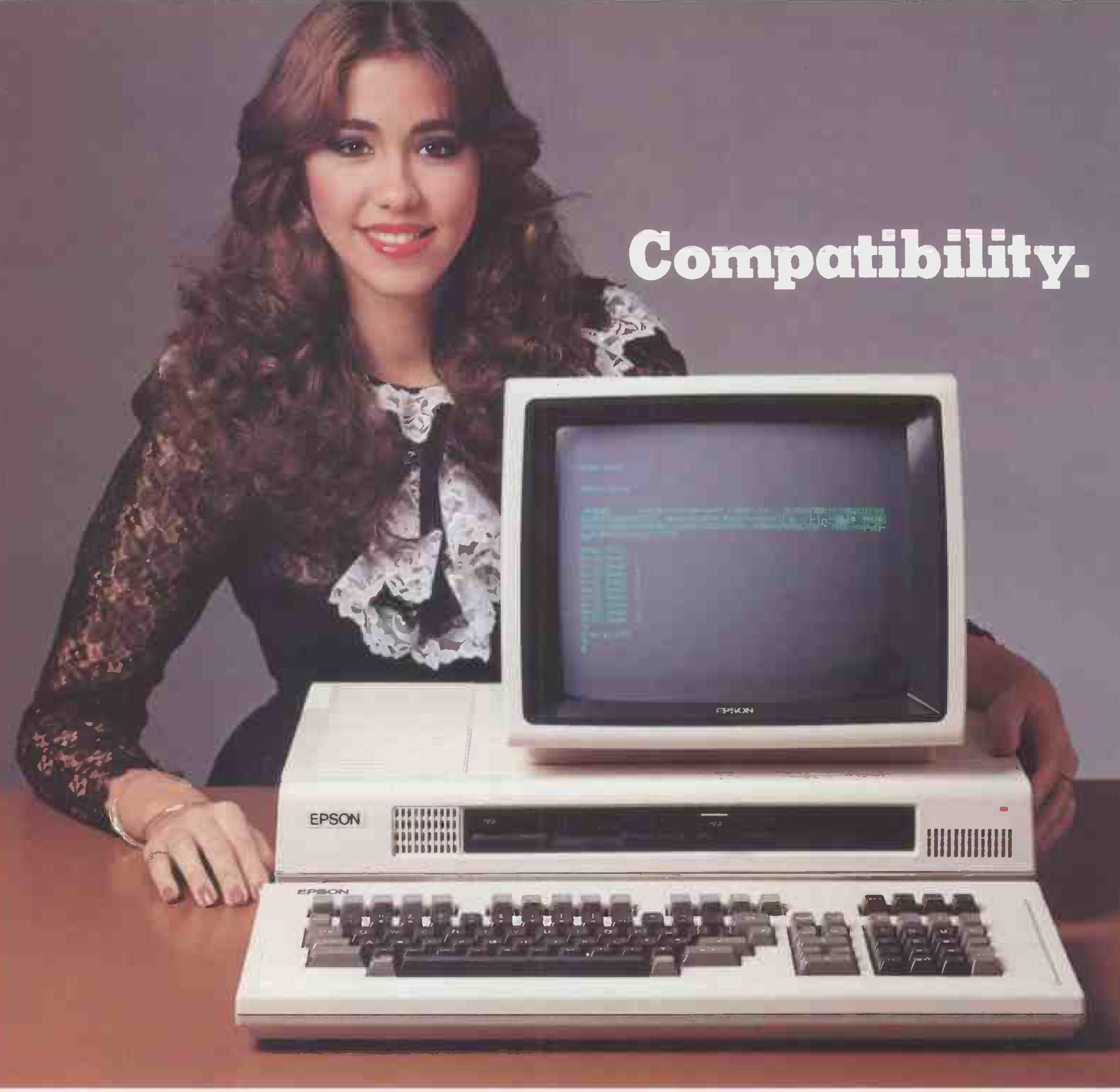

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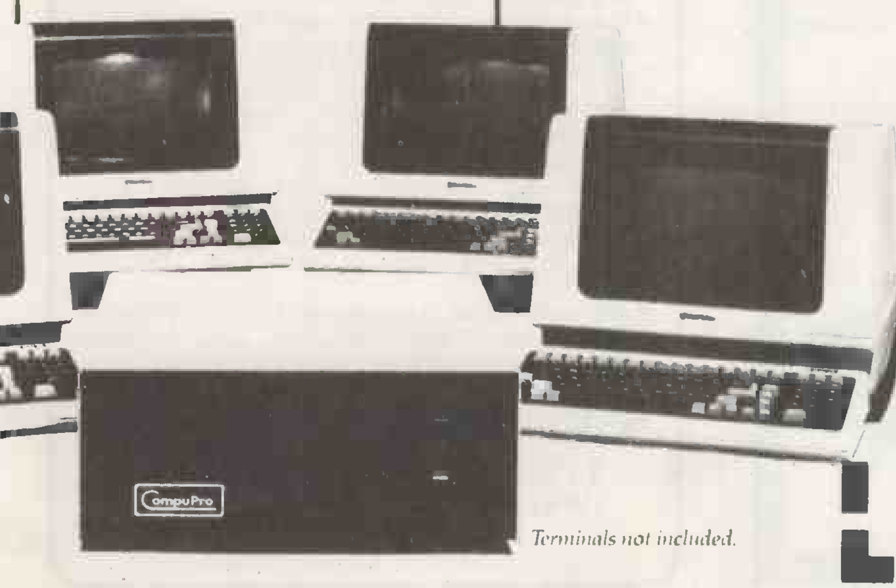

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● Circle No. 141

sinclair special

1

Inside...
Latest prices round-up...
Latest software...
Order form...

Introduction

One thing's certain about the Sinclair world – there's never a dull moment.

Every month sees new software and new hardware, produced by Sinclair enthusiasts, or produced by Sinclair itself.

The magazines do a fantastic job of keeping you up to date with the input of enthusiasts. We want to keep you in touch with Sinclair's own developments.

Every month, there'll be a Sinclair Special in this magazine.

Sometimes, inevitably, there won't be anything new to say – we want to break away from the breathless announcements of hardware and software you just can't buy.

But when something new *is* available, we want you to have accurate information – fast. You'll find it here.

This month, we're giving you the latest information on the recommended retail prices of Sinclair equipment. They're *our* prices, and you may well find things cheaper (or dearer) in the shops. If they're cheaper – terrific! Snap them up. Note, however, that from us the ZX81 is down to £39.95.

We're also announcing six superb new Sinclair cassettes for the Spectrum, and three more which make full use of the ZX81. There's an order form at the back of this Special.

Next month... but there, next month is another story! Watch (as they say) this space.

Nigel Searle

Nigel Searle.
Managing Director,
Sinclair Research Ltd.

Spectrum – latest recommended retail prices.

16K was £125.00

16K now £99.95

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ZX Printer was £59.95 — *ZX Printer now £39.95*

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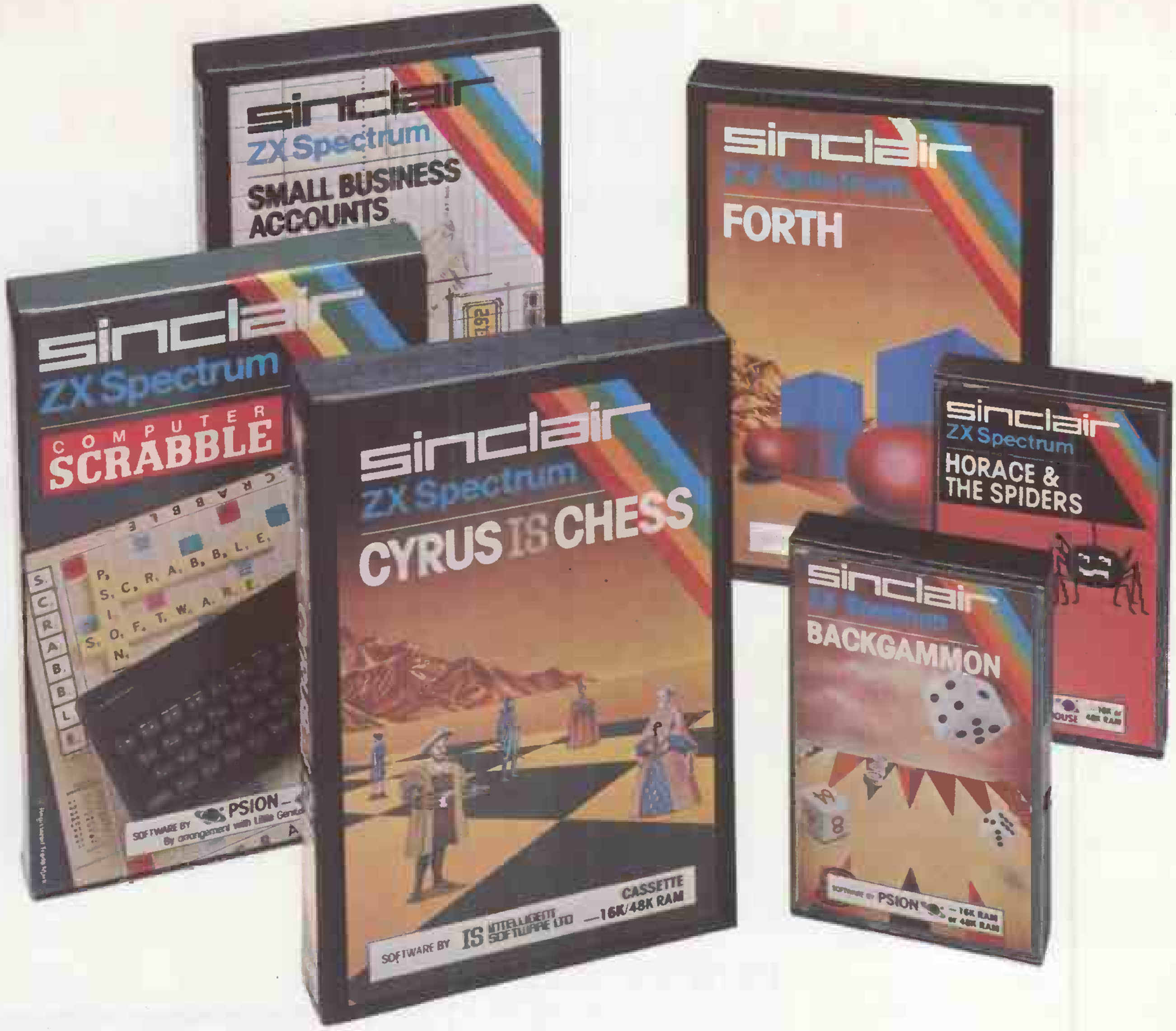

Six new ways to make more of your Spectrum.

Take a look at these brand-new titles. Each is an outstanding new program using the full potential of the Spectrum, for games with stunningly animated graphics, for strategies of fiendish cunning, for masterly applications of computing capability...

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(SCRABBLE trademark and copyright licensed by Scrabble Schutzrechte und Handels GmbH – a J.W. Spear and Sons PLC subsidiary.)

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FORTH Learn a new programming language, as simple as BASIC, but with the speed of machine code. Complete with Editor and User manual. For 48K RAM Spectrum.

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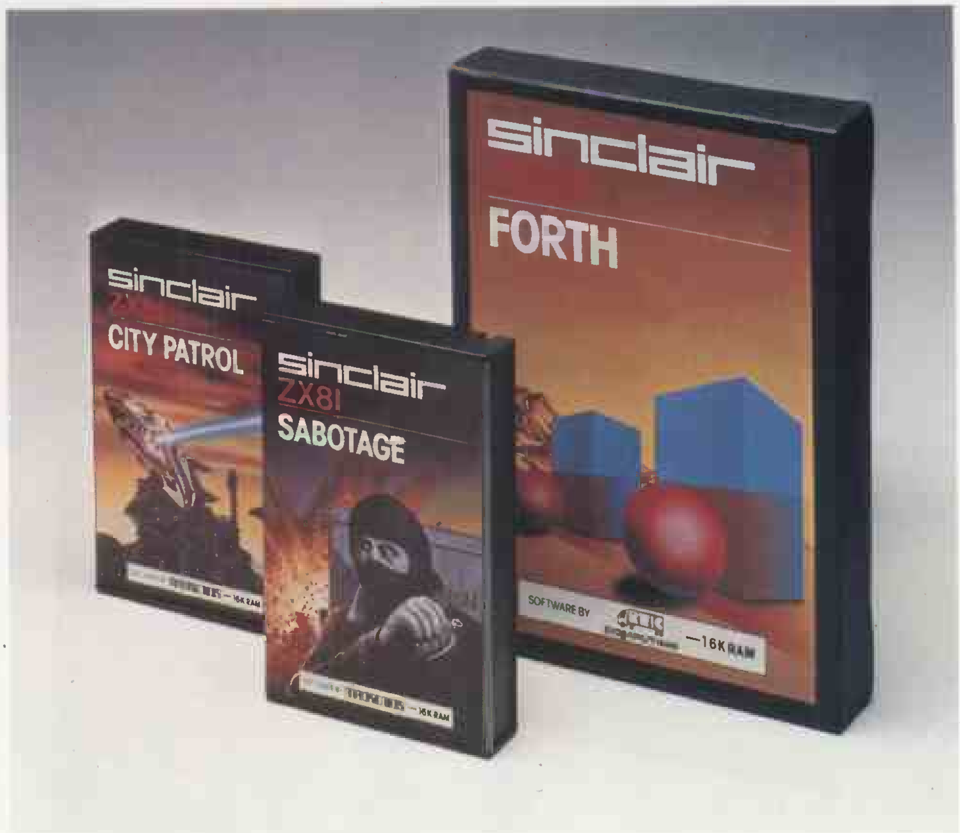

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Printers for beginners

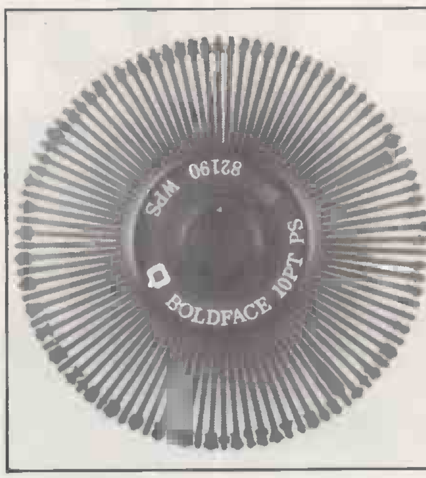
Jack Schofield looks at why you might want a printer, and what to look for when it comes to choosing one.

ONE OF the more amusing aspects of microcomputing is the so-called electronic or paperless office. In fact, the average microcomputer in business is hooked up to at least one printer to produce hard copy on paper. Reams and reams of the stuff.

Even in the home, the microcomputer used for serious purposes quickly acquires a printer of some sort as a peripheral. At first the printer is used for listing programs: they are easier to check against printed listings than by comparing them with the screen. The paper listing is also easier to debug when you can see more than 24 or 40 lines of code. Your printed listing can even be submitted for publication in your favourite magazine.

Later the printer is used to print results for future use. It might be a simple shopping list or your household accounts, an index of your butterfly collection, or whatever. At this level, of course, the print quality does not matter much; if it is legible, it is useful.

More advanced uses often mean better-



Qume daisywheel — as pictured in colour on the cover of this issue.

quality printing is required. You can use a micro to write love letters, or complaining letters to your bank manager. In either case the recipient is unlikely to be impressed if it comes on the sort of narrow silver paper produced by the Sinclair printer. For complex graphs and charts, or impressive pictorial effects, a graphics printer or plotter is required.

In business, printers are essential, not optional. A good accounting package will, for example, allow if not enforce the printing out of a complete record of the transactions, both for the auditor and your own peace of mind. Discs are fragile. Data does become corrupted and lost. Printers are useful too for writing cheques and sending out invoices, statements and letters.

There are a great many printers available to fulfil these needs. The first step in choosing one, however, is to identify and cost the application. You must identify it specifically because some applications will require particular facilities. For example, you may need to print on standard headed notepaper or produce extra-wide business plans or accounts.

You may need to be able to print scientific formulae with unusual characters

Suppliers

ACT
Dot-matrix and daisywheel models. ACT House, 111 Hagley Road, Birmingham B16 8LB.

ANADEX
American dot-matrix models. Anadex, Weaver House, Station Road, Hook, Basingstoke, Hampshire.

BROTHER
Cheap 16cps daisywheel. Brother, Jones and Brother, Shepley Street, Manchester.

CANON
Advanced colour ink-jet model under £600. Canon (U.K.), Waddon House, Stafford Road, Croydon.

CENTRONICS
Dot-matrix and daisywheels. Centronics, Petersham House, Harrington Rd, Lon don SW7.

CPU PERIPHERALS
Daisywriter. CPU peripherals, Rodd Industrial Estate, Govett Avenue, Shepperton.

DATA PRODUCTS
Dot, daisy and a thermal printer. Micro Design, 40 West Street, Crewe, Cheshire.

DATAC
40-column dot-matrix and tally-roll printers. Datac Ltd, Tudor Road, Altrincham, Cheshire.

DEC
Supplied with DEC micros or separately. Digital Equipment Co. Ltd, Imperial Way, Reading Berkshire.

DIABLO
Major daisywheel maker, a Xerox Company. Printers supplied by Rapid Recall, Rapid House, Denmark Street, High Wycombe, Buckinghamshire.

EPSON
Japanese leader in dot-matrix printers. Epson (U.K.) Dorland House, 388 High Road, Wembley, Middlesex HA9 6UH.

FACIT
Famous Swedish company with dot-matrix and daisywheel printers, supplied by Advent Data Products, Merlin Way, Bowerhill Industrial Estate, Melksham, Wiltshire.

GENERAL ELECTRIC
American dot-matrix maker. ISG Data Sales, Unit 5, Wellington Industrial Estate, Basingstoke Road, Spencers Wood, Reading, Berkshire RG7 1AW.

INTEGREX
Dot-matrix colour printer using three-colour ribbon. Integrex, Church Gresley, Burton-on-Trent, Staffordshire.

LOGABAX
Dot-matrix printers. Technology for business, 157 Farringdon Road, London EC1.

If you have an electric typewriter it can probably be converted to a slow but high-quality printer. The Printer-Adaptor is shown here under an IBM Selectric. It adds parallel and serial interfaces, and the facility to program control codes. The supplier is Pontoppidan (U.K.), 11 Hunterhill Road, Paisley, PA2 6SR, Scotland.

An acoustic hood can be invaluable in a busy office, reducing printer noise by about 80 percent. Nowadays hoods are available to suit most popular printers. The THS Model 1190 is shown here with a Qume daisywheel printer. The hood costs £235 from THS Data Products, 11 Techno Trading Estate, Bramble Road, Swindon, Wiltshire.

and sub- and superscripts. You may need to draw graphs, or produce "correspondence quality" letters which look typed rather than computer printed. Having identified such needs, you have to cost them. Is there a printer which will do what you want at a price you can afford?

Assuming you have done all this, the rest of this article will describe, in general terms, what is available and what the terms mean.

Impact. The most obvious way to get a computer to make an image on paper is to do it the same way as a typewriter, using impact printing. A type element with a raised image strikes a ribbon against the paper, leaving behind its outline in ink.

It is tempting simply to connect a printer to a suitable typewriter. By and large this can work reasonably well as long as high-speed printing is not required. However, typewriters are generally not built to withstand the sort of punishment they get when attached to a computer, so this is not a serious option except for the home user.

Dot-matrix printers. To cope with computer speeds, two developments were made: dot-matrix and daisywheel printers. They produce quite different types of character.

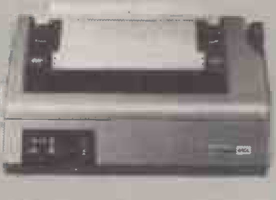
The character on your video screen is made up of a collection of dots on a matrix. The dot-matrix printer works the same way. The print head consists of a set of pins, each of which can be fired at the ribbon. The pins are selected to form the character required.

The quality of the dot-matrix image depends mainly on the number of pins. A five by seven matrix is cheapest, but not enough to provide proper descenders on letters like q, p, j and y. A seven by nine matrix provides a better result, and a nine by 14 better still. Dot-matrix printers have the advantage of being reasonably cheap and fast.

Daisywheel printers. Because the golf-ball type of printer is too slow for computer printers the daisywheel was invented to replace it. The letters are on the end of fine

(continued on next page)

LUCAS LOGIC
Dot-matrix printer. Lucas Logic, Welton Road, Wedgnock Industrial Estate, Warwick.



MANNESMANN-TALLY
German dot-matrix printers. Mannesmann-Tally, Molly Millars Lane, Wokingham.

MICROPERIPHERALS
Dot-matrix and cheap Juki daisywheel printers. Microperipherals, The Street, Basing, Basingstoke, Hampshire RG24 0BY

NEC
Japanese maker of Spinwriter series. Thame Systems, Thame Park Industrial Estate, Thame, Oxfordshire.

NEWBURY DATA
Large supplier of dot-matrix and daisywheel printers, mainly to OEMs. Newbury Data, Hawthorne Road, Staines, Middlesex TW18 3BJ.

OLIVETTI
Interfaced typewriters and dot-matrix printers. Olivetti, PO Box 89 86-88 Upper Richmond Road, London SW15.

OLYMPIA
Interfaced typewriter and daisywheel. Supplied by Intelligent Interfaces, 18 Central Chambers, Wood Street, Stratford upon Avon, Worcestershire.

PERIPHERAL HARDWARE
Suppliers of AES daisywheel and Oki dot-matrix printers. Peripheral Hardware Ltd, Unit 13, Monkspath Industrial Park, Highlands Road, Shirley, West Midlands.

QANTEX
Fast dot-matrix printer. Mellordata, Woodgates Road, East Bergholt, Colchester.

RICOH
Japanese daisywheel printers sold under the Flowriter and OEM labels. Appropriate Technology, 2-4 Canfield Place, London NW6.

QUME
ITT subsidiary and leading maker of daisywheel printers. ISG Data Sales, Unit 5, Wellington Industrial Estate, Basingstoke Road, Reading, Berkshire.

SANYO
Cheap 16cps daisywheel printer. Sanyo Marubeni (U.K.), 8 Greycaine Road, Greycaine Estate, Watford, Hertfordshire.

(table continued on next page)

Printers for beginners

(continued from previous page)

spines around a hub — as shown on the cover of this issue. The daisywheel works by impact in the same way as a dot-matrix printer, but gives a typewriter-quality result. Average speeds are rather slower than with dot-matrix printers: 30 to 50 characters per second is typical, compared to 80 or so.

Thermal and electrostatic printers. These are a variation on dot-matrix printers, but use special paper instead of ink from a ribbon. Thermal printers use tiny spark plugs to burn away an aluminium coating on the paper so that the black underneath shows through. The Sinclair printer is the most common example of this type. Such printers are usually small, and allow only 20 to 40 characters a line, but they are cheap and are also quiet.

The laser printer is a relatively rare beast that uses a laser to burn a row of dots on a sensitised drum. The image is then transferred to paper by electrostatic means, just as in a photocopier.

Ink-jet printers. Ink-jet printers use tiny droplets of ink to form the letters. This is a fast way to print as the system does not have to cope with the mechanical inertia of normal dot-matrix printers. It is possible to print in colour just by having different coloured inks, which is much easier than using coloured ribbons.

Until quite recently ink-jet colour printers have been far too expensive for most people to consider, but Canon has recently launched a model at under £600. Others are sure to follow.

Daisywheel printers are required for high-quality correspondence, but tend to be either very slow or very expensive. The Olympia ESW-3000RO offers a good compromise: it prints bidirectionally at up to 50cps and costs around £1,100 plus VAT. Tractor feed and a single-sheet feeder are optional extras. The supplier is Olympia Business Machines Ltd, Olympia House, 199-205 Old Marylebone Road, London NW1 5QS.

Print quality. Thermal printers give the lowest print quality, dot-matrix printers give medium quality, and daisywheel printers give typewriter-quality results. There is also a trade-off between speed, print quality and price. Higher speeds and better quality cost more.

Versatility. Of the two important types of printer, the dot-matrix is more versatile than the daisywheel. The daisywheel can provide different character sets because you can simply change the wheel; the dot-matrix printer can be programmed to produce a wide range of character styles in software. The dot-matrix can easily provide condensed and expanded characters, or more readable emphasised characters by double striking.

Many dot-matrix printers can also print graphics, as long as each pin can be fired individually, not just in character patterns. Both types of printer may offer proportional spacing, which means that narrow letters like i take up less space than wide ones like w.

Print width. A cheap printer may only print 20 to 40 characters per line. For serious use printing at 80 full-size characters per line on A4-width paper is

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(table continued from previous page)

Selkosha GP-700 colour printer.

Above: Silver Reed's daisywheel from X-Data. Left: letter quality dot-matrix by Toshiba.

SEIKOSHA
Japanese manufacturer of cheap dot-matrix models, and new GP-700A colour printer at £425. Supplied by DRG, Unit 8, Lynx Crescent, Winterstoke Road, Weston-super-Mare.

SILVER REED
Typewriter maker's 16cps daisywheel. Supplied by X-Data, 750 Deal Avenue, Slough Trading Estate, Slough SL1 4SH.

SMITH CORONA
Cheap daisywheel printer, supplied by Discom, Dresden House, 51 High Street, Evesham, Worcestershire

STAR MANUFACTURING
Dot-matrix printers supplied by Micro Peripherals, 69 The Street, Basing, Basingstoke, Hampshire.

TEC
Starwriter daisywheels and a dot-matrix printer. DRG, Unit 8, Lynx Crescent, Winterstoke Road, Weston-super-Mare.

TOSHIBA
Japanese dot-matrix printer with letter-quality mode. Thame Systems, Thame Park Industrial Estate, Thame, Oxfordshire.

TREND
Fast dot-matrix printers. Trend Communications, Knaves Beech Estate, Loudwater, High Wycombe, Buckinghamshire.

TRIUMPH ADLER
Daisywheel and dot-matrix models from Triumph Adler, 27 Goswell Road, London EC1.

WALTERS MICROSYSTEMS
British dot-matrix printer manufacturer. Impact Data, 1 Chilton Road, Edgware, Middlesex.

ZENITH DATA SYSTEMS
American dot-matrix printer. Zenith Data Systems, Bristol Road, Gloucester.

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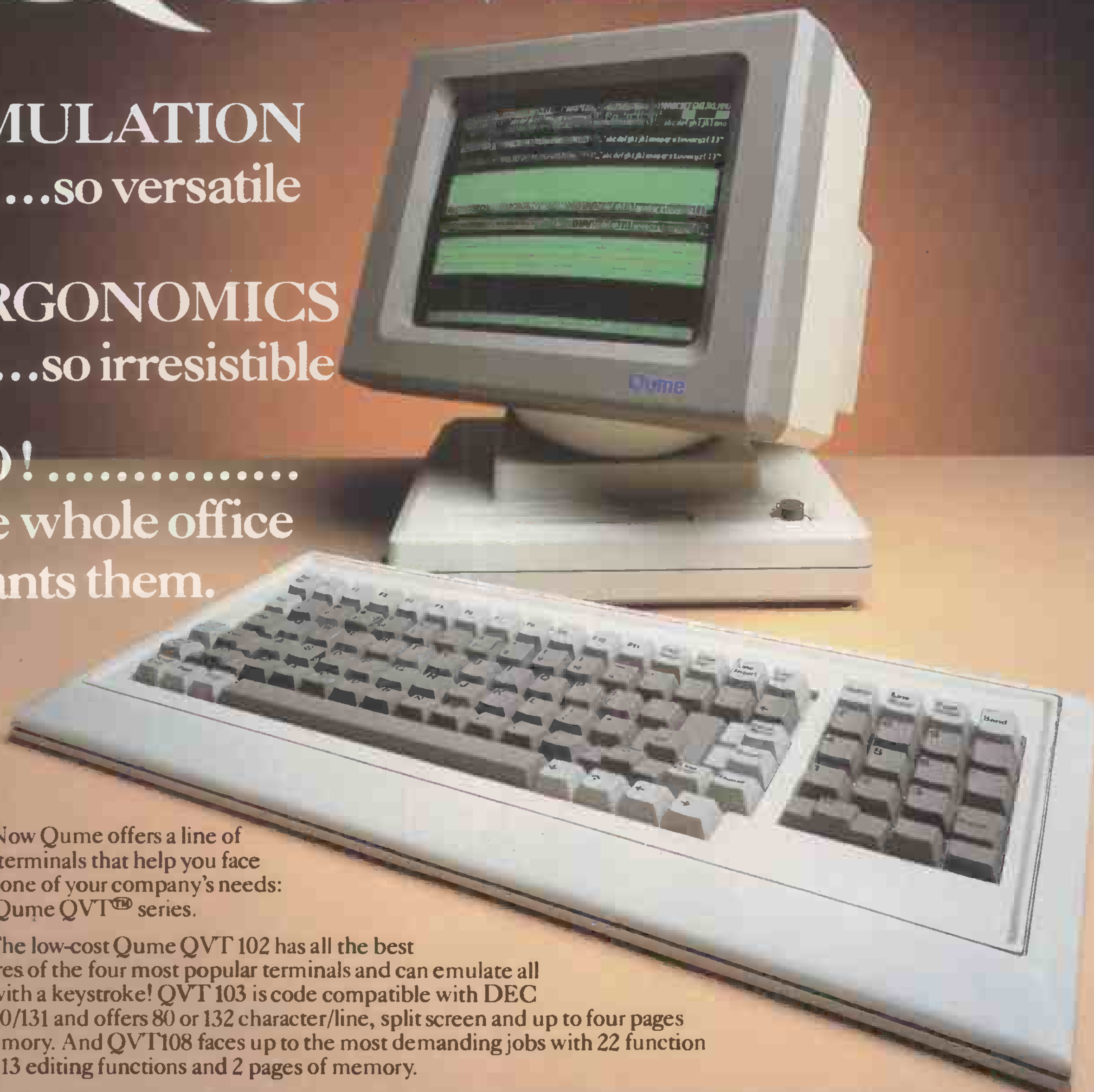

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Bytech Ltd., Earley, Reading, Berks. Tel: (0734) 61031

ISG Data Sales Ltd., Reading, Berks. Tel: (0734) 884666

Alphatech Computer Systems Ltd., Bourne End, Buckinghamshire. Tel: (06285) 28237

Daisy Terminals Ltd., Haywards Heath, West Sussex. Tel: (0444) 457546 London Office – Tel: 01-434 2821

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Printers for beginners

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essential. An 80-character dot-matrix printer should also offer 132 characters per line with condensed characters, which may be vital for printing out the results of spreadsheet calculations. For screen dumps, the printer should offer at least as many characters as your screen.

When it comes to dot-image printing there may not be much to be gained from a printer which can print a higher resolution than is offered by your microcomputer.

Intelligence. Intelligent printers are better than downright stupid ones, and intelligence can be shown in a number of ways. For instance, a printer is dumb if it wastes time doing nothing during a carriage return.

A smarter printer remembers a whole line at a time and provides bidirectional printing. That is, it prints lines from right to left then from left to right in turn. It may also be logic-seeking, which means it attempts to print the shortest line. A logic-seeking or space-skipping printer is useful for printing, say, forms or invoices. It skips all the unwanted spaces and moves straight to the next print position.

An intelligent printer will often have a larger memory or print buffer. It accepts a lot of text from the computer and prints it at its leisure instead of making the micro feed it a line at a time.

Paper. There are two basic forms of paper feed: friction and tractor. A tractor-feed printer has toothed wheels to carry the paper through the printer and requires corresponding sprocket holes in the paper. This kind of paper often comes in flat sheets joined with perforations: it is called fan-fold paper. The sprocket holes may also be on perforated strips which can be torn off so that single sheets of paper result. If the perforations are micro-perforations, the edges may have a reasonably smooth finish.

Both cheaper and more expensive types of printer use friction feed. The pressure of a single roller carries the paper through the printer. The problem is that the paper tends to slip and skew, leading to disaster. Rolls of paper work reasonably well when they are narrow.

Companies often want to print on their standard headed letter paper, and this means adding a cut-sheet feeder to the friction-feed printer. Otherwise you have to feed each sheet by hand. These feeders are generally expensive and tend, in real life, to be not wonderfully reliable. One solution is to have single sheets attached to fan-fold paper. This requires special printing of the top sheets, which is economical in quantity.

Interface. Obviously, when choosing a printer, it must link to your computer. This link involves more than the physical connection, which can be tedious in itself. It also means that the characters your computer sends to the printer will be correctly interpreted by it. Unfortunately most computers seem to have their own version of control codes, and so do printers. Getting the two to work together can take even an expert weeks. A separate feature in this special section describes some of the problems.

The safest option is to buy your computer manufacturer's brand of printer. This will probably be a standard printer which has been badge engineered — only the badge is different. Thus the IBM PC printer is actually an Epson MX-80.

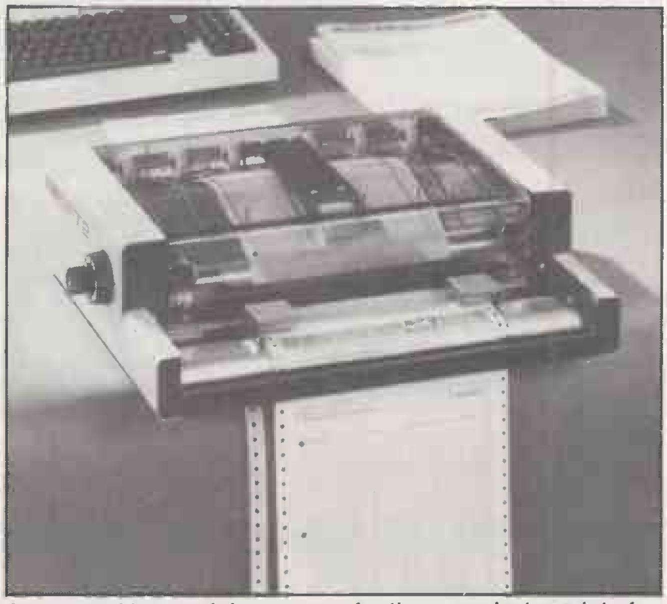
Another idea is to buy the printer from the same dealer who sold you the computer, if he can demonstrate the two working together. Otherwise you can get into a situation where the printer man says it's the computer that is at fault, and the computer dealer says it's the printer. Alternatively they may both blame the software. You have been warned.

Cost and other factors. Many other things must also be considered when choosing a printer. These include noise, convenience and cost. Most printers are noisy, and to use one a busy office may require you to add an acoustic hood as a silencer. Convenience factors include the ease with which ribbons can be changed. Also, can you change the Dip-switch settings, if any, without removing the case? Dip switches may be used to set the line spacing, form length, character set, etc., though they should also be software selectable.

Your analysis of the cost of a printer should also include the cost of any cables, any stand required, the cost of special paper, if required, and the likely cost of replacement ribbons. Businesses must also consider the cost of a maintainence contract.

To judge by the quality of the results that arrive daily in this office, most printer users cannot afford ribbons. A useful tip for new users is to print a test with a new ribbon and keep it handy for comparison with later results. For the rest, some 95 percent of printer users could dramatically improve the quality of their results not by buying a super new printer, but by — please! — just investing in a box of new ribbons.

The LA-50 is a typical modern dot-matrix printer which can produce a variety of type styles with a seven by nine matrix, plus bit-map dot-addressable graphics. It prints at 100cps bidirectionally. In the enhanced typeface it overprints to provide a 13-by-nine dot character at 50 cps. It has both tractor and friction feed and can handle fan-fold, single sheets and rolls of paper. The LA-50 is from DEC but can be supplied for most small micros by Rapid Terminals, Rapid Recall Ltd, Rapid House, Denmark Street, High Wycombe, Buckinghamshire HP11 2ER.



An unusual but useful accessory for those producing a lot of hard copy is the Micro-Burster Model FT2K. It automatically separates fan-fold paper into individual sheets, and an optional accessory removes edge sprockets. The supplier is Advanced Media Ltd, Unit H, St Anthony's Way, Faggs Road, Feltham, Middlesex TW14 0NH.

OLIVETTI JP-101

For Chris Bidmead this is the ink-jet printer with a difference — it works.

NEARLY TWO YEARS AGO an ink-jet printer arrived in this office for testing. It was supposed to print at high speed, but unfortunately in attempting to keep up with the print head the rather less nippy pin-feed platen turned the paper into handfuls of confetti.

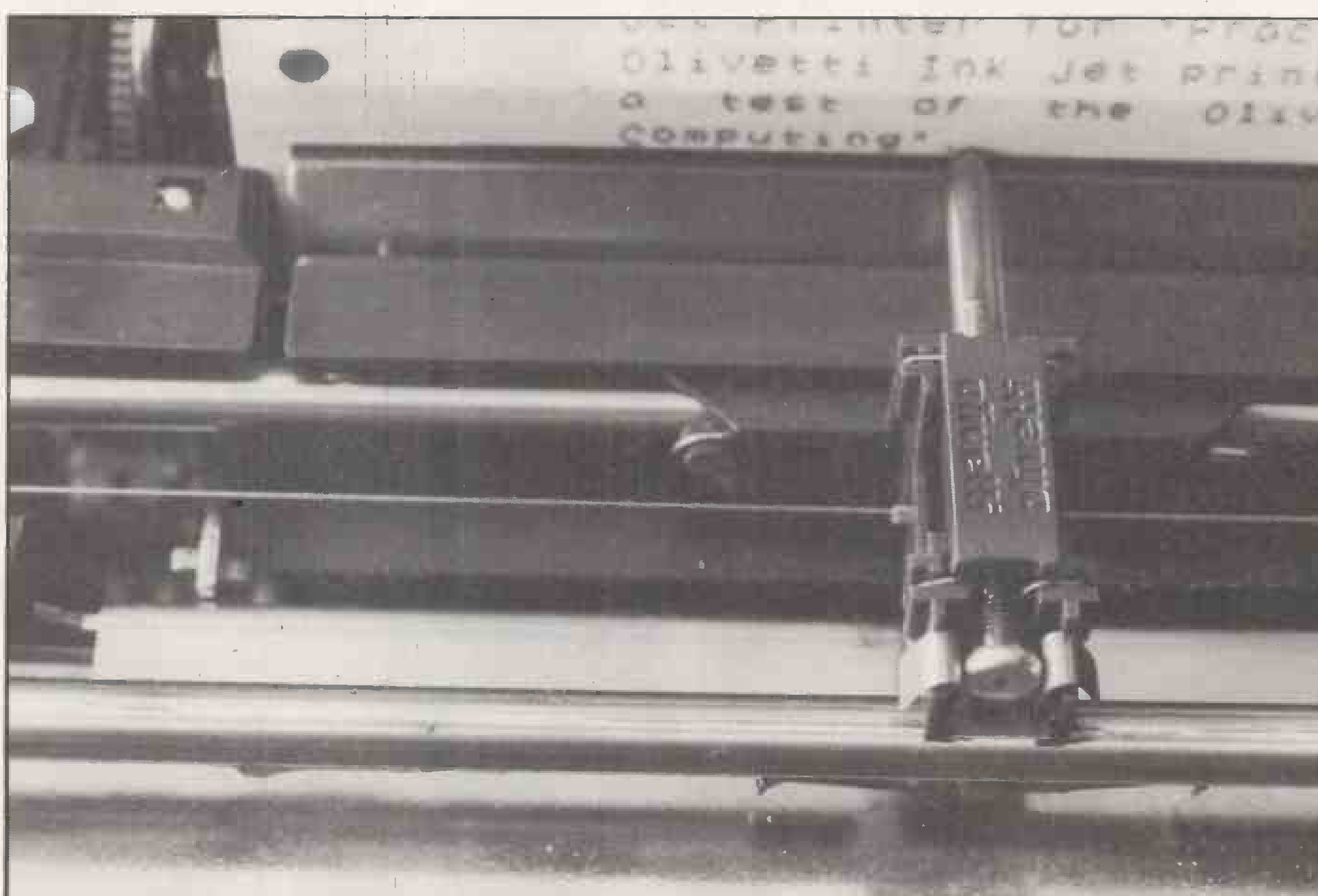
It is not easy to write an interesting review of a printer that will not actually print, so I invited its manufacturer to take the machine away and bring it back when the problem had been sorted out. I have not heard from them since.

So you can imagine that the term "ink-jet printer" echoed somewhat hollow in my ear when I heard it again at the end of last year, this time from Olivetti. It quickly became clear, however, that this is an ink-jet printer with a difference. For one thing it works — with some reservations I will come to later.

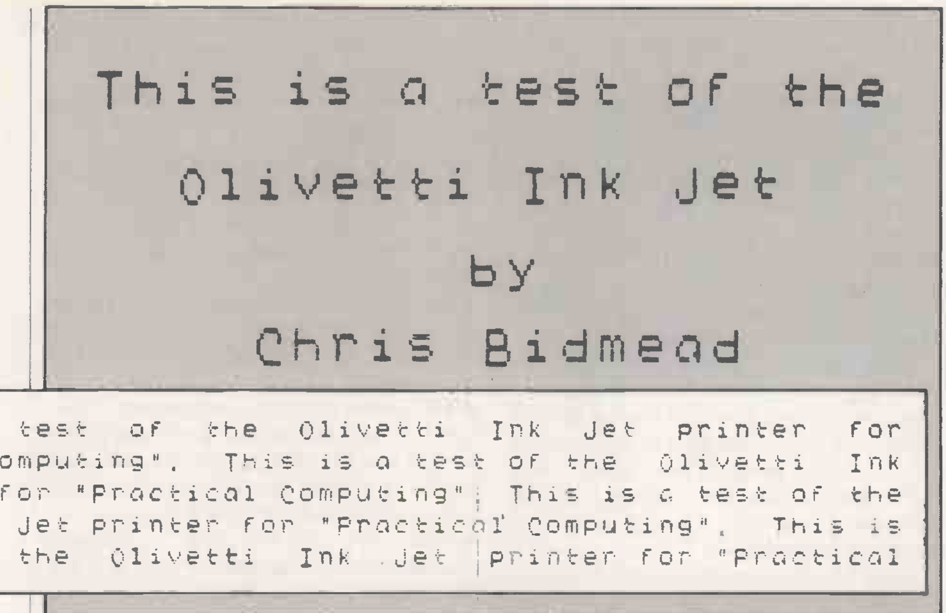
Putting aside the unfortunate connotations in this office, I would not be inclined to call the Olivetti JP-101 an ink-jet printer at all. For one thing, it does not actually use ink — the marking medium is a small carbon rod encapsulated in glass. Its full name is "spark ink-jet printer": the black dots are built up on the paper by a small electric discharge running from the tip of the carbon rod through the paper to an earthing plate behind it. The discharge carries over a tiny quantity of the carbon and bonds it to the paper.

This novel technology results in the smallest and lightest print head I have ever seen on an 80-column printer. There is virtually nothing to it except the replaceable carbon element, which weighs about one gram. It looks like a 2in. nail bonded to a small plastic mount, and four of them come in a container the size of a matchbox.

You may have noticed that the 19th-century adage "build it solid, build it big" has gone out of the window in recent years, at least as far as computer peripherals are concerned. It is not simply the recession that is driving designers to pare down their products. We are coming to realise that a kind of Occam's razor applies to hardware as much as to philosophy. "Less" is better



The replaceable carbon element weighs about one gram and is bonded into a small plastic mount.


This is a test of the
Olivetti Ink Jet
by
Chris Bidmead

test of the Olivetti Ink Jet printer for
omputing". This is a test of the Olivetti Ink
for "Practical Computing". This is a test of the
Jet printer for "Practical Computing". This is
the Olivetti Ink Jet printer for "Practical

because there is less to go wrong, and savings at one end of a process have implications all the way down the line. A light print head demands a less powerful motor, with a lighter current consumption which means a smaller power pack with regulators that run cooler.

The Olivetti is an excellent example of the new minimalism, with unfussy external design to match. The case is dark grey and fashioned in the squared-off styling that marks out other Olivetti products. Allowing for protruding plugs at the rear the Olivetti JP-101 takes up no more than 11½in. by 15in. of desk space and stands 4½in. high, not counting the roll paper feeder.

Two interfaces were provided on the review machine: Centronics parallel and RS-232 serial. The Centronics interface worked directly when plugged into the IBM PC parallel port, and printed text without problems. Screen dumping of graphics produced nonsense, however, because the Olivetti does not understand the IBM PC's escape-code sequences. This is only to be expected.

Setting up the RS-232 interface meant removing the top half of the case to get at the DIL switches. Dismantling the machine is pretty well a foolproof operation, thanks to some very sensible design. All you have to do is turn it upside down, unscrew a bolt in each corner, turn the machine the right way up again and lift off the case.

Some Olivetti points of finesse emerged at this stage, of which other manufacturers might well take note. The four bolts are captive. Once unscrewed they stay attached to the case ready for reassembly. There is no scrabbling around the workshop floor looking for the one that got away. As you lift the case away there are no wires to disconnect, no knobs to lever off and nothing protruding from the chassis that has to be manoevred through an awkward cutout. The case lifts away cleanly, taking with it the Line Feed, Form Feed and Local push buttons, which in use simply connect with the actual electrical switches attached to the chassis.

Once the cover is off, there is no need to probe into the mechanism to set up the interface. The three banks of Dil switches you have to reach are out in the open, directly in front of you. I recently did battle with a dot-matrix printer costing over £2,000 that required a major dismantling of the printer mechanism to reach the switch that changed the form-feed length.

There are optional settings for the full range of baud rates from 300 to 9,600, and the usual choice of parity and word length. I was pleased to see that all three major handshaking conventions are catered for: hardware handshaking on pin 20, Data Terminal Ready; XOn/XOff, and ETX/ACK.

There is also a convention I had not come across before whereby the printer sends a Break down the TX line whenever the buffer becomes three-quarters full. This could be good news if there is a Usart at the other end that can detect Break and reflect it on one of the pins. You could then set up what amounts to hardware handshaking without using a third wire.

On the other hand there may be Modem-like devices on the line that reads Break as a prompt to do something the little Olivetti is not expecting — like cease transmission and go into Reset mode. In a case like that it would be useful to be able to switch out this ingenious flourish, but unfortunately whoever put the PROM together does not give you that option. This was not the only experience I had of the unit's rather cavalier attitude to the software design.

Threading the paper into a pin-feed machine is sometimes a painful process. Although not ideal, the Olivetti makes it reasonably easy. You lift the hinged translucent half-cover and discover a release lever on the right-hand side of the print mechanism that raises the platen clear of the paper-tension springs beneath. This gives you a good look at the curious construction of the platen, which is designed to do double duty as a friction feeder.

Where you might expect to find a solid cylinder the Olivetti makes do with a thick plastic rod on which three rubber rings are mounted. This simplified construction helps to keep down the weight of the platen, and hence the power of the motor needed to drive it, and so on. In practice the arrangement works very well, even allowing you to feed in unperforated sheets of labels, which are notorious for slipping in conventional friction-feed machines. I found it particularly useful to be able to shove in any old sheet of scrap A4 for the odd one-off dump from DDT.

The Olivetti allows for a variety of perforated paper widths by permitting the right-hand pin-wheel to slide along the platen. Once the paper is installed it can be set at the top of form by pressing a lever on the left which unlatches the platen drive, leaving it free to roll forwards or backwards.

It seems a pity that this lever cannot be accessed once the translucent hinged cover is lowered into the operating position. For work like label printing that requires precise positioning of the paper I found it best to keep the cover open, which meant devising a bent paper-clip gizmo to defeat the Cover Open switch.

Perforated paper has the disadvantage of needing a fairly well organised feed-in-feed-out flow path. I have never understood why manufacturers invariably arrange for the RS-232 cable connection at the rear to be at just the point where it is going to interfere most with the paper flow. Olivetti continues to subscribe to this well-established tradition.

There is a way out if you do not mind using a continuous roll of unperforated stationery. The solution is a paper-roll holder which comes with the machine and can be clipped on at the back. I found it very useful to be able to move the printer around the office with its own built-in paper supply.

The characters on the page are built up out of an array of seven by seven dots, but unlike the more usual multi-needle dot-matrix printer the print head is only capable of delivering one dot at a time. Every line of characters therefore requires a multiple scan, with the ultra-lightweight head flashing backwards and forwards across the paper. "Flashing" may be taken literally: if you peer through the translucent lid you can actually see the tiny sparks discharging.

Seven by seven is not great resolution, but Olivetti has managed to produce a clear and rather pleasing character set by relaxing the rules and allowing capitals to descend. This gives a somewhat folksy look to the output, but I found it very legible even when compressed down to the smallest size of 18 characters to the inch. Switching on double height and double width produces useful headline-style characters.

(continued on next page)

OLIVETTI JP-101

(continued from previous page)

Olivetti demonstrates the 110 dots-per-inch graphics capability of the machine with a test printout derived from the video image of a young woman who seems to have other things than printers on her mind. Unfortunately I do not have access to the equipment necessary to follow this up — a digitiser, I mean — and I did not feel inclined to spend long hours recreating her in Basic.

The A5-sized red manual tells you very clearly how to cope with the graphics. In fact there is a very good discussion of practically everything you could possibly want to know about the machine, and as far as the hardware goes it appears to be accurate. The software side of things is a slightly different story, but this is hardly the manual writer's fault. The manual describes what ought to happen; it's whoever wrote the PROM that got it wrong.

The heart of the problem seems to be in the handling of Line Feeds, lf, and Carriage Returns, cr. It is one of those printers that will not do a cr without automatically throwing in an lf, which is a nuisance for bold printing and underline, although a command for automatic underlining is provided. As a corollary, whenever it finds an lf following a cr in the data stream it throws it away.

Unfortunately it also throws away any following cr/lf pairs. This remarkable phenomenon will save you a great deal of paper over the course of a year because it prevents the printing of blank lines embedded in the text, rolling all the paragraphs into one — a sort of built-in compression technique.

There are other minor infestations in the software that really should have been shaken out by now, but they pale beside this splendid howler. How it has passed quality control I cannot imagine. Word processing that stores blank lines as one or more spaces will not show up this problem, so perhaps the machine works fine with the Olivetti M-20 micro.

	Characters	Time(s.)	Char./s.
Walters 2000	3572	43	83.07
Olivetti: Ink Jet	3572	58	61.59
Paper Tiger	3572	63	56.70
Adcomp	3572	75	47.63
Average	—	—	62.25

Conclusions

- **Physically the Olivetti JP-101 is a very nicely designed machine, although you might feel the need for a little "user-redesigning" to enable operation with the cover open.**
- **Its ingenious technology is very simple and should be trouble-free. There is a tendency for the print to be a little smudgy: it is charcoal, after all.**
- **The printer is cheap — excuse me, "low-cost" — at £365 for the Centronics-only version and £415 for the RS-232 enhanced model. It is quite fast for its price range, and commendably quiet in action.**
- **With full RS-232 and Centronics communications the printer should work with virtually any hardware.**
- **There is a rather silly problem with the current version of the PROM. The bug itself is nothing to get hung up about — it is so serious that the manufacturer will simply have to fix it to sell any machines at all — but it is terribly worrying that nobody at Olivetti seems to have spotted it.**
- **This JP-101 is supplied on an OEM basis to Acorn, which sells it as the JP-1 customised to the BBC Micro.**
- **Olivetti is at Olivetti House, PO Box 89, 86-88 Upper Richmond Road, London SW15. Telephone: 01-785 6666.**

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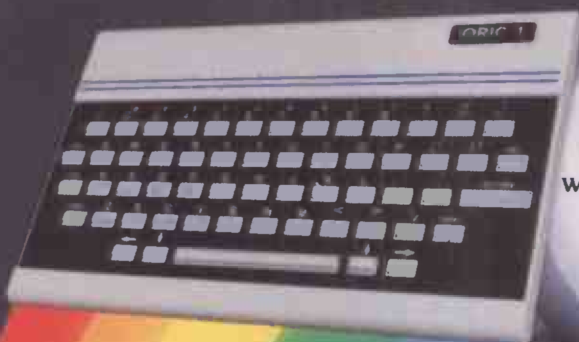

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● Circle No. 160

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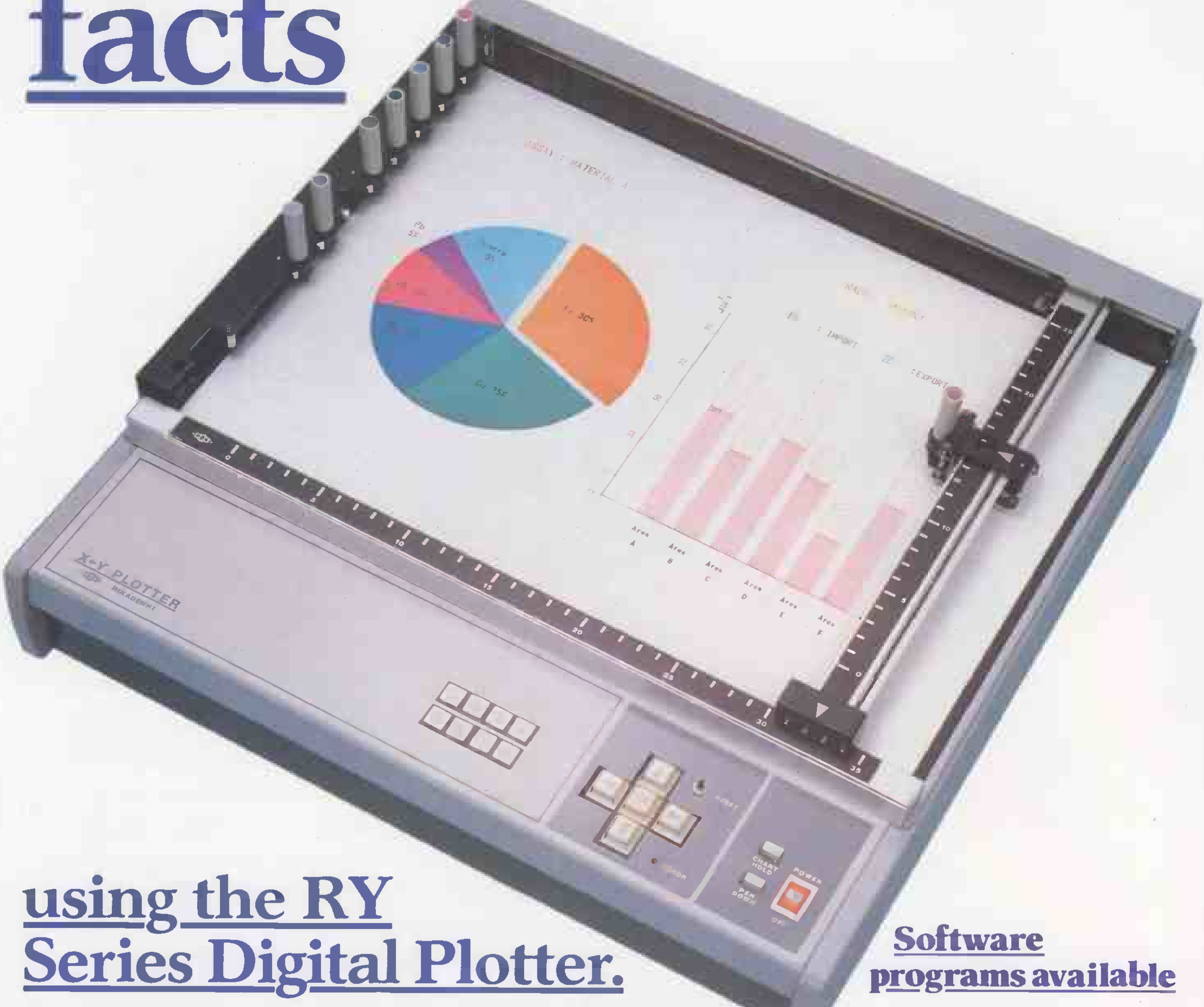

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● Circle No. 161

EPSON FX-80

Epson's MX-80 has almost become the industry-standard dot-matrix unit. Chris Roper looks at its successor, which features proportional spacing and user-defined characters.

THE EPSON MX series of dot-matrix printers from Japan set new price/performance standards for the microcomputer industry when they were first introduced four years ago. The FX-80, which made its appearance at the beginning of this year, is designed to consolidate Epson's dominance in its chosen sector of the market without making MX owners feel that their machines are obsolete.

The new machine is scarcely more expensive than the MX-80 F/T III. It features proportional spacing though it operates only in the larger of the two basic type faces, Pica and Elite. Proportional spacing means that narrow letters, such as an i or t, do not occupy the same space as an m or w.

The FX-80's user-defined character sets allow the user to define special symbols or letters, or even to create a whole new alphabet. They have obvious applications for foreign languages or scientific use, but even ordinary British users can find it helpful if, for example, they have an American software package with dollar signs embedded in the format. It can be virtually impossible to alter these to pound signs unless you can make the printer produce the £ symbol whenever it meets the $ symbol. But be warned, like many other features of the Epson, this facility may be compared to a conjuring trick — it looks easier than it is.

If users can define their own character sets it is not difficult for the manufacturers to include an italic set. Epson's works reasonable well, though the italic m has curiously knobbly knees. It may appeal to some users, but I have always hated italic script on typewriters and think that its only effect is to make a document harder to read.

The hex dump is a really useful trouble-shooting device for the experienced programmer. It allows the user to print out all the hex values of the instructions the printer is receiving from the host computer. Given the difficulties that can be experienced with all Epson printers and their associated interface cards, it can be a useful signpost.

The reverse paper feed allows the user to line feed in both directions. It is particularly useful in formatting complex tables or charts, and in printing-out graphics in the printer's bit-image mode.

Most Japanese printer manufacturers force the user to remove the machine's entire outer casing, undoing up to four inaccessible screws, to reach the Dip switches. I reached the FX-80's switches in 15 seconds, undoing a single retaining screw on the top of the printer. In fact, you do not often need to touch the switches as all their functions can be defined or changed from the keyboard of your computer.

The FX-80 does seem more robustly built than its predecessors. Epson probably will not thank me for saying its new printer looks and feels more like an Oki Microline machine, while retaining the greater virtuosity of the old Epsons.

The FX-80 is roughly twice as fast as the MX-80, running at 160cps. It may be useful for some applications though the importance of pure speed has been greatly reduced by the advent of buffered interface cards, which free the computer for use in a matter of seconds.

There are some other minor improvements: the leads out of the back are now positioned to avoid interference with the paper feed; the warning bell is less strident; you can tear off paper closer to the last printed line; and the manual is spirally bound, and does not fall apart after three days use.

The manual, however, looks better than it is. It still reads as if English is not the author's first language. It reminded me of trying to find my way in a Japanese street, where the houses are not numbered sequentially according to their location, but according to their date of construction. This is fine if you know where you are going or have an encyclopaedic knowledge of Japanese architecture, but not much help to strangers.

There are a few warnings in the manual of the difficulties facing a novice:

p.3-3: "Note that in some programming languages such as Basic, Pascal etc., there are a few codes which cannot be sent to the printer."

p.3-5: "Basic itself is different depending on the specifications of the host computer, and there are certain versions in which certain codes (such as Chr$(9) or Chr$(13)) cannot be sent to the printer."

That may seem slightly cavalier, given the popularity of Basic and Pascal, but there is worse to come. The manual gives no hint as to how these deficiencies may be remedied. Such an attitude may have been justified when most microcomputer owners were programming enthusiasts/hobbyists, but is intolerable in the new market place of users

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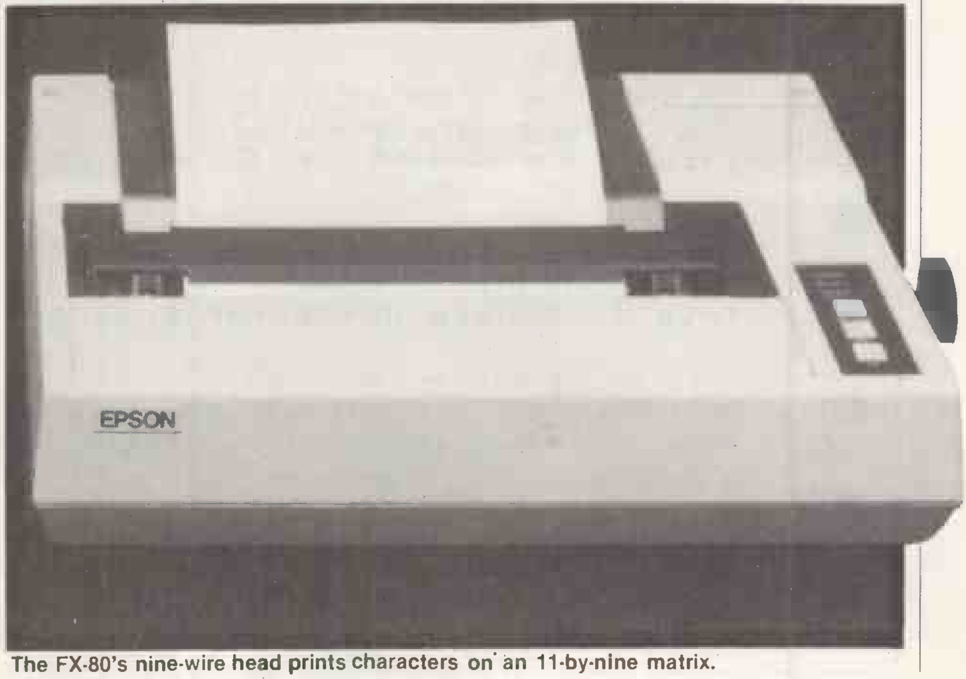


The FX-80's nine-wire head prints characters on an 11-by-nine matrix.

EPSON FX-80

(continued from previous page)

who do not know a Peek from a Poke. Epson cannot be unaware of the problem which has plagued the lives of some MX owners.

The manual is too modest in its warnings. It does not say that the interface card is likely to be an even greater source of frustration than the particular version of Basic resident in the host computer, doggedly refusing to pass control characters through to the printer.

My original guide to the mysteries of my own Epson MX-80 was Mike Glover of the Leicester Computer Centre. I turned to him again for help with the FX-80. His experience is entirely Apple-based, but we suspect that Epson printers present similar problems when used with other equipment.

Mike Glover actually had to program an EPROM to overcome deficienceis in the interface card Epson supplies to Apple owners. The chip enjoys steady demand from other Epson dealers. He has also written machine-code routines for a variety of the more common interface cards used by Apple owners to drive their printers. These routines allow the programmer to send any character through to the printer. His final contribution to the mental health of Epson printer owners is a neat bit-image editor, which offers far simpler means of creating your own character set than the clumsy routines offered in the Epson manual.

Nevertheless, even with his special knowledge of Epson printers and using his routines, it took us the better part of an hour to convert the $ symbol to a £. We used the hex dump to discover that the printer card was blocking a crucial piece of code.

So when you read in the advertisements that you can create Sally's Gothic or Tom's Roman, think twice. It is not simple to do it from the manual without some additional knowledge, like an understanding of machine-code programming. Perhaps the best advice to people buying for the first time is to make sure the dealer has the printer working with the type of computer and interface you are going to use. Make sure that all the advertised features work in this configuration, and be sure you understand how they are made to work.

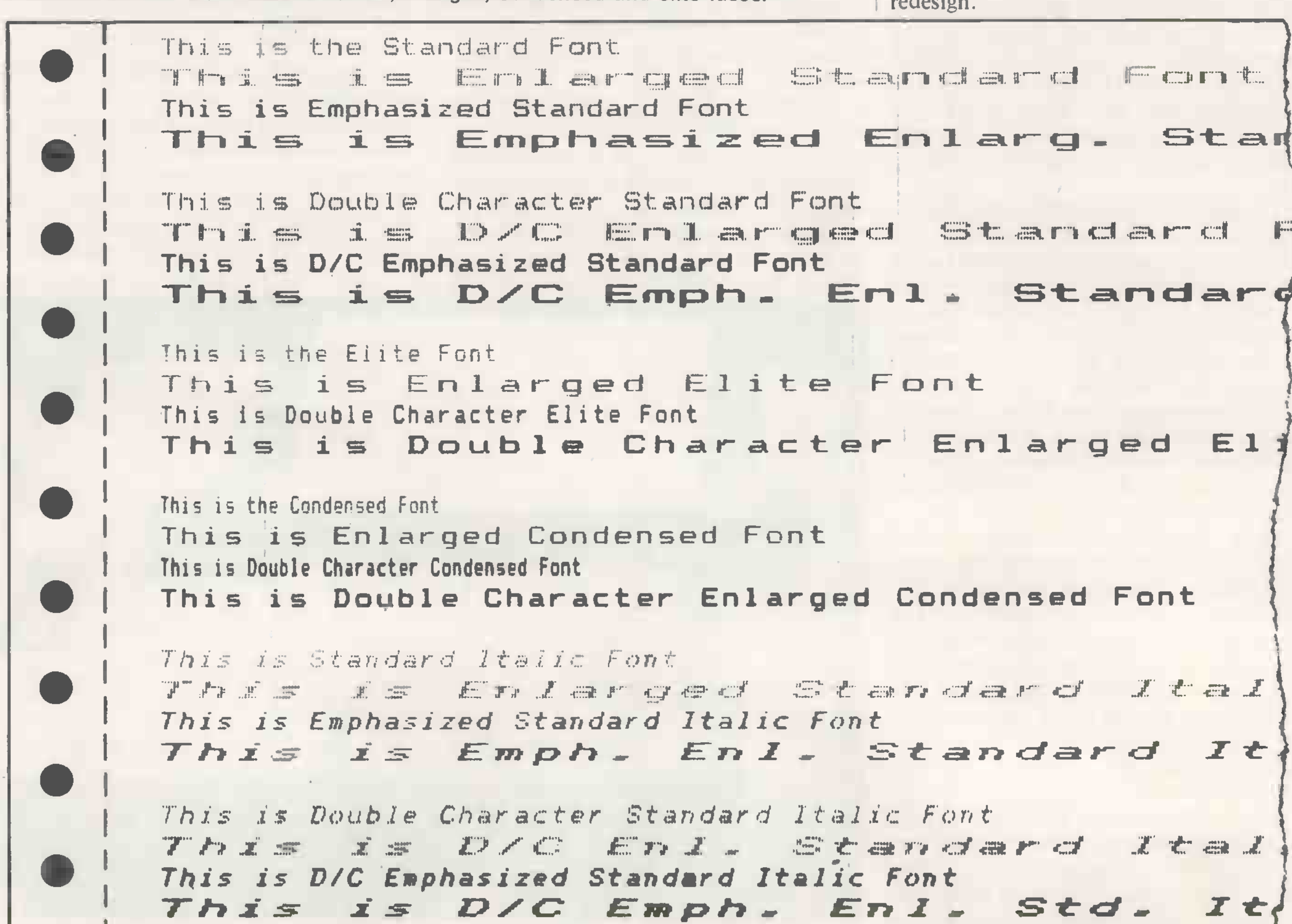
Epson could easily have got it right by having the manual written in the United States or Britain, and by considering the equipment most likely to be used to drive its printers. This must include Apples and CP/M machines, not to mention the BBC Micro and machines running under Pascal. It might have cost Epson £2 to £3 per machine to have provided a more helpful and more comprehensive manual, in standard English with a proper index.

The print quality of the FX-80 is probably as good as you can get from a nine-wire printing head, printing characters on a nine-by-11 matrix. Improved print quality, currently available in dot-matrix printers costing two or three times as much as the Epson, requires more wires to create more dots per letter. For Epson to match these printers would require a major redesign.

	Characters per line	Width	Height
Normal/emphasised (pica)	80	2.1	3.1
Enlarged	40	4.2	3.1
Condensed	137	1.05	3.1
Elite*	96	1.4	3.1
Proportional	variable	variable	3.1
Super/subscript	80	2.1	1.6

*Using the Elite face, one cannot also emphasise, condense or have proportionally spaced lettering

Character sizes and densities in normal, enlarged, condensed and elite faces.



Conclusions

- If you liked the MX, you will be very happy with the FX. But it is not worth trading in the MX to buy an FX. If you did not like the MX, the FX is unlikely to change your mind.
- If you are thinking about buying a printer for the first time Epson remains an outstanding product, provided you know what you are doing or have someone who does to advise you.
- Leicester Computer Centre, 67 Regent Road, Leicester will be producing its own interface card designed by Derek Bland, with interchangeable EPROMs to drive a variety of printers from the Apple without hassle.

Specification

Print speed (max.): 160 cps
Print head: nine-pin dot matrix
Character set: ASCII, pica and elite typefaces in roman or italic; nine international character sets
Print mode: bidirectional logic seeking or unidirectional
Buffer: 2K
Paper: fan-fold, 9.5in.-10in., adjustable pin feed; cut sheet, 7.25in.-8in. friction feed with optional roll holder
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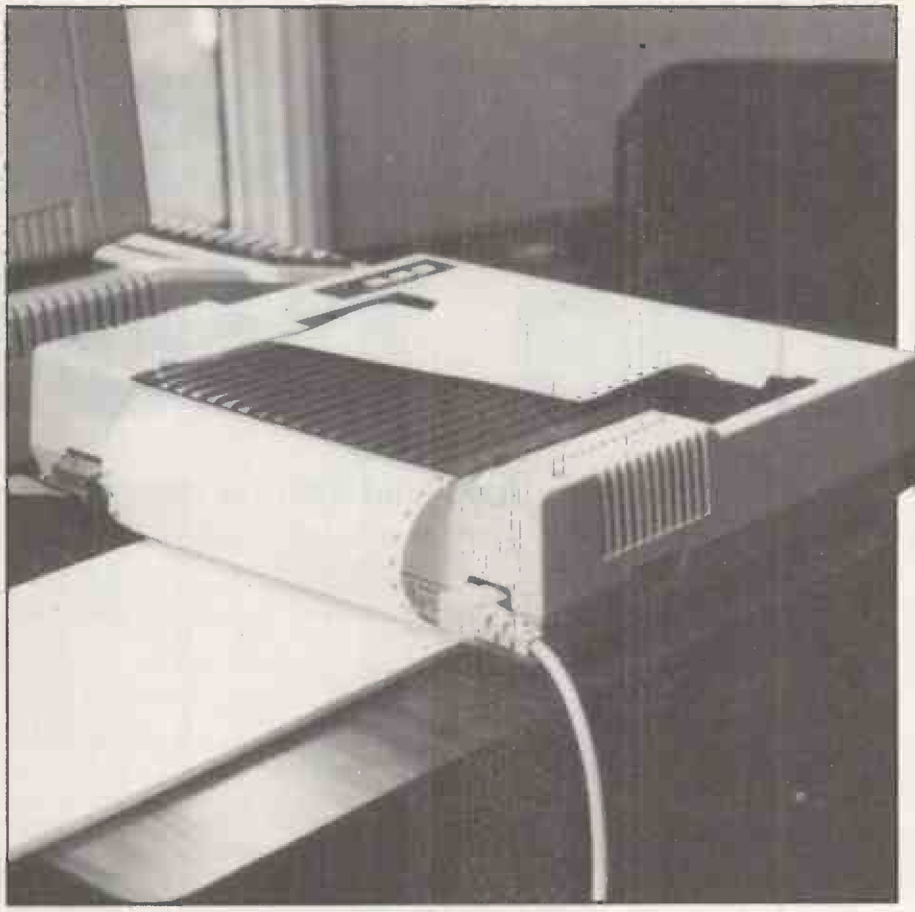
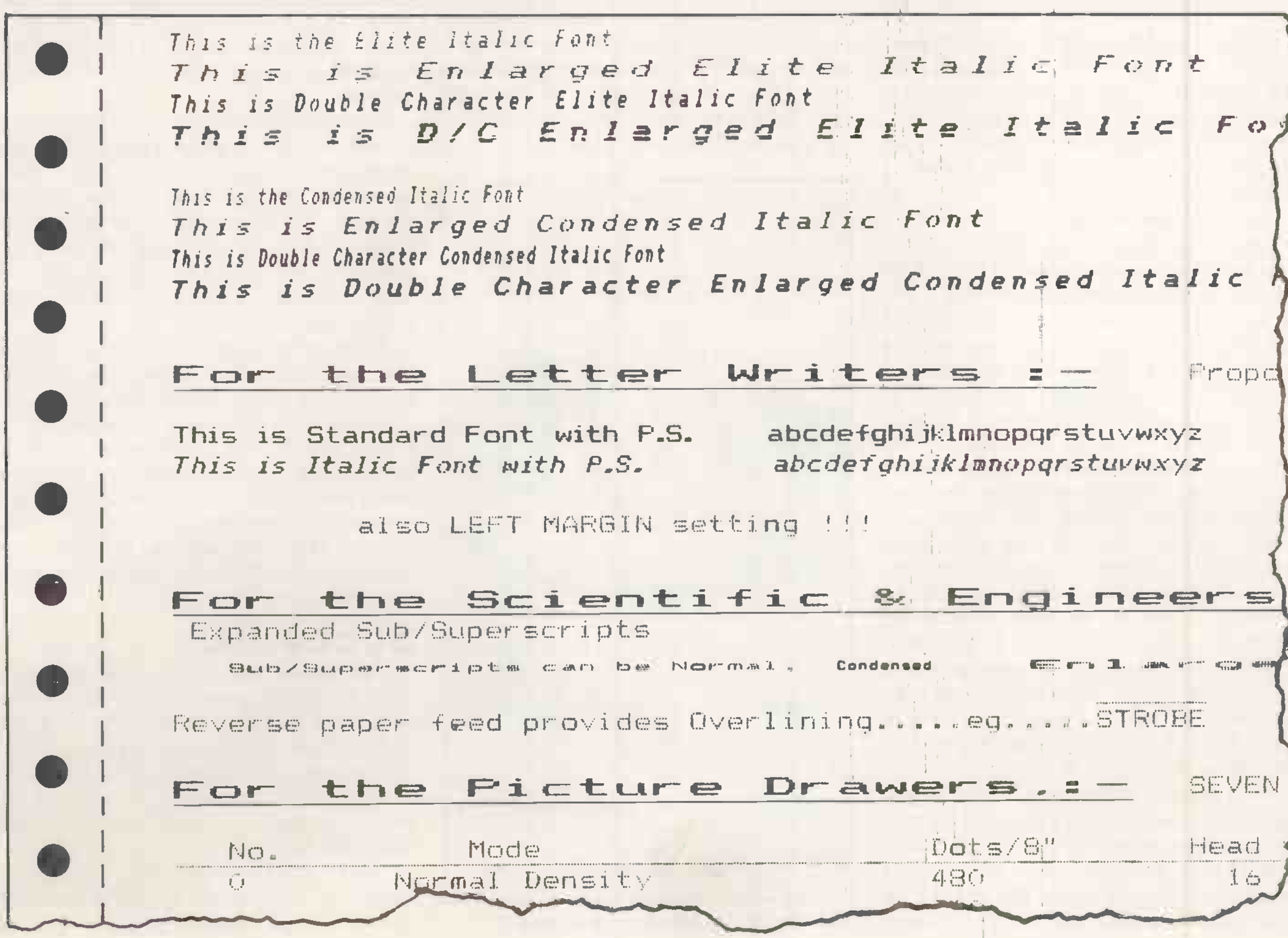


Fan-fold pin feed and cut-sheet friction feed are standard on the FX-80.



This is the Elite italic Font
This is Enlarged Elite Italic Font
This is Double Character Elite Italic Font
This is D/C Enlarged Elite Italic Fo

This is the Condensed Italic Font
This is Enlarged Condensed Italic Font
This is Double Character Condensed Italic Font
This is Double Character Enlarged Condensed Italic

For the Letter Writers :— Propo

This is Standard Font with P.S. abcdefghijklmnopqrstuvwxyz
This is Italic Font with P.S. abcdefghijklmnopqrstuvwxyz

also LEFT MARGIN setting !!!

For the Scientific & Engineers
Expanded Sub/Superscripts
Sub/Superscripts can be Normal, Condensed Enl

Reverse paper feed provides Overlining.....eg.....STROBE

For the Picture Drawers .:— SEVEN

No.	Mode	Dots/8"	Head
0	Normal Density	480	16

Unmasking the plotters

Bill Bennett's enquiries lead from a cheap drum to a top-price flat-bed.

ADDING A PLOTTER to a microcomuter system is not something you do every day. For most purposes, a dot-matrix printer will provide adequate hard copy. If you need to produce a lot of text then a daisywheel is probably a worthwhile investment. Modern dot-matrix printers are sophisticated devices, and are capable of providing a high-quality graphic output. But the cost of a higher-resolution plotter is in the same price range.

Which device you choose will depend entirely on your application. For laboratory work or for producing slides for an overhead projecter a plotter is the obvious tool for the job. Matrix printers come into their own as aids for programmers who simply need a quick listing. On the whole, plotters are significantly slower than printers, especially when it comes to producing text. However, plotters have a much higher resolution and offer a greater degree of flexibility.

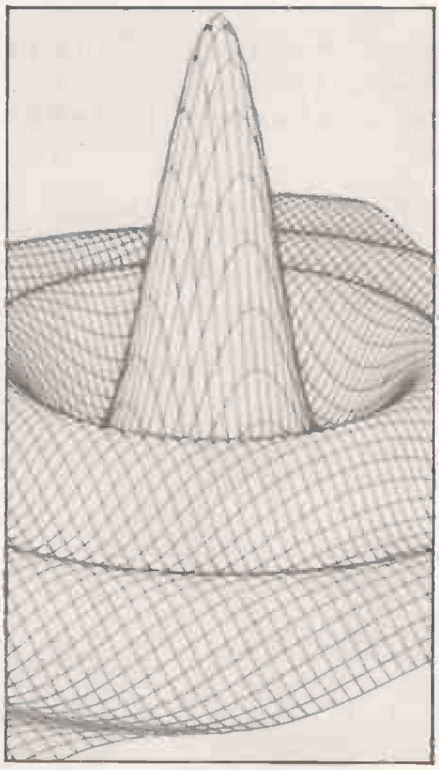
A printer usually works by something — a pin or a type head — impacting a ribbon and pushing it against the paper to form an image. A plotter operates by moving a pen to a point on the paper and then allowing the pen to touch the paper and moving again, thus marking it. This introduces a certain level of flexibility as it allows the user to exercise some choice over the pen. Many plotters are designed so that virtually any pen can be used in conjunction with it.

Such an arrangement gives the user almost infinite control over such parameters as the colour of ink being used and the size and type of nib. Some plotters allow a number of pens to be selected by the machine at any one moment. This can be done by using a carousel arrangement which carries several pens in the same unit as the one that is actually drawing. An alternative is to site the pens somewhere away from the main plotting area and let the plotter select pens from a rack.

Even those plotters which do not have a facility for automatically changing a pen often allow a manual change. If not, then it is up to the software author to include a routine which will move the pen to an unimportant point and wait for long enough to allow the user to change the pen by hand.

Multiple-pen plotters appear to be colour-blind. They do not know which colour pen is which. If, for example, a mischievous person were to swap the red and green pens in a four-colour plotter, chaos could result. As far as the plotter is concerned colours are numbers. The plotter only knows that pen 1 is pen 1, though the software may be written assuming that pen 1 is red. Until a more sophisticated plotter which can distinguish colours is developed it is up to the user to ensure that the right colour pen is in the right place at the right time.

Felt-tip pens tend to be the first choice of plotter manufacturers. Their advantage is that they offer a wide range of colours and tips. Generally speaking, the finer the resolution of the plotter, the finer the tip of the pen which is used. However, if large areas of colour have to be filled in, a pen with a wide tip may be preferable.



The Strobe 100 resolves to 0.05mm.

One problem of felt pens is that they dry up rather quickly. The only way of avoiding it is to ensure that the cap is replaced on the pen after use. When testing the review plotters in the *Practical Computing* office, I found that I repeatedly forgot to replace the pen caps. Another drawback of felt tips is that they can easily be distorted and become frayed with use.

The pen-up pen-down operations subject the tip of a pen to a lot of pressure, and consequent damage. This can result in blotches on the paper, but more frequently simply destroys the plotter's high resolution. What is the use of having a device that is precise to 1/1,000th of an inch, when the pen is 1/16th of an inch across?

For day-to-day plotting, the felt-tip pen is probably best. Special pens for making overhead projector slides and other specialised jobs can easily be fitted to most plotters. Higher-resolution results can be obtained with a pen like the Rotring Isometric, which can have a very fine tip and is capable of using a wide range of colour inks.

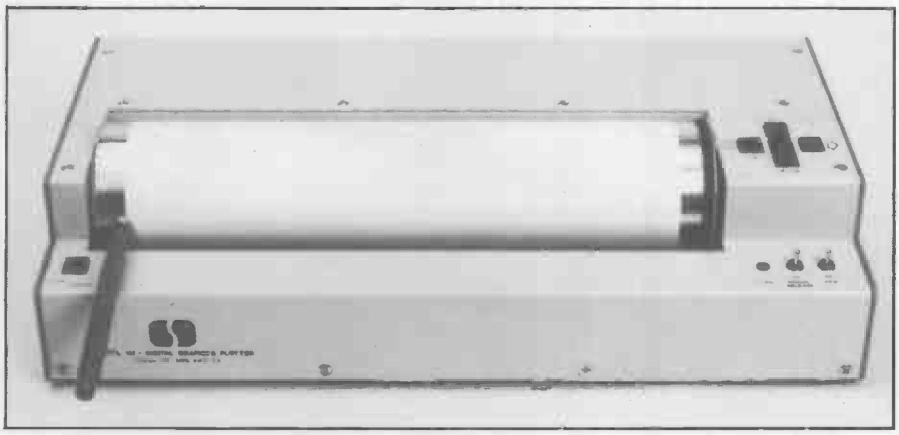
There are two main methods of moving the pen across the paper. On flat-bed plotters the paper lies flat and the pen is moved in both the x and y directions. In the other type the pen only moves in the x direction, the plotting along the y direction being achieved by moving the paper. These devices are generally known as drum plotters since the paper is fastened to a drum which rotates to give the movement in the y direction.

Strobe 100

The Strobe 100 plotter is of the drum type. For the purposes of the review it was connected to a BBC Micro via a ribbon cable between its own parallel port and that of the computer. Halfway along this cable is a resin box containing a number of resistors that perform some simple buffering function.

Unlike a number of other plotters, the Strobe is well served by software. The review system came complete with a

Rikadenki's top-of-the-line RY-10MZ — a graphics tool for office or laboratory.



The Strobe 100 drum plotter from Data Efficiency comes complete with BBC software.

demonstration program and a library of subroutines for using the plotter. The plotter costs £576, and was the crudest one reviewed as well as the cheapest.

Supplied with the Strobe were four felt-tip pens and a number of sheets of special glossy paper. It only took a few minutes to get the system up and running. Unfortunately the paper is not a standard size. It is only slightly wider and shorter than A4, but A4 sheets cannot be loaded on to the drum as easily as I would like.

Paper is fitted on to the drum simply by working it under a strip of metal. In practice it is held tightly enough for printing. It is important to be careful when loading the paper to ensure that the pen does not mark it. The documentation suggests that the pen should be moved to the extreme right for this purpose; I found it best to remove the pen.

Fitting and removing pens on the Strobe is a risky business. The unit that accepts the pens is a triangle of brass with a thread cut into it. It moves from left to right and back again across the width of the paper. You are recommended to use fibre-tip pens with a soft plastic body and to fit them by initially cutting a thread into the plastic.

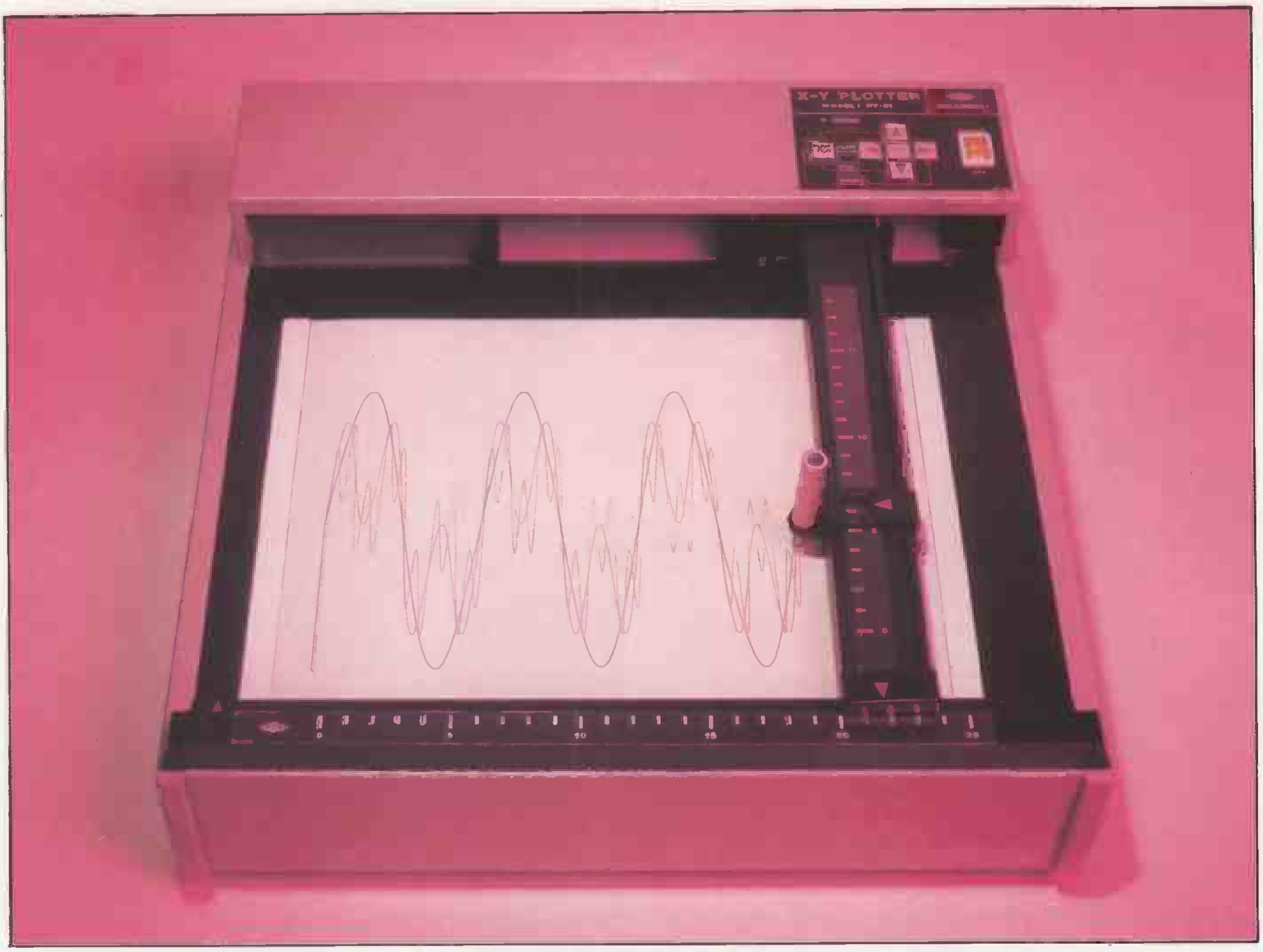
There are a number of imponderables associated with this process. The first pen that I tried to thread on to the unit was not threaded deeply enough, and consequently did not manage to reach the paper when drawing. I then tightened it up a little more, only to find that I had cut right through the body of the pen, rendering it useless. Too deep a cut on the second pen I tried meant that the pen did not lift off the paper when it was supposed to be moving rather than writing.

On the positive side, it does mean that some very cheap pens can be used. Those supplied with the unit were Pilot Razorpoints, which are easy to find in the shops. I assume that an experienced user would be able to fit the pens properly without any trouble.

Data Efficiency is distributing the Strobe plotter in the U.K. and also provides a number of interfaces, software products and pens and other accessories. The strongest card in this pack is the software, which is available for a large number of machines, and includes a package which allows VisiCalc files to be plotted.

Software supplied with the Strobe for the BBC Micro includes a program called BBCPlot. It consists of a set of routines

(continued on next page)



The Rikadenki RY-21 plots at a lively 200mm. per second.

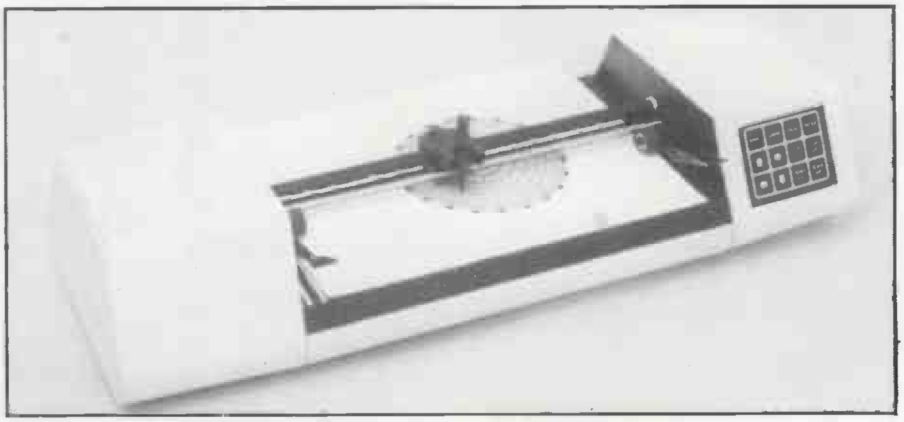
(continued from previous page)

which drive the plotter and can be supplied either on tape or disc. It is numbered from line 30,000 onward, which leaves plenty of scope for the user's own programs, though because the BBC Micro uses vast quantities of memory for its high-resolution graphics it is not possible to use screen modes 0 to 3. That is a pity, because it means it is impossible to view a display on screen before plotting it out, though that is the fault of the micro, not the plotter.

A good manual complements the software. It explains that the stepper motors are driven by patterns of binary bits sent via a table stored in the micro's memory. The Strobe is capable of resolution of 0.002in. or 0.05mm. thanks to these motors.

ProcLabel is a procedure used by the BBC Micro to write characters on the plotter. It uses a character fount stored in the memory of the BBC, which gives it the advantage of being changeable. However this also produces the disadvantage of denying the user a lower-case character set, since there is no room for it.

Compared with the other plotters I looked at the Strobe 100 is slow. It is, however, very well supported and in this respect is ideal as a tool for a school or college when used in conjunction with the BBC Micro. Interfaces and software are also available for the Apple, Pet, Xerox and Osborne micros, as well as the S-100 bus and RS-232 port.

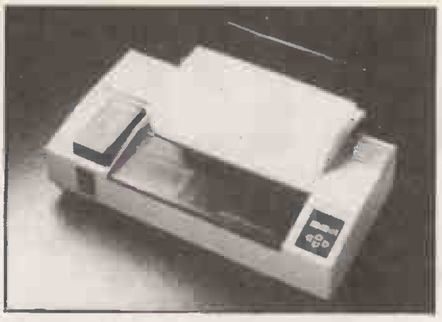


The Hiplot-40 from Houston Instruments is distributed in the U.K. by Sintrom Electronics. Firmware inside the beast allows automatic generation of curves, arcs, ellipses and circles of any required size. There are 11 different styles of line, and normal or italic characters can be drawn at any of 360 angles and 255 sizes. The machine costs £865 and includes an RS-232 interface as well as a number of self-test routines.

Rikadenki RY-21

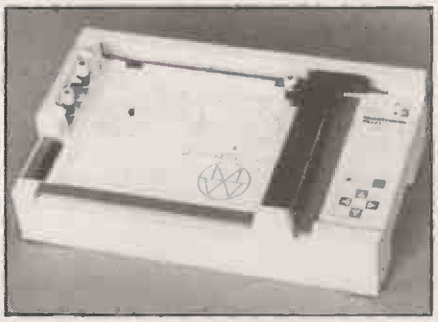
The RY-21 is the bottom-level machine in a wide range of plotters which has something for every possible type of plotter user. It is A4 sized, which allows it to take standard paper or projector film or whatever. Although it is nominally only a single-colour plotter, it is so easy to change pens that this really does not matter very much.

Plotting takes place at 200mm. per second, which is fairly fast for a plotter, and the pen certainly dashes about across the paper. It is an x,y plotter: an arm moves from left to right in the x direction, while the pen carriage slides up and down the arm



The Plotwriter from Environmental Equipments (Northern) Ltd. is both a printer and a plotter. Costing £1,531 plus interface the Plotwriter has a set of 45 commands employing a wide range of intelligent facilities. There are four pens, which are changed automatically, and three founts. Printing and plotting is performed on a 100-metre roll of paper which allows a 1.6-metre addressable area.

The Gould Colourwriter is a digital plotter which can add plotting to almost any computer system. It can use up to 10 pens. There is an integral buffer memory which is expandable from 2K to 16K and five character sets are included as standard.



The Pixy 3 is a three-colour plotter aimed at the personal-computer user. Its own local intelligence comes courtesy of a Z-80 processor which helps in the generation of circles, arcs and curves. There are nine character sets plus scientific symbols, nine line types with a variable pitch and 15 character sizes. Pixy 3 costs £599 from Mannesmann Tally.

in the y direction. Naturally this is all done on a flat bed. The paper is held in place by flexible strips of magnetic material.

Pens simply screw into the carriage, which is fitted with a standard thread that accepts the set of four coloured pens that is supplied. An added bonus is that it also accepts Rotring Isometric pens as well. These really do make for a much better-quality plot and come in a variety of nib sizes. There is also a range of ink colours to choose from. Ball-points can also be used.

Pens are held bolt upright by the carriage, which is the best orientation for most pens, including the Rotrings. The mechanism which brings the pen down to make contact with the paper is sprung so that pen nibs and tips are not bashed out of shape by repeated hard contact with the plotter bed. The mechanism makes a clicking sound each time it is switched on or off.

A character set is built into the RY-21. That is a godsend because, unlike the Strobe plotter which is supplied complete with software, the Rikadenki was only supplied with some example software written by the house BBC Micro enthusiast. The penalty is that some flexibility is lost, but not much, and certainly not enough to worry about as extra founts can easily be written by the user.

The resolution of the RY-21 is not as high as that of the Strobe 100, but for the most part the difference did not really show. As a test I tried plotting a sine curve right across the page width. I started by using each of the possible steps across 2,000 increments, each being 0.1mm. wide. I then plotted the same curve using 0.5mm. steps. The difference was almost invisible, except that it plotted much faster using the larger steps.

Using the RY-21 with the BBC Micro was not easy. Once again this was more the fault of the micro than the plotter, but some driver software for this unit would certainly make a lot of difference. However, to compensate the plotter does have a reasonable number of built-in plotting commands such as circle drawing and so on to make life easier.

Rikadenki RY-10MZ

Right at the top of the Rikadenki range is the RY-10MZ eight-colour plotter. It is like a robotic artist, and watching the plotter run through the test routine is entertaining. The pen moves across the paper at high speed, pausing every so often to grab another colour pen from a rack of 10 on the left-hand side.

"Intelligent" is not often used as an adjective to describe plotters, but there is a degree of intelligence incorporated in this machine in the form of an 8085 processor. There is also 2K of memory, which is quite a lot in terms of what it represents as a graphic image on the paper. The unit is similar to the RY-21 in many respects, but is A3 sized as opposed to A4. The pen moves at 400mm. per second, which is twice as fast as the RY-21.

Like the RY-21, the RY-10MZ has three character founts in ROM: the normal English set, a Greek alphabet set which will please all those physicists and engineers, and a Japanese character set.

Again like the smaller plotter, the RY-10MZ has a selection of buttons which can move the carriage about under manual control. A function button gives each of the direction buttons a second use, including selection of the test mode. Pressing the centre and left button makes the plotter enter its print mode,when it becomes a listing device.

Unlike the smaller machine, the RY-10MZ has an extra row of buttons which are used to change the pen colour. If you press one of them in the middle of a plot, the carriage will swap the pen. You can try and confuse the plotter when it is drawing with pen 1, say, by moving pen 2 into the empty pen 1 cradle. The plotter has the good sense, having found pen 1 to be full, to look for the first empty cradle and put its pen there.

The RY-10MZ uses an electrostatic technique to hold the paper in place. It works well and the paper clings to the base like a limpet. There is also an option to attach a device which feeds a continuous roll of paper across the base area.

At a list price of £1,775 plus VAT, the RY-10MZ plotter is not a toy likely to be linked up to a ZX-81. It is a proper graphics tool that would be equally at home in the office or laboratory. Symbol Computer Services of Norwich has written a number of packages to interface the Rikadenki plotters. They will work with any micro blessed with an RS-232, Centronics or IEEE interface, using information entered manually or from existing files to plot pie-charts, bar-charts or x,y plots. There are also control files which are used to drive the device.

Suppliers

Rikadenki Mitsui Electronics U.K. Ltd, Oakcroft Road, Chessington, Surrey. Telephone: 01-397 5111.

Symbol Computer Services Ltd, 45-53 Prince of Wales Road, Norwich, Norfolk. Telephone: (0603) 29581.

Data Efficiency Ltd, Finway Road, Hemel Hempstead, Hertfordshire. Telephone (0442) 60155.

Mannesmann Tally, Molly Millars Lane, Wokingham, Berkshire. Telephone: (0734) 788711.

Gould Instruments Ltd, Willow Lane, Mitcham, Surrey. Telephone: 01-640 3490.

Sintrom Electronics, 14 Arkwright Road, Reading, Berkshire. Telephone: (0734) 875464.

Environmental Equipments (Northern) Ltd, Environ House, 64 Welsh Row, Nantwich, Cheshire. Telephone: (0270) 652115.

A buffer at the

If printed output is part of your regular computing routine a buffer could be the best investment you ever make, says Paul Sutcliffe.

YOUR COMPUTER is forced to slow down to match the speed of your printer whenever you need to print. The fastest matrix printers can operate at around 100 characters per second, and a few daisywheel printers can average around 30 to 40 cps. Yet microcomputers can actually send out data at thousands of cps.

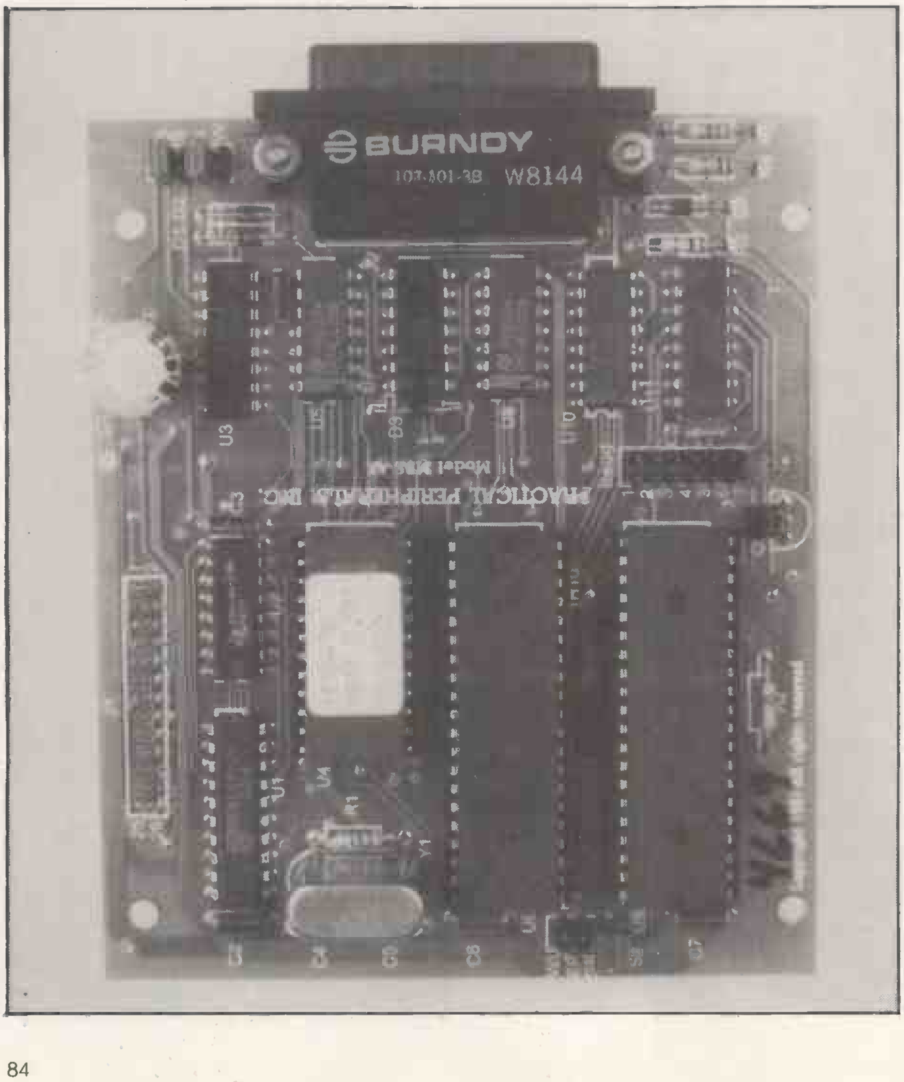
With many applications, such as program listings, mail-shots, invoices/payslips, word processing and financial modelling, your computer can spend far more time waiting for the printer than actually computing. Instantaneous printout is a remote prospect, so an interim solution is needed.

Spooling was the earliest answer to the problem. It involves sending the output to a disc and printing it later when the computer is not in use. There are also some spooler control software packages which take over the control of printing while you have another program running.

In practice, spooling systems have two major disadvantages. The spooler clearly requires space in the computer's main memory, and reduces the space available for the program you are actually trying to run. It can also decide that it wants to print a chunk of text from the file on disc at unpredictable moments. So your program stops in its tracks until normal service is restored.

The print buffer is the best solution yet devised. It comprises a small board containing extra RAM and some built-in control software. The computer can dump output for printing into the buffer in a matter of seconds. Computing can then be resumed at once. Meanwhile the buffer's control software takes over the job of re-transmitting the output to the printer.

The Practical Peripherals buffer from Northamber in versions from 8K to 32K.



This article contains about 11.5K of text. The typescript was printed out in draft form several times before completion on an Epson MX-100/II fitted with a 16K E/Buffer. The emphasised text option was used for maximum legibility.

The time taken to load the print overlay and transmit the text to the E/Buffer was a mere 23 seconds, after which the computer was back in use. But the Epson took over six minutes to print the text. Printing half a dozen drafts during the day, with no buffer, would have wasted almost 40 minutes.

Of course, it is not only authors who value the ability to give a Print command without losing the use of their computer. Professional programmers also benefit from print buffers when writing, testing, and debugging programs, and no longer need to save huge batches of listings to print out on a rainy day.

General-purpose buffers — otherwise known as "in-line" or "stand-alone" — occupy a separate box between the computer and the printer. They can perform other tasks besides print buffering, including communication between otherwise incompatible computers, or indeed other peripherals.

Print buffers are buffers which have a single function — to receive output destined for the printer at the speed of the computer and then to retransmit at the speed of the printer. Some are installed inside the printer; others slot into the computer itself.

The most popular buffers are those designed to fit into the Epson printer range. Their popularity arises partly because of the vast numbers of Epsons sold and partly because Epson provides an auxiliary input slot ideal for the purpose.

There are several buffers of this type on the market. One of the price/performance leaders is the U.K.-designed and built E/Buffer, which is also marketed as the MCS Super Spooler. It offers 2K, 16K or 32K of RAM, and is backed by an impressive two-year guarantee. Another is the Microbuffer from Practical Peripherals, imported by Northamber. The Ricoh RP-1600 daisywheel can also be obtained in a modified form with up to 8K of RAM buffer installed.

As with the Epson, so with the Apple. There is a wide range of buffers currently on the market which fit directly into one of the Apple slots. Some of them require an existing printer interface card. Apple buffers include the Orange Micro

end of the line

Buffer	Manufacturer	RAM sizes	Interfaces (Note 1)	Price (inc VAT)
Epson Internal				
E/Buffer	MCS	U.K. 2K	S	£75
		16K	P,S	£109
		32K	P,S	£155
Microbuffer	Practical Peripherals	U.S. 8K	S	£144
		16K	P	£144
EIPB	Gram	U.K. 32K	PS	£149
		64K	PS	£204
EB-16	ACG	U.K. 16K	S	£109
EB-60	ACG	60K	S	£161
Wizard EBI	Wesper Micro	U.S. 16K	P	£125
Apple internal (note 2)				
IPB	Gram	U.K. 16K	PS	£149
		64K	PS	£251
Bufferboard	Orange Micro	U.S. 16K-	P	£129
		64K	P	£232
Microbf'r II	Practical Peripherals	U.S. 16K	P	£229
		32K	P	£275
General purpose				
Spriinter	Mutek	U.K. 2K	P,S,I	£190
		32K	P,S,I	£282
DB16-1	Aculab	U.K. 16K	P,S	£259
DB64-1		64K	P,S	£323
SB-16	ACG	U.K. 16K	S	£172
SB-60	ACG	60K	S	£218
Pipeline	Interactive Structures	U.S. 8K	P	£160
		128K	P	£298

Note 1. P, Centronics parallel; S, RS-232C serial; I, IEEE-488.
Note 2. Some Apple buffers require printer interface card.

Bufferboard, and Practical Peripherals' Microbuffer II.

The Aculab and Spriinter buffers fall within the group of general-purpose buffers. The Mutek Spriinter, for example, provides both buffering — with 2K, 4K, 8K, 16K, 24K and 32K options — and configurable interface conversion. It can be used either as a straight-through buffer, say RS-232C computer output to RS-232C printer input, or as a buffer which converts from one interface mode to another, say from the Pet's IEEE-488 output to a Centronics parallel printer input. Moreover, the configuration can be altered simply by changing a few switch settings.

When choosing a buffer first assess the volumes you will require your buffer to hold. If you only print a screenful of data at a time at infrequent intervals, then a 2K buffer will be ample.

On the other hand, densely-packed text may need up to 4K per printed page. Regular printing of more than 16 such pages could mean either buying a very large buffer at 128K or 256K or stacking two or more smaller buffers in line. For most commercial applications you are likely to require between 8K and 64K.

Secondly, consider your present equipment and whether you are likely to change it in the near future. If you use an Epson printer or an Apple computer, I would recommend that you go for one of the purpose-built buffers. The Epson-based buffers in particular are easy to install.

Last and least, price. Only worry about price if you really have to. The value of the time you save by using a print buffer in a commercial environment will probably exceed its cost within a month, maybe even within a week. Big savings can be made in operator time as well as computer time.

For a non-commercial application, buy the biggest buffer you can sensibly afford. As a guide, the 16K E/Buffer costs £109.25, VAT inclusive, in either parallel or serial versions.

Stacking can best be explained by considering the situation where an Epson printer fitted with a 32K E/Buffer is being operated in conjunction with a 32K Spriinter. Suppose a 68K text file has to be printed. Output from the computer first goes to the Spriinter, which immediately sends it on to the E/Buffer. The E/Buffer starts to send data to the Epson one line at a time. Each line sent to the printer releases space at the bottom of the E/Buffer, which is still being filled at the top. Whenever the E/Buffer is completely full it sends a signal to the Spriinter, which starts to fill up in turn.

After a few seconds of this, the printer will be printing flat out and both the buffers will be full. Only then will the Spriinter signal to the computer that no more output can be handled. So for about two minutes the computer will wait for the printer to catch up. As soon as the printer has printed 4K of text, however, the computer will be available for more work.

The initial impetus for manufacturing buffers came, as usual, from the U.S. It may be some months before the U.K. manufacturers dominate their own home market. A respectable number of U.K. firms are already well entrenched in this field, and there may even be prospects of our own manufacturers securing a good proportion of the U.S. and German markets.

Just over the horizon there are some new developments in stand-alone units, which will be made available in permanently configured, and therefore cheaper, versions. Industry sources also suggest that, if interest is strong enough, a U.K.-built dedicated print buffer for the IBM PC — easier to use and much cheaper than some imported "do-everything" boards — could be available by late autumn.

If your printing takes a long time because you are running a very slow program then a buffer won't help you. On the other hand, frequent halts while a few lines of data are printed can be completely eliminated, and cumulatively this can save many hours.

Anyone thinking of buying a 16-bit processor and throwing out their eight-bit machine should seriously consider instead the effect of buffering their existing set-up. Depending on the application, better results could be obtained at a fraction of the cost of a new computer. Printer-based and general-purpose buffers have a hidden benefit: when the computer is changed in favour of a more powerful machine, it is not necessary to change the buffer or printer.

You can extend the productivity of your computer system beyond recognition with a print buffer. There are few ways in which you can upgrade your system at such low cost and receive such dramatic benefits. If you don't believe it, try and see a buffer in action, or better still borrow one — you'll be converted on the spot.

Paul Sutcliffe is managing director of A-Line Computer Systems, Nottingham.

The ins and outs of RS-232

Mark Shepperd connects with the standard serial printer interface.

THE RS-232 serial interface has become one of the commonest interfaces between microcomputers and the outside world. It is flexible enough to communicate with any peripheral device, from a printer to a Modem, providing of course that the peripheral is equipped with a similar RS-232 interface. Yet the mode of operation is virtually the same, except for the way in which the computer would perform the handshaking routines with the peripheral or indeed the communications device.

The RS-232 interface can often be recognised by the presence of a D-type 25-way connector on the rear panel of the computer. Just to make things difficult, however, several manufacturers are now using male and female equivalents of the connector for various other interfaces. In some cases RS-232 compatible interfaces lurk behing non-standard DIN-type connectors of which the nearest family is found most frequently on the rear panels of hi-fi equipment. This lack of standardisation is always inconvenient when marrying systems together.

Screened cable should always be used to connect units together, and the number of cores has to be decided with care. It is safest to use a cable 5mm. or 6mm. in diameter and carrying around 10 independent cores shrouded by the screen. You may only need three cores plus the screen, but the extra cores allow you to use eight or nine cores, if you need to, for the handshaking sequence. Figure 1 shows a 25-way connector as it is connected for printer operation. The screen braid should be connected to pin 1 of the connector at both ends.

The RS-232 interface is outlined in a set of rules and regulations compiled by the CCITT and called recommendation V-24. It describes the timing sequences to be used when trying to establish the interchange circuits between data terminal equipment and data circuit-terminating equipment. It also deals with the electrical characteristics

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and goes into quite detailed descriptions of all the various modes of operation of the V-24 interface.

Each pin or channel in the RS-232 interface is given a CCITT interchange circuit number and a name which defines that interchange circuit. There are approximately 43 different channels defined by the recommendation. Table 1 shows some of those which are most important with respect to printer operation. Table 2 gives the channel definition each beginning with the CCITT interchange circuit number followed by the pin number allotted to that circuit when used with the standard 25-way D-type connector.

Pin		Telco	CCITT
1	protective ground	AA	101
2	transmitted data	BA	103
3	received data	BB	104
4	request to send	CA	105
5	clear to send	CB	106
6	data set ready	CC	107
7	signal ground	AB	102
8	carrier signal	CF	109
9–19	not used		
20	data terminal ready	CD	108
21			
22–24	not used		
25			

Figure 1. Pin assignments.

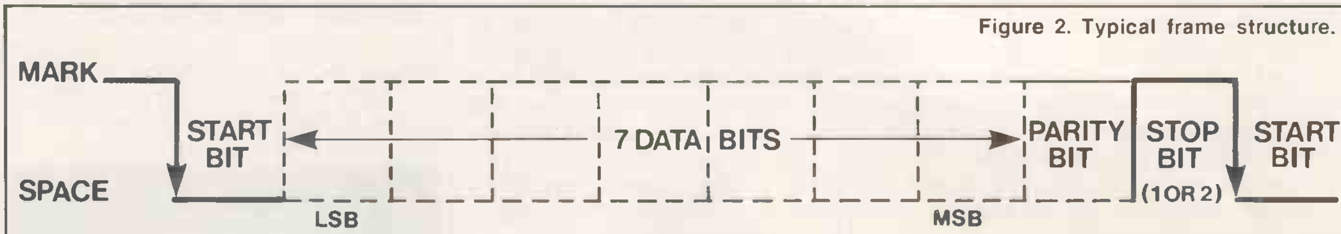
When transmitting data from one device to another in a serial format, it is important to tell the receiving device how and when characters are to be sent. The process of packing characters in a serial stream is called framing. In the case of the printer it is usually necessary to configure the device manually by setting DIL switches. Alternatively you set the frame at the computer to correspond to the printer's requirements.

Figure 2 shows a typical frame structure. Parity is usually set at the printer end. An additional parity bit is added to a character or block so that the sum of the binary is either odd or even. Conventionally, odd parity is a feature of synchronous systems and even parity a feature of asynchronous systems. If the parity bit is incorrect the receiving device knows that the data has been corrupted.

When you are faced with a microcomputer and a printer, both with RS-232 interfaces, take the following steps in trying to establish the connection:

- Check that the baud rate of both printer and computer asynchronous serial port are identical. Baud is equal to bits per second when two-state signalling is used.
- Check that the frames are compatible. In other words check that the printer expects to see the correct quantity of stop and start bits and that the word length is correct.
- Check that parity is set correctly at the printer end. The choice is between odd, even or no parity at all.
- Check that the form of handshaking is compatible, software or hardware. Hardware handshaking uses DTR and DSR interchange circuits most frequently. Software handshaking is achieved by the host sending control

Figure 2. Typical frame structure.



characters to the printer via the data lines.

- Finally, check both the computer and printer manuals carefully, noting the directions of the RS-232 control signals on interchange circuits which are to be used in achieving the correct form of handshake. Never connect interchange circuits which conflict in direction.

The length of cable which will work correctly is largely determined by the capacitance of the cable used. A rough rule is not to use a cable much over 150 feet long. A cable that long must always be screened.

Figure 3 shows the voltage levels which have to be maintained in order to establish a reliable data link between computer and printer. A device called a "breakout box" helps to determine whether the data link is functioning correctly. The unit is connected in series with the cable, and LEDs monitor each line's status. A breakout box is useful in determining whether the correct control lines are activated to stop data transfer when the printer buffer is full, for example. If the system does not operate first time, don't despair, try again. The chances are that you have forgotten something extremely simple. Good luck.

Interchange circuit number	Interchange circuit name	Ground	Data		Control		Timing	
			from DCE	to DCE	from DCE	to DCE	from DCC	to DCE
102	signal ground or common return	X						
102a	DTE common return	X						
102b	DCE common return	X						
102c	common return							
103	transmitted data			X				
104	received data		X					
105	request to send					X		
106	ready for sending				X			
107	data set ready				X			
108/1	connect data set to line					X		
108/2	data terminal ready					X		
109	data channel received line signal detector				X			

Table 1. Some channels defined by recommendation V-24.

Figure 3. Typical RS-232 voltage levels.

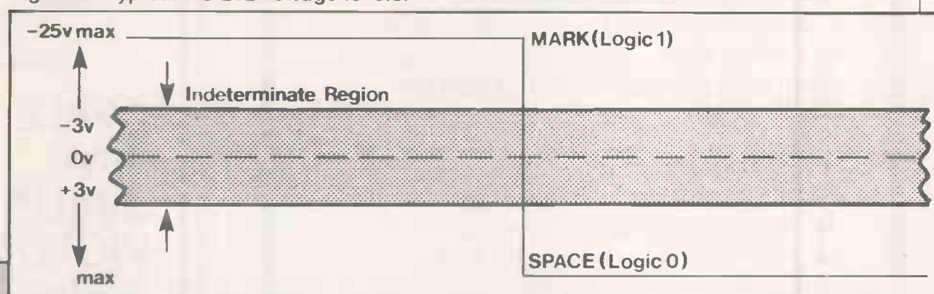


Table 2. Circuit functions.

Circuit 102, pin 7. This channel establishes the signal common return for unbalanced interchange circuits according to CCITT recommendations. The connection of this channel is essential for correct operation.

Circuit 103, pin 2 or 3. This channel can occur at either channel because occasionally channels 2 and 3 — which are Transmit Data and Receive Data — are crossed over. In normal operation the Transmit Data pin at the computer end would have to be connected to the Receive Data pin at the printer and vice-versa for the other channel. You could not allow the Transmit Data pin of the computer to be connected to the Transmit Data pin of the printer: the printer will do absolutely nothing if connected together in this mode. The connection of these two channels is essential for the communications link.

Circuit 104, pin 2 or 3. This channel is usually Receive Data. However, as already stated, transmission and reception of the serial binary data stream may occur at either of these two pins, depending on the equipment used. A quick glance at the users' manual should show which is which. Watch out for descriptions such as "transmitted data", which may mean the receive channel.

Circuit 105, pin 4. This channel is called Request to Send, RTS. The direction of this signal is to the DCE. The On condition causes the DCE to assume the Data Channel Transmit mode. The Off condition causes the DCE to assume the Data Channel Non-transmit mode, when all data transferred on circuit 103 has been transmitted. This circuit is not always used, but if the facility is available at both the DEC and DTE it is best to connect it. The direction of the signal is again all-important in this case. This signal may have to be strapped to another interchange circuit if directions on this circuit conflict at both the DTE and DCE. It is sometimes necessary to strap this circuit to circuit 108, Data Terminal Ready, to achieve the correct conditions for hardware data transfer.

Circuit 106, pin 5. The common name for this channel is Ready for Sending, although it is sometimes called Clear to Send, CTS. The direction is from the DCE. Signals on this circuit indicate whether the DCE is prepared to accept data signals for transmission on the data channel or for maintenance test purposes under control of the DTE. The On condition indicates that the DCE is pepared to accept data signals from the DTE. The Off condition indicates that the DCE is not prepared to accept data signals from the DTE.

Circuit 107, pin 6. Commonly called Data Set Ready, DSR, this circuit is important and is usually used. The direction of the signal is from the DCE and signals on this circuit indicate whether the DCE is ready to operate. The On condition indicates that the signal convertor or similar equipment is connected to the line, and that the DCE is ready to exchange further control signals with the DTE to initiate transfer of data, providing circuit 142 is off or not implemented. Circuit 142 is a test indicator commonly used with Modems and is never used with printers. The Off condition indicates that the DCE is not ready to operate.

Circuit 108/1/2, pin 20. There are two modes of operation for this circuit depending on the user modes of operation. It is commonly used to display the buffer status and hence suppress data flow temporarily; hence the name of this circuit, Data Terminal Ready or DTR for short. The DTR mode of operation is specified in definition 108/2 of the CCITT recommendations. The direction is to the DCE. The On condition, indicating that the DTE is ready to operate, prepares the DCE to connect the signal-conversion or similar equipment to the line, and maintains the connection after it has been established by supplementary means. The DTE is permitted to present the On condition on circuit 108/2 whenever it is ready to transmit or receive data. The Off condition causes the DCE to remove the signal-conversion or similar equipment from the line, when the transmission to line of all data previously transferred on circuit 103 and/or circuit 118 has been completed. This circuit should be used with virtully all printers.

Circuit 109, pin 8. This circuit is most commonly known as Data Carrier Detect, although its official name is Data Channel Received Line Signal Detector. This circuit is not often used. The direction is from the DCE. Signals on this line indicate whether the Received Data channel line signal is within the appropriate electrical limits as specified in the relevant recommendation for the DCE. The On condition indicates that the received signal is within the appropriate limits. The Off condition indicates that the received signal is not within the appropriate limits and a link would not be established.

Pin 1. Pin 1 on RS-232 connector is an Earth link which is usually connected to the screen. It becomes useful when a cable is run for long distances.

Using the Lisa

more than just a pretty interface

Apple's Lisa is certainly an impressive machine, but is it a practical one? Ian Stobie gives his verdict after two weeks with a Lisa in the office.

WITH THE MOST advanced user interface available on any micro, 2Mbyte of software coming with the machine and an £8,000 price tag, the Apple Lisa might seem a little over the top for everday office use. In the March issue of *Practical Computing* I wrote an extensive preview of the system based on a couple of visits to Apple to look at the machine. Since then I have had the opportunity to use the machine at my own desk.

Lisa comes with six software applications to do a variety of different office tasks, and they are substantial pieces of software. I have been using three of them — the word processor, the graphing and the drawing tools — to produce copy for this issue.

Physically, the Lisa does not look particularly unusual. It consists of three off-white boxes; the main unit contains the screen and floppy-disc drives; there is a separate keyboard; and a third unit contains a 5Mbyte hard disc. Inside the main unit is a 16-bit 68000 chip and 1Mbyte of internal RAM. The two built-in floppy-disc drives and the separate hard disc unit provide a total of 6.7Mbyte of on-line disc storage.

In addition to its keyboard the Lisa has a mouse pointing device. It is used in conjunction with the Lisa's high-resolution screen in almost all interactions with the machine. The mouse is a small box with a button on top. Set into the underside of the mouse is a ball which senses movement of the mouse on the desk. As you move the mouse a pointer moves on the screen; you use the mouse to control the system by pointing to and manipulating symbols on the screen.

You start a session with the Lisa by turning on the hard disc and inserting a floppy diskette into one of the drives in the main unit. The hard disc takes several seconds to get up to operating speed and check itself out. Like most hard disc drives used with micros, it has a non-removable disc permanently mounted inside it, so some discipline over keeping back-up floppies is advisable.

Turning on the main unit causes the system to carry out a series of diagnostic tests, displaying a set of graphic symbols to show how the system checks out. Then the hard disc clacks, and after a delay puts up a screen representing the Lisa desk top as you left it when you last switched off. This process can take anything up to a minute.

It is easy to print out an exact dump of

(continued on page 94)

Figure 1. The screen looks something like this when you first start the system up. The grey area represents a desk top, with a number of graphic symbols called icons scattered on it.

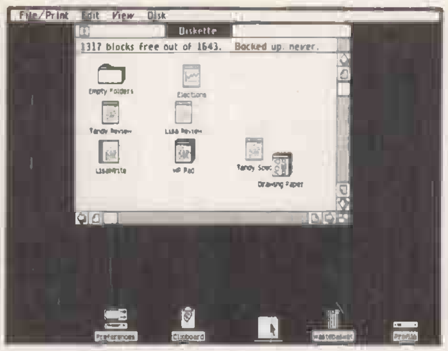


Figure 2. Moving the pointer over the diskette icon with the mouse and clicking it opens up the diskette icon into a window revealing what is on the diskette.

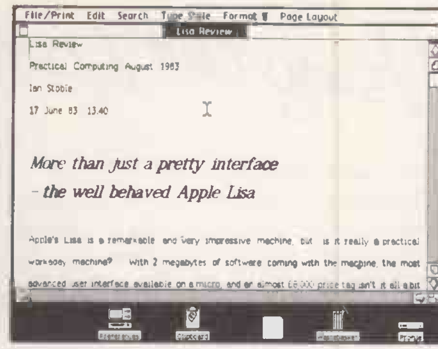


Figure 3. The Lisa Review document stored on the diskette has been opened by moving the pointer over the Lisa Review item and clicking the mouse button. Opening the Lisa Review window automatically loads the document into memory and brings the word-processing software into operation without the user having to issue any conventional operating system commands.

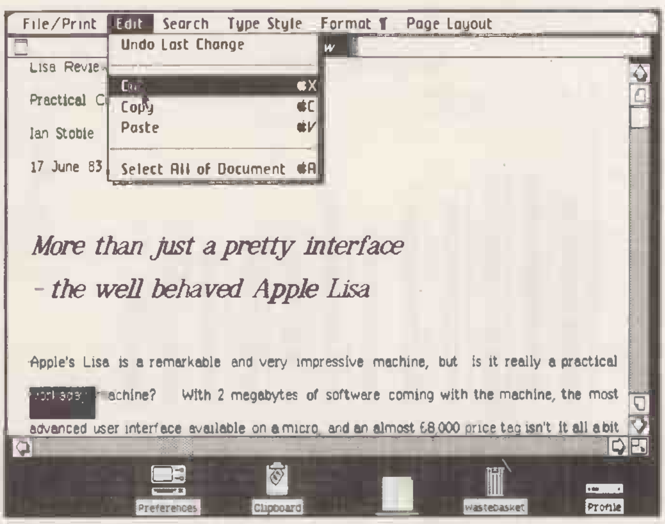


Figure 4. The words along the top of the screen are menu titles. When pointed to, the menu pops down and commands can be chosen to act on selected portions of the text. Here the word "workaday" Is being cut from the document.

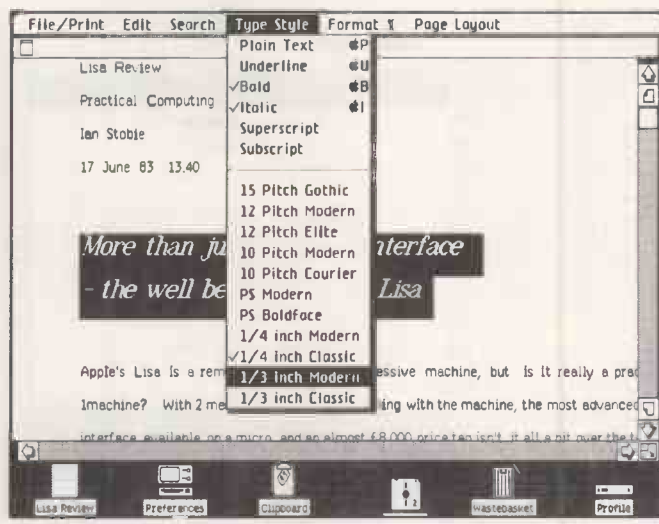


Figure 5. The Type Style menu provides a wide variety of typefaces for use with the dot-matrix printer. The ticks show the present style of the selected, highlighted, text. Any other style can be selected simply, using the mouse to highlight it.

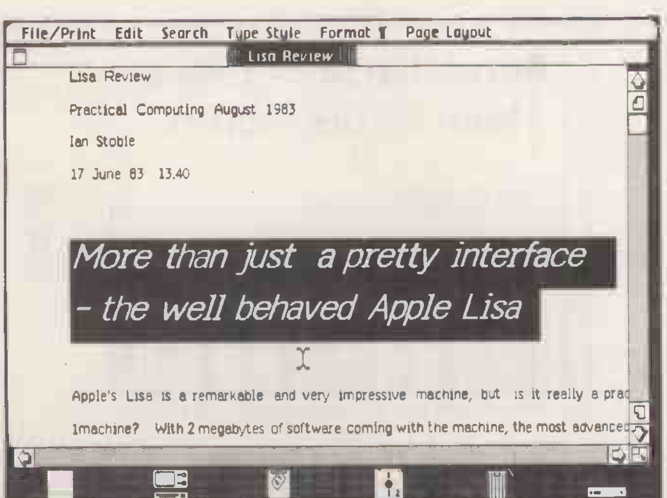


Figure 6. The highlighted text has been changed from italic, bold 1/4 Classic to italic, bold 1/3 inch Modern. The change occurs instantly. As you release the mouse button the menu pops up out of the way to reveal the new style.

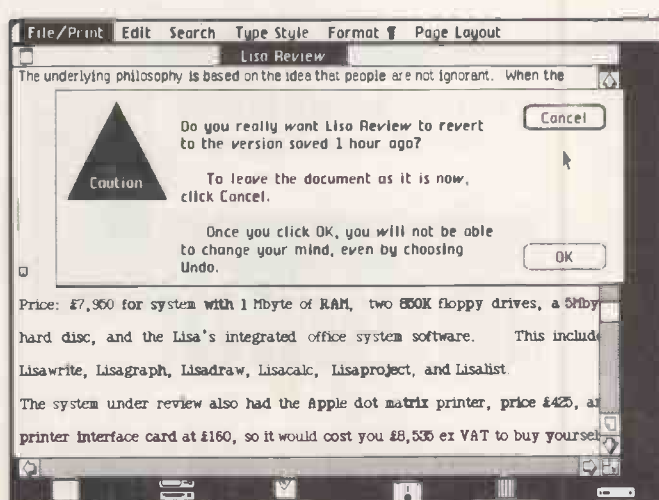


Figure 7. Lisa help and error messages are displayed in a large box across whatever you are doing on the desk top. They are very intelligent. Here the system is responding to an order to abandon an edit by checking if you really want to revert to a previous version, using the clock to jog your memory.

Using the Lisa

(continued from previous page)

whatever is on the screen on the dot-matrix printer, so we have been able to illustrate many of the points I am discussing. The grey area on the screen represents a desk top, with a number of graphic symbols called icons scattered on it. The desk top shown in figure 1 is fairly empty, because I left it tidy before switching the machine off at the end of the previous session.

The icons represent various things in the Lisa system, including physical storage devices like the diskette and hard disc, information like the system preferences currently set, tools like the Lisawrite word processor, and documents and folders. Within the Lisa system all these things are handled within the terms of a consistent metaphor of the desk top.

The underlying philosophy here is that people are not ignorant. When they come to a computer system for the first time they bring with them all the learning and experience from other areas of their lives. If a computer system can be made to resemble something people already know then they will already know a lot about how to use it. The tool for making such computer systems is metaphor — hence the Lisa desk top.

The arrow pointer is what moves as you move the mouse around your real desk top. Moving the pointer over the diskette icon and clicking the button on top of the mouse opens up the diskette icon into a window. This reveals what is on the diskette, again represented as a set of icons. In figure 2 I have documents called Tandy Review, Tandy Spec and Lisa Review on my diskette, plus some other things. Word-processing documents are represented by icons which resemble writing paper, while my graph file of general-election results is on graph paper. The diskette also contains a pad of drawing paper and a pad of writing paper, as well as some folders to file things away in.

To start word processing a document all you have to do is open it, again using the mouse. Opening the Lisa Review document, for example, automatically loads the right document into memory and brings the word-processing software into operation without any conventional operating-system commands being necessary.

The Lisa is very consistent. The window into the Lisa Review document is very similar in format to any other Lisa window. The title appears along the top, and a border contains various control boxes

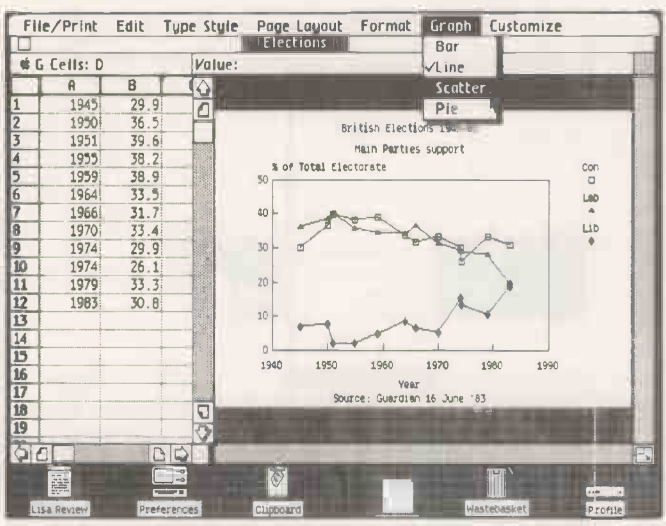


Figure 8. Lisagraph paper is for preparing graphs. As values are typed into the table the graph is automatically changed and redrawn. Data can be displayed in several different ways, selected from the pull-down graph menu.

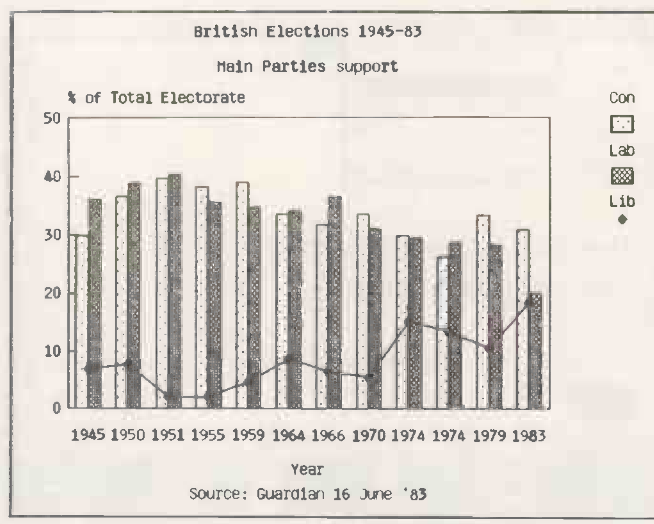


Figure 9. The graph is printed out by selecting the appropriate option from the file/print menu. Since you can try out different format charts easily you can usually find a clear way of bringing out the point you wish to make with your data.

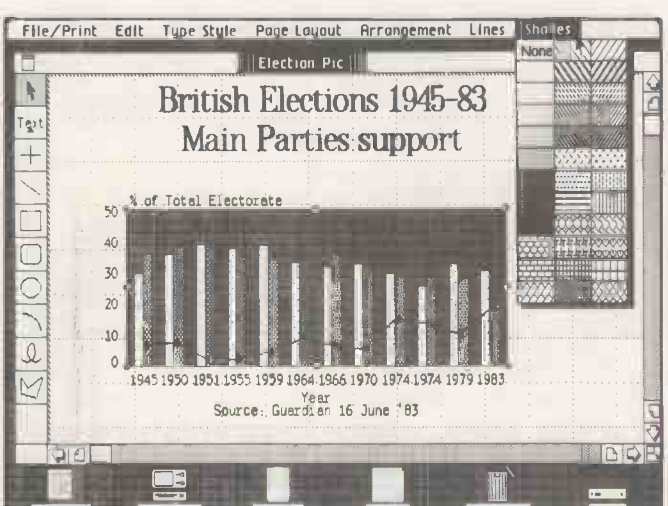


Figure 10. The election graph can be further beautified by transferring it via the clipboard to Lisadraw paper, where all the drawing tools can be put to work on it. The symbols down the left-hand side represent different ways of using the mouse to draw.

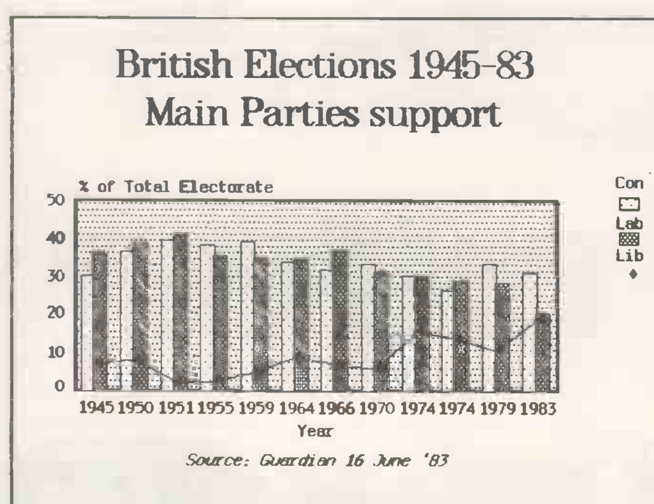


Figure 11. The finished graph as printed out. Lisadraw has been used to move words, change type styles, thicken lines and add shading.

which allow you to control what you are viewing. The arrow boxes, for example, are used for scrolling. To move the document up one line you simply move the pointer over the appropriate arrow and click once. Two clicks move it two lines, and so on.

The page boxes next to the up and down arrows move you around a page at a time. You can also move the whole window, by pointing to the top left corner and holding the button down as you move the mouse, or shrink the window using the control box at the bottom right. It may sound complex, but you rapidly get the hang of working this way. The mouse system is like driving a car: you look at the road, not your hands on the wheel, yet you are still capable of very precise control. With the mouse you just look at the screen, and your actions become accurate and automatic within a couple of days.

The words along the top of the screen are menu titles. When you point to one of them a menu pops down, and commands can be chosen to act on selected portions of the text. You select the text you want to act on beforehand, by dragging the pointer through it with the mouse button held down. In figure 4 the word "workaday" is being cut from the document.

For the first few days the Lisa is very exhilarating to use. Not much work gets done, as it is such a fine toy to play with. But once the novelty wears off this becomes less of a problem, and it becomes just another office tool, albeit one which makes everything else seem very dull.

An abiding problem is the Lisa's response time. It may be that the development version of the software on the system we were provided with is slower than the eventual release, as it still contains diagnostic code. Loading a document could take five or six seconds, saving up to half a minute. The Lisa is doing a lot of processing to support its nice user interface.

Lisadraw documents were generally the slowest, even from the hard disc, with many disc accesses necessary to bring up a simple drawing. Once a graph, drawing or document was in memory there were few delays, but I couldn't help feeling that the Lisa, with its 1Mbyte of RAM, would be a better machine with 5Mbyte of RAM instead of, or as well as, a hard disc. Lisa's 68000 processor is capable of addressing up to 16Mbyte, so this enhancement is a real possibility at some future date. Lisa represents the current state of the art, but how easily we are spoiled.

Specification

System includes: 1 Mbyte of RAM, two 850K floppy drives, a 5Mbyte hard disc, and the Lisa's integrated office system software.

Standard Software: Lisawrite, Lisagraph, Lisadraw, Lisacalc, Lisaproject and Lisalist.

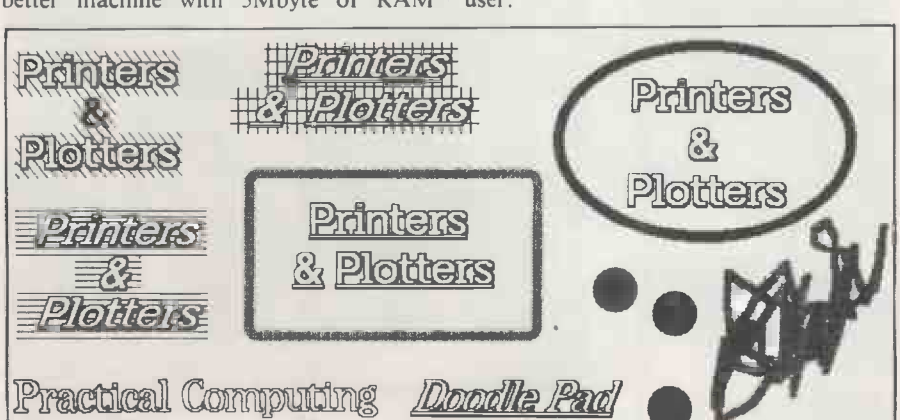
Price: £7,950.

U.K. Distributor: Apple Computer (U.K.) Ltd, Eastman Way, Hemel Hempstead, Hertfordshire, HP2 7HQ. Telephone: (0442) 60244. Lisas will be available in volume in August.

The system under review also had the Apple dot-matrix printer, price £425, and printer interface card at £160. A daisywheel printer is available from Apple at £1,350.

I did not like the mini-floppies These double-sided 5.25in. discs are of an unusual design, with two slots cut in them instead of the usual one. Apple says this was done to make them more reliable, as the conventional arrangement for double-sided disc drives has two read/write heads pressing against the disc from opposite sides, and unequal pressure can distort the recording medium. The problem with the Apple solution is that it is easy to get your fingers all over the recording surface, which introduces dirt as another possible source of disc failure. What Apple has gained on the high-technology roundabout it has immediately lost on the human swings. It would help if the new format discs had the outer cover in a contrasting colour to the recording surface.

The Lisa encourages spontaneous methods of work because all the tools are to hand. As well as the features I have been using it includes the Lisacalc spreadsheet, Lisalist database and Lisaproject scheduling tool. It is rather like VisiCalc written very large — you can try things out and then undo them. Since this is true of all the Lisa applications, not just the spreadsheet, there is a major gain for the user.



Some examples of printed output from Lisadraw.

Lisa is supposed to be a completely integrated environment, with data readily transferable between the different Lisa tools. yet I found there were things I expected to be able to do but could not. I was able to transfer a graph prepared on Lisagraph paper across to Lisadraw paper for further work, but I could not copy the same graph across to a Lisawrite document, where I actually wanted it. Instead I got a message on the screen, confirmed in the manual, that only text can be copied on to a text Lisawrite document. I hope this is a temporary limitation, as the whole design of the system leads you to expect you can do this. I checked with Apple and was told the initial August release of Lisawrite will only be able to accept data from Lisacalc.

I did have limited success in copying text from a Lisawrite document on to a piece of Lisadraw paper. The restriction here is the size and shape of the drawing paper. I kept getting messages that told me to keep text clear of the paper boundary, as the drawing tool has none of the wordwrap features found in Lisawrite.

Lisa has been criticised as overpriced, but the price is not as steep as it seems. If Apple were to sell the basic system with 1Mbyte of RAM and its two floppy drives for around £4,000, then charge for the 5Mbyte Profile hard disc and each of the application tools separately, it would not seem exceptionally expensive. Apple is probably right to bundle the prices together since the whole Lisa concept is to integrate all the software applications into a consistent user environment and hide the hardware behind a metaphor of a graphics desk top.

The main software development environment for the Lisa is to be based on Pascal. It will include an extensive library of routines to enable independent software writers to produce applications which interact with the user in a way consistent with the rest of the system. Cobol and Basic will also be available. None of these products was available for review.

Conclusions

- **The Lisa is a very impressive system. It is both powerful and easy to use.**
- **First-time users around the office were able to do some tasks very soon after coming across the machine.**
- **Response time could be improved. Even with the hard disc, loading and saving some types of data took too long for what is meant to be the ultimate user-friendly system.**
- **The three applications reviewed — Lisawrite, Lisagraph and Lisadraw — are all powerful and easy to use.**
- **The Lisa is a true personal computer; it makes computing power directly available to the individual user with as little fuss as possible.**
- **Not everyone wants or can afford the Lisa, but the ideas behind it are already reshaping the way people expect computer systems to behave.**

TANDY 100

A computer which will be there when you need it most, tested by Ian Stobie.

TANDY'S MODEL 100 is a battery-powered portable computer with a proper full-size keyboard and liquid-crystal display. By current standards of LCD technology the display is very large: it can show eight lines of 40 characters. The other distinctive thing about the Model 100 is that it comes with an unusually large amount of software in ROM, and includes a Microsoft-written text editor in addition to Basic.

The Model 100 looks a bit like the Epson HX-20 portable, the obvious machine to compare it with. The Model 100 ranges in price from just under £500 including VAT, for the minimum configuration with 8K RAM to £730 for a 32K RAM system. The Tandy is therefore slightly more expensive than the Epson, which costs £462 for a 16K machine, but then big LCD arrays are not cheap.

The Tandy is the slightly lighter machine, weighing just under 4lb, but both computers fit a full-size, full-travel keyboard on to a roughly A4 size package. Tandy has opted for the super-large display which occupies the whole of the top part of its machine above the keyboard, in the space where Epson fits its smaller four-line by 20-character display, on-board mini-printer and optional micro cassette drive. With the Tandy machine you use an external printer and an ordinary external cassette recorder.

The large display and text-editing software makes the Tandy an obvious candidate for use as a portable word-processor. The Model 100 has an RS-232C interface as standard and built-in communications software. It should be possible to download files on to other machines for more sophisticated word processing.

It is probably fair to say that Tandy products do not have an outstanding reputation for finish, but the Model 100 is built for Tandy by Kyocera in Japan. It is very well made and generally pleasant to handle. The casing is made of strong plastic in off-white and black.

The keys themselves and the screen surround are black. To the right of the screen is the Tandy Radio Shack logo, incorporating the TRS-80 legend which seems to be becoming like Heinz's 57 varieties as an intrinsically meaningless badge of corporate identity.

Just below the badge is the battery-low indicator. When it lights up you have roughly 20 minutes of battery power left. A panel underneath the machine pulls off to reveal four AA batteries. They can be

Turning on the machine brings up the main menu, including date and time.

changed without losing the contents of memory because the Model 100 has a second set of rechargeable NiCad cells hidden away inside. The first thing the Model 100 does when a new set of AA batteries is installed is top up this reserve power source.

When you exhaust your main batteries the warning light goes on, and about 20 minutes later the machine stops functioning. The reserve NiCads give you at least a further eight days with memory preserved intact to fit some new ones, according to Tandy. The Model 100 is fitted with a 6V DC socket on the side so you can run it off an optional mains adaptor, cost £8, if you prefer.

A quick look round the outside of the machine shows that it is well provided with connections to the world, as befits a portable machine. As well as the RS-232C communications interface there is a parallel printer port and a DIN-style socket for connecting to a domestic audio cassette recorder. There is also a bar-code reader connector of the HP pattern, indicating that this is a machine designed with business as well as purely personal use in mind.

Next to the cassette socket is a closed-off hole in the casing which on U.S. machines has a direct-connect telephone Modem socket. Unfortunately this is not available in the U.K., and the circuitry to support it has been removed. One day British Telecom may give approval to this type of device, but Tandy does not seem to want anyone to jump the gun.

Underneath the machine a second panel pulls off to reveal a ROM socket and a 40-pin external bus connector. The ROM socket will take a 32K module which will switch the existing 32K of ROM out of the Model 100's 64K address space when installed, so it looks ideal for customising the Model 100 for special-purpose applications.

Turning the machine on brings up the main menu. Next to the On-Off switch at the right side of the Model 100 is a knurled wheel, which can be used to aim the display electronically to suit your viewing angle. It provides excellent contrast. Liquid-crystal displays are much less tiring to look at than TV-type cathode-ray tubes, so let's hope the technology continues to advance. Epson has recently demonstrated a pocket TV with flat, colour LCD screen, so clearly there is plenty of research going on.

The T-100 represents the current state of the display art in reasonably inexpensive consumer products. Each character is made up on a seven-by-five matrix of dots, lower-case letters having a one-dot descender. For graphics any of the screen's 15,000-plus dots can be individually addressed, giving 64-by-240 dot graphics.

The main menu shows the current date and time — which updates every second as you watch it — and the amount of memory free to the user. It stands at 21,446 bytes free on the 24K model if you have no files of your own in memory, 5,062 bytes on the 8K model.

The menu also shows a directory of all the files in memory, both yours in RAM and the ones the system comes with in ROM. They are:

- Basic,
- Text, the text editor,
- Schedl, the appointment scheduler,
- Address, the address list program,
- Telcom, used with the RS-232C for computer-to-computer communications.

There are 19 free slots for your own files, which can be Basic programs, text files or machine-language files.

You select from the menu by typing the name you want, or more rapidly by moving the cursor over the appropriate file name. The four cursor-control keys are on the right of the row of special keys positioned just under the display.

The keyboard has a very nice feel to it. For fast typing I prefer the Model 100 to the Epson, which also has a very good quality keyboard. The Tandy layout is closer to what appears to be the emerging standard, recognisable by the large Enter key. The numeric shift key to the right of the keyboard redefines the U,I,O,J,K,L and M keys to give numbers so that you have, in effect, a numeric keypad in the middle of the keyboard when you want it. The Graphics Shift key gives you access to 39 special graphics characters, and a set of block graphics characters can be reached with the ordinary Shift key.

The editor, called Text, is a simple but useful word-processing program. You can enter, alter, move, duplicate or delete blocks of text with it, storing the finished product in RAM or on tape, or sending it to an external printer. Text makes extensive use of the function keys F1 to F8. Hitting the key marked Label brings up on the bottom line of the display definitions of what the function keys do — Find, Load, Save, Copy, Cut, Select and Menu.

To move a block of text you position the cursor at the start, hit the Select function key, move the cursor through the text, which highlights it, and then hit the Cut key. The text disappears, but if you then move the cursor to the new position and hit the Paste key it reappears in its new location.

Text is quite a handy piece of software. You can enter any printer control code easily, and can also use it to edit Basic programs as well as ordinary documents.

(continued on next page)

Benchmarks

The table shows the time in seconds to run eight standard Basic routines. The benchmark routines test out various typical tasks, each repeating an appropriate set of Basic statements 1,000 times.

	1	2	3	4	5	6	7	8	Av
Tandy Model 100	4.8	10.1	26.7	29.7	31.4	47.5	63.6	323.0	67.1
HP-75C	2.5	4.4	21.0	21.0	23.0	39.0	56.0	130.0	37.1
Epson HX-20	2.6	15.2	33.4	33.2	35.2	59.6	101.0	132.0	51.5
Sharp PC-1500	15	70	121	122	178	293	383	510	211.5
IBM PC	1.2	4.8	11.7	12.2	13.4	23.3	37.4	31.0	16.9

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The package lives in ROM and is therefore always available with the minimum of delay, which encourages spontaneous memo writing. Obviously there are limitations compared to a disc-based word processor: you cannot do find-and-replace operations and, more seriously, you cannot have double or triple line spacing.

Schedl is a simple notebook program that lets you find messages you have written to yourself by time, date or content. The program operates on a Note file you create with Text, carefully observing the required format. When using Schedl to find messages you can search either by entering a time, date or character string, or by browsing through the file. You may have only one Note file in memory and Schedl makes no use of the built-in calendar clock, so it is a very limited program, but still useful. Hewlett-Packard's HP-75C probably remains unchallenged as the portable machine with the most powerful general diary and scheduling features built in.

Address works in a similar way to Schedl, with a text file you have to set up called Adrs. Again it is very simple, but it lets you find addresses and phone numbers easily. Because both programs reside in ROM, with their files in RAM, they are rather more useful than they sound because everything happens quickly. You simply turn the machine on, select the appropriate new option, hit a function key and type in your search string.

Telcom lets you use the Model 100 to send and receive information from another computer system. Although the U.K. model does not have the built-in telephone Modem it does have the RS-232C, so the Model 100 can be used with similarly equipped TRS-80 computers and other machines with the right interface and software — perhaps via an acoustic-coupling Modem. Text files can be transferred to a Tandy Model II and edited with Scripsit, for example.

Once you have selected Telcom from the menu you can configure the RS-232C in various ways, setting a baud rate in the range 92 to 19,200 and specifying word length, parity and stop bits. Hitting function key 4 puts you into terminal mode, where you can transfer incoming data into a standard Model 100 RAM file, echo it to an external printer, or transmit your own data.

The Model 100's Basis is a very full version similar to Microsoft's other recent Basics. The maximum numeric precision it can handle allows you numbers with exponents ranging from −64 to +62, displaying them with up to 14 significant digits. The Basic includes Print Using for business-like output formatting and On Error and On Time$ Goto statements.

The specific Model 100 hardware is generally well complemented by the Basic.

Four AA batteries power the Tandy 100, with rechargeable back-up to maintain RAM.

The LCD screen is well supported with PSet, PReset and Line commands. The Line command even boasts a box fill parameter, so for instance

LINE (3,3) – (30,40),1,BF

produces a dark rectangle at the appropriate place on the screen. The sound command includes pitch and duration parameters.

An unusual and impressive Basic statement is the On Key Gosub, which is followed by a list of line numbers. Hitting one of the eight function keys while your program is running will cause a branch to the appropriate Basic routine from the list of line numbers. This powerful feature is only really possible because the Model 100 is built around a chip with good interrupt-handling features — the 80C85, which is the low power-consumption version of he 8085, itself an evolved member of the eight-bit 8080 family.

Benchmark tests show the Basic to be quite fast, considering it is running on a CMOS machine. Although the Epson HX-20 has a better average figure, on most of the benchmark routines the Tandy was a little quicker, the average being brought down by slower trignometric functions.

The documentation to describe all these features is good. The system comes with two manuals, a comprehensive 200-page spiral-bound A4 book and a pocket-size 50-page reference guide. The larger book describes setting up and using the applications programs in a simple way, and then goes off into a detailed reference section on the Basic, followed by technical appendices. The reference guide is very clear. All that is missing is a tutorial guide to Basic, but possibly books for other Tandy machines with similar versions of the language would fulfil this need adequately.

Battery-powered portable machines are clearly becoming powerful enough to attract a whole range of users. Tandy's other portable, the PC-2, is an excellent machine which is better known in the U.K. as the Sharp PC-1500. The Model 100 may at some stage appear on the market through another channel under another brand name in a similar way.

Specification

CPU: 80C85, eight-bit CMOS 8085 look-alike, running at 2.4MHz
ROM: 32K containing Microsoft-written Basic, text editor, address list, appointment scheduler and communications software
RAM: 8K expandable to 32K
Size: 300 by 215 by 51mm.
Weight: 1.36kg.
Power source: Four AA batteries or equivalent, or 6V DC. Internal NiCad back-up batteries are fitted as standard, AC adaptor is optional extra
Display: eight-line by 40-character liquid crystal, measuring 194 × 53mm. Each dot of the display is individually addressable, giving 64-by-240 dot graphics
Keyboard: full-size QWERTY layout, full-travel keys; eight programmable function keys and eight other special keys
Manufacturer: Kyocera, Japan for Tandy Corporation
U.K. price: (inc VAT): £499 for 8K version, £649 for 24K version, £80 for 8K RAM upgrade kit
U.K. distributor: Tandy Corporation, Tameway Tower, Bridge Street, Walsall, West Midlands WS1 1LA. Telephone: (0922) 648181

Conclusions

● Battery-powered portables are becoming increasingly powerful and useful. The Model 100 with its very large eight-line by 40-character display and excellent keyboard marks the latest step forward.

● Tandy machines have not always been renowned for finish, but the Japanese-made Model 100 is generally well built and finished.

● Tandy is likely to sell the machine as an out-and-out home machine and as a personal machine for professionals. In both roles it should do well.

● The Model 100 will only be available from Tandy and Radio Shack stores, not from specialist computer dealers. This probably gives the Epson HX-20 the edge in high-volume fleet sales to large companies with special-purpose software added on.

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IF YOU WATCHED *Making the Most of the Micro* on BBC TV you will already have seen the BBC Buggy demonstrating the principles of computer control.

The Buggy was designed by Mike Bostock, Technology Manager of the Newcastle-based Microcomputers in Education Project. Its body is a 5in. cube made from Fischer Technic parts, and it is driven by two independently controlled stepper motors. It is controlled by signals from on-board sensors and by programs run on the BBC Micro Model B. Production models of the Buggy are not yet on sale — the projected price is £165.

The sensors include two microswitch collision detectors operated by a split plastic bumper. They are intended for detecting obstacles, though quite a lot of pressure is required to operate the bumpers because of the resistance of the plastic hinges.

There is a light detector, and an infrared transceiver similar to the device used in supermarket bar-code readers, which can be used to follow black or white lines. It protrudes in front of the bumpers and is therefore quite likely to hit obstacles before they do. The sensor has obviously been mounted to make it easy to adjust its height, but it is a point on which the design could be improved. The Buggy is equipped with a pen-up, pen-down mechanism, which allows it to hold a pen and trace its route.

The control circuitry is contained on two printed-circuit boards. One is on the top of the Buggy itself, and collects the input signals from the sensors and distributes power to the stepper motors. It is connected by a long 16-wire ribbon cable to the second board, which is in turn connected to the power outlet, user port and analogue port of the BBC Micro. It can be mounted in a rack but may conveniently be taped to the top of the BBC Micro with the cables tucked away beneath it. An eight-LED display shows the signals being sent out or received from the Buggy.

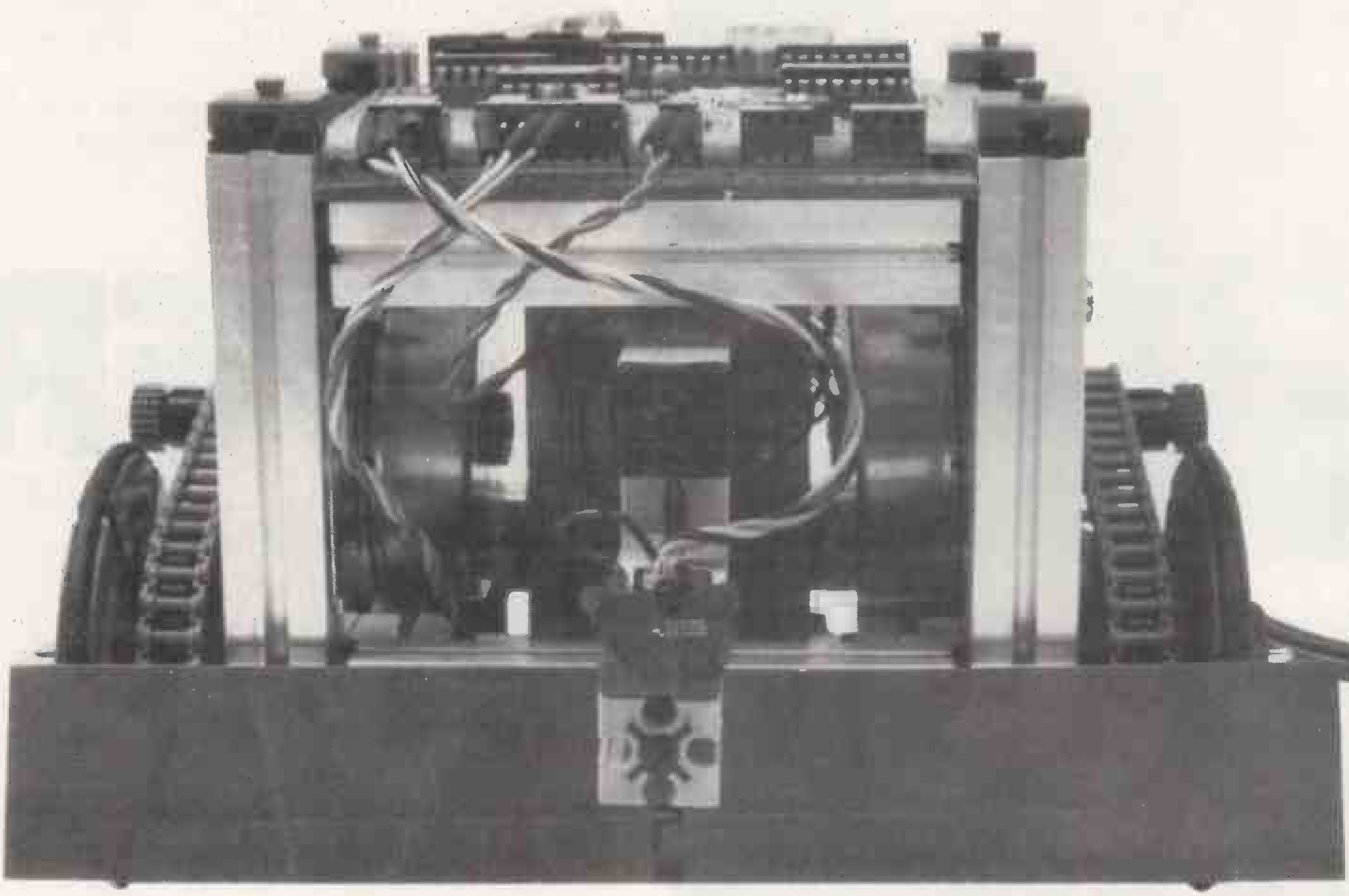
The Buggy has been constructed from readily available parts, so it should be easy to replace those lost or damaged. The whole device has been designed in a modular fashion and is easy to take apart, add to or rebuild in new configurations.

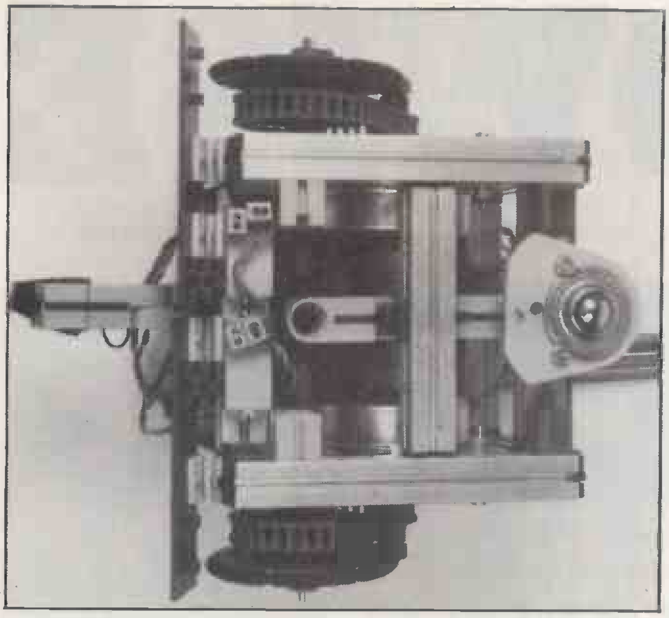
The machine is to be sold together with 13 programs, which are all easy to use if rather simple. They are intended to show you how the Buggy is used and to encourage experimentation with the Buggy. The test program checks that the Buggy is set up correctly and that all the sensors work. It may also be used to set the height of the bar-code reader, which has to be adjusted so that the value displayed by the program changes significantly when the Buggy is lowered on to a white background.

A simple program called Switch shows how to program the Buggy in Basic. You drive the Buggy using the arrow keys. If its motors are both turning in the same direction the Buggy moves either forwards or backwards. Turning the motors in opposite directions makes the Buggy spin on its axis. The prototype system seemed to have been wired incorrectly: pressing the Left Arrow key sent it turning to the right and vice versa.

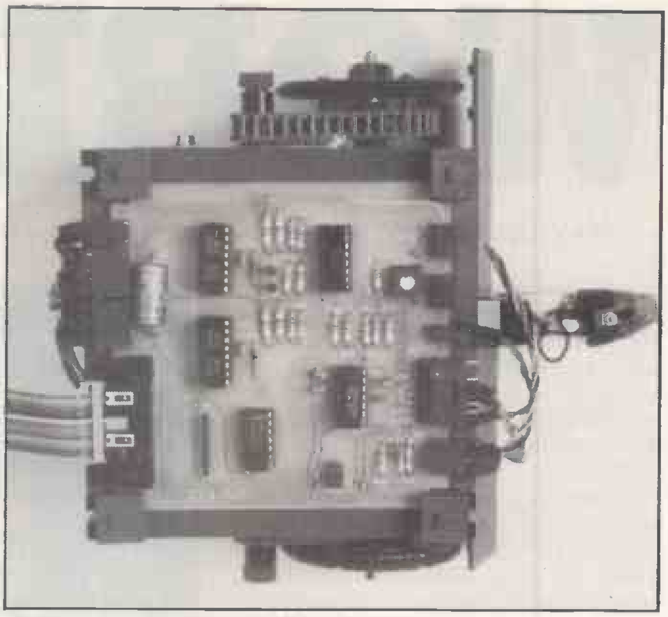
BBC BUGGY

David Watt is on the move with a computer-controlled trolley to interface with the BBC Micro, and the software to run it.

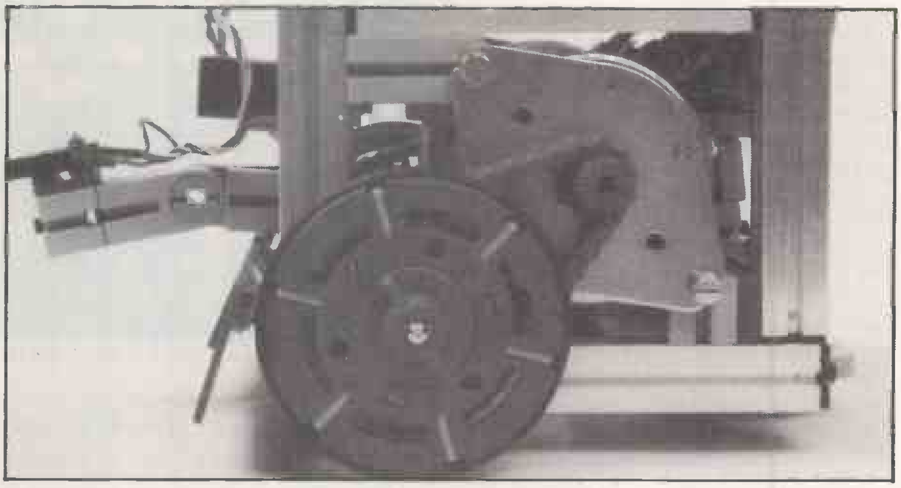




The wheels are driven independently by stepper motors.



An exposed circuit board sits on top of the Buggy itself.



A light detector, similar to a bar-code reader, protrudes beyond the front bumpers.

The program Memory Switch is very similar to Switch, except that it records the route the Buggy follows. You can instruct it to return home and then retrace the route, or follow a new route. The program demonstrates the accuracy of the stepper motors: I sent the Buggy on a route about two metres long, marked the final position, returned to the original start position and retraced the route. At the end of this sequence the Buggy was about 25mm. from the position I had marked. If you want to draw a map of the Buggy's route on the screen as it is driven around you can use the Recorder program to do so.

A program called Snail is used to prepare a series of coded instructions to drive the Buggy. For example,

L20, F10, R90

means left 20 degrees, forward 10cm. right 90 degrees. The route is then mapped on the screen as in Recorder. By using Route Planner you can plot the route on the screen first, then instruct the Buggy to follow it.

The program called Explore for Object is supposed to demonstrate some of the principles of artificial intelligence. The Buggy is programmed to use the collision detectors to locate an object and work out its size and shape. Its shape is then displayed on the screen. The object has to be firmly fixed or the Buggy is likely to push it out of position. There also is a tendency for the Buggy to slip when it hits the object because of the resistence of the bumper hinges. The bar-code reader has to be moved out of the way of the bumpers for this program. A similar program called Explore for Wall determines the size of the area in which the Buggy is placed.

According to the rather primitive documentation supplied, Sunseeker is supposed to direct the Buggy to seek out a light source, negotiating objects in the way. When I used it, the Buggy just turned in a circle until it located the direction of the brightest light; it made no attempt to negotiate any obstacles or to look for a brighter source. Man Versus Buggy is similar, but here information is displayed on the screen and you may control the Buggy with the arrow keys. The idea is to see how well you can do compared to the Sunkseeker program.

The Line Follower program was demonstrated on the TV show. It uses the bar-code reader to follow either a black line on white background or white line on black background. John Williams of Economatics, the company supplying the Buggy, advised me that the Buggy was best at following a line of black electrician's tape on a white Melamine board.

Two programs, Barplan and Tin Pan Alley, are designed to use the infrared detector to read special bar-coded cards, which were not supplied with the review Buggy. A set of cards should be included in the package when the machine goes on sale.

There were some problems with the software control of the motors. Beside the Left and Right Arrow keys being interpreted the wrong way round, pressing two keys at the same time made the Buggy vibrate back and forth without going anywhere. The stepper motors tended to heat up after a time, though I understand the software is being adapted to switch off the motors when they are not in use.

Conclusions

- **The Buggy should be attractive to schools, laboratories, universities and home enthusiasts. It is a splendid teaching aid and experimental device, particularly as it is so easy to build into different configurations.**
- **It might be built in different configurations for use in some light-engineering applications, for control of certain types of laboratory experiments or for developing aids for the physically handicapped.**
- **The circuit boards should be enclosed in plastic cases. At present the complex circuits are exposed to spilt coffee and similar environmental hazards.**
- **The proposed price for the Buggy is £165, which should keep it within reach of those people who have a definite use, whether educational or experimental.**

WORDWISE

Neville Maude wonders whether this BBC word processor lives up to its name.

WORDWISE was the first ROM-based word processor to be announced for the BBC Micro. I ordered mine back in July 1982 but, as with all ROM-based BBC software, a series 1.0 or subsequent operating system is required; waiting for Acorn to deliver it is like waiting for Godot.

In the fullness of time, series 1.2 operating systems appeared and paged or "sideways" ROMs could be used. Plug-in ROMs are an excellent way of providing word-processor facilities on computers. Tapes take time to load and good ones swallow large amounts of precious memory.

Inserting the ROM is simple. Most people will want the machine to cold-start into Basic, so the Basic chip goes into the right-hand socket. The Wordwise ROM goes into any of the remaining four sockets and is selected simply by typing

*WORDWISE

or, in practice

*W

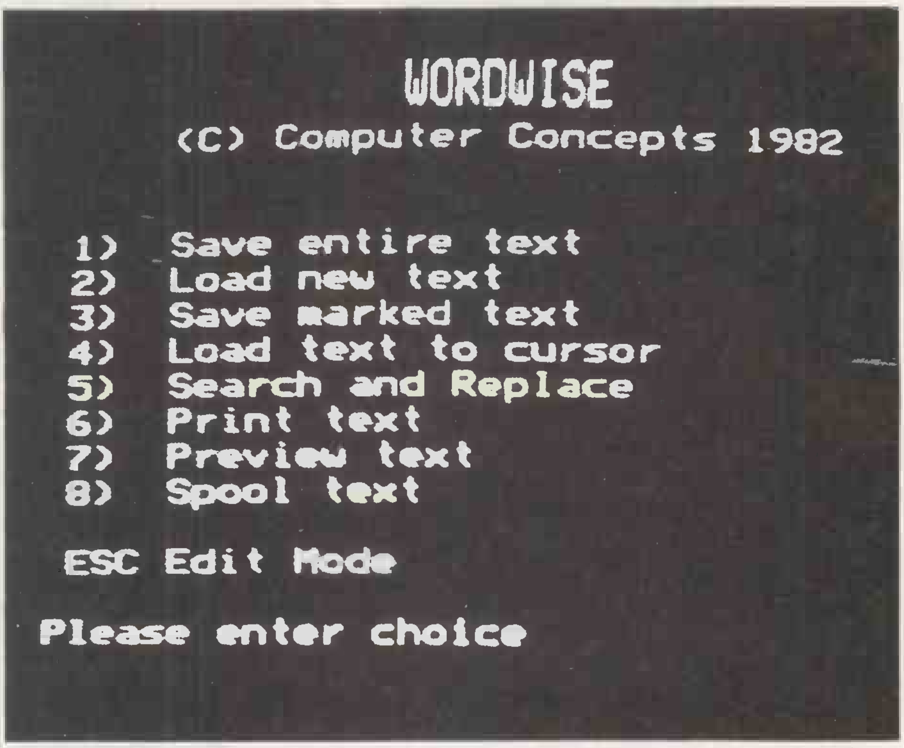
The system is then up and running.

At any time you can go back into Basic and out again without losing any entered text. When in the main Menu mode, typing * passes the subsequent line to the operating system so commands such as * Cat, * Tape or * Disc can be entered without even going into Basic.

Wordwise first asks if there is any old text in memory. If not, the title page or menu appears with eight options. Options 1 and 3 save text on to disc or cassette, either in total or in marked sections. Option 2 loads text previously saved, and 4 loads text at a point indicated by the cursor, which can be anywhere, even in the middle of a word.

Option 5 is an editing facility giving a global or selective search for specified text items to be replaced. For example, it could search through an entire article for a name such as Barbara and either replace it with, say, "Mrs Smith" everywhere or ask if it should replace at each occurrence. This powerful tool can also be used in editing Basic or other programs.

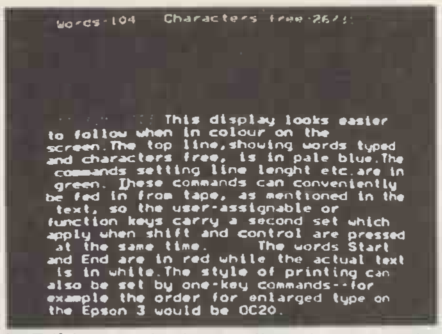
Menu option 6 sends text to the printer. Option 7 displays the text in its formatted form. It uses an 80-column screen, mode 3, if enough memory remains unused or 40-column mode otherwise. Normal memory capacity is 27,378 characters but for 80-column display 16,000 must remain unused. Acorn's ROM-based view is similar in this respect. However, even in 40-column code it is easy to see where the page ends and so check the format.



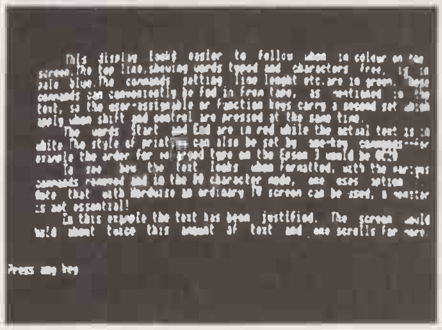
Wordwise first asks if there is any old text in memory; if not the menu appears with eight options.

Table 1. Wordwise embedded commands.

Command	Range	Default	Function
LMn	0 to 150	5	Left margin
LLn	10 to 200	70	Line length
INn	0 to LL-10	0	Indent
TIn	0 to LL-10	0	Temporary indent
CI			Cancels all indents
PLn	10 to 200	66	Number of lines per page
TSn	0 to 50	7	Top space
DHn	1 line		Define heading
HPn	0 to TS	3	Heading position
BSn	0 to 50	7	Bottom space
DFn	1 line		Define footing
FPn	0 to BS	3	Footing position
JO		On	Justification on
NJ		Off	No justification
LSn	1 to 50	1	Line spacing
SS		1	Single spacing
CEn	1 to 200	1	Centre lines
OCn, n,	0 to 255		Output control code
SPn	0 to 200	0	Space — number of blank lines
CO		On	Continuous output, no paging
EP		Off	Enable paging
BP			Begin new page
PNn	0 to 1999	1	Set page number
CPn	0 to PL		Conditional new page
DPn	0 to 255	96	Define pound sign
PCc	! to z		Define pad character
DTn, n,	0 to 200	10, 20...	Define Tab stops
EM		Off	Enable paper message
DM		On	Disable paper message
PP	1 to 9999	PN	Print page number
GF"xxx"			Get file from tape or disc



In Editing mode the top line shows words typed and space left.



On a TV screen, 80-column mode is just readable.

Option 8 sends the formatted output to the filing system — it is different from option 1 in that it saves text unformatted with embedded commands. It could be used to send tapes of documents to people without a Wordwise system and could be used to send to a typing service for those without a printer.

Pressing Escape moves Wordwise into and out of Editing mode. The top line on the screen shows the number of words typed, followed by character space left. On the right is a letter I or O and Marker indication. If the top line is partly off the screen, move it down with the usual * TV255, 0. Keys have a fixed auto-repeat after the usual delay of about half a second.

The cursor is moved one character at a time by the arrow keys; in conjunction with the Ctrl key this becomes one unit, either a word horizontally or 23 lines, a page, vertically. Pressing Shift and an arrowed key moves it all the way to the end or start of the document. Delete works the usual way, while Ctrl-A deletes immediately above the cursor and Ctrl-D deletes the word and closes the gap. Ctrl-S changes the letter from upper to lower case and vice versa.

The BBC user-defined keys are used to expedite text control. Embedded commands, which control the text but are not printed, appear on the screen in green. With a monochrome monitor this becomes a light grey but is still easily distinguishable from text to be printed. A printed strip fitted under the clear plastic shows the various one-key commands. For example, f0 changes the cursor function from Insert to Overwrite, as shown by letters I or O. Pressing f1 starts an embedded command and f2 finishes it. So to start a new paragraph you could press f1, TI5, f2. TI5 stands for a five-character temporary indent on a new line. It appears in green with white text returning subsequently. Table 1 lists other commands.

At this point the user may appreciate how useful it is to have single-key commands but regret that the BBC Micro does not have another set of free user-definable keys to control the size and style of type used by the printer. In fact this is possible: the user-definable keys carry a second set of definitions, which are reached by pressing Shift and Ctrl at the same time.

Suppose you have an Epson 3 printer and wish to switch the condensed typeface on or off with the single-key commands. The appropriate commands in Basic for keys f1 and f2 would be

* KEY1¦!!OC15¦!"

and

* KEY2¦!!OC18¦!"

Similar lines could control other printer settings such as enlarged, emphasised, subscript or underlined text. Again a key could be used for a whole set of commands such as line and page lengths plus fixed margins and tabulation settings. These commands are saved on tape and fed in, perhaps with a preparatory * FX6, 0 to provide the auto line feed which the Epson needs and the BBC Micro otherwise suppresses by default.

Table 2. Editing commands.

Key	Function
f0	Insert overwrite
f1	Embedded command Start
f2	Embedded command End
f3	Marker
f4	Move cursor to specified character
f5	Word count to specified character
f6	Delete up to specified character
f7	Delete marked section
f8	Move marked section to cursor
f9	Copy marked section to cursor
Ctrl-A	Delete character at cursor
Ctrl-S	Swap case of character at cursor
Ctrl-D	Delete word at cursor
↑	Cursor up one line
→	Cursor right one character
↓	Cursor down one line
←	Cursor left one character
Ctrl-↑	Cursor up 23 lines
Ctrl-→	Cursor right one word
Ctrl-↓	Cursor down 23 lines
Ctrl-←	Cursor left one word
Shift-↑	Cursor to start of text
Shift-→	Cursor to last character on line
Shift-↓	Cursor to end of text
Shift-←	Cursor to first character on line
Delete	Delete character to left of cursor
Tab	Insert tab character
Esc	Swap between Edit and Menu mode

In practice Wordwise is easy to use and common sense solves the initial minor problems. For example, if the cursor refuses to move one character at a time, changing back to capitals from lower case restores that function; lower case makes the computer think that Shift is being pressed at the same time. If you are using the Epson with an unusual typeface, such as condensed superscript, the spacing may not conform with the formatted presentation. This is a characteristic of the printer, not the word processor, and in general this combination is admirable and any printer can be used.

There are a great many other useful commands including CE to centre lines automatically, PP for page numbering with automatic increments, JO for justification and Get to persuade the computer to print a file directly from tape or disc. There is also a word-counting command.

The maximum number of characters per line is 200. Though short of the 240 or so which most printers can handle with condensed type, it is an improvement on Acorn's View, which stops at 132. Wordwise permits immediate printout and so is much faster than View when cassettes are used. However, View offers very fast saving and loading with discs; it is the fact that text must be saved before it can be printed which slows it down for cassettes.

Computer Concepts utilised the delay imposed by the late arrival of a suitable operating system to improve the specification of Wordwise — and also to reduce the price. Since Computer Concepts is an honest firm, this price reduction was automatically credited to waiting customers, and in any case cheques were not cashed until the products were sent. Firms operating "forward financing" please note. In the mean time Acorn's View ROM appeared — see the review in the April issue of *Practical Computing*.

Wordwise costs £39 plus VAT and £1.50 for postage and packing, say £46 in all. Beebug has a special offer, for members only, of Wordwise plus the 1.2 system for £45 inclusive. The Wordwise package includes the ROM and fitting instructions, together with a 32-page ring-bound instruction book and an introductory cassette. The book is written in a clear and sensible manner.

Conclusions

- **Wordwise is simple to use, versatile and convenient. It is first-class value for money.**
- **It cannot access external files to produce standard letters, though they can be reproduced and changes made as required.**
- **It cannot handle documents longer than the RAM memory allows — about 4,000 words — but longer features could be produced in instalments.**

Two images for three dimensions

Dave Watson explains a technique for plotting data as a pair of maps which combine to form a stereoscopic image.

WEATHER MAPS, such as those seen every night on television, show patterns of isobars which interpret a set of individual pressure measurements. All too often the pattern circles round a low-pressure centre. The pattern indicates its position even though no measurement may have been made at that spot. Similarly, harbour and coastal soundings are used to develop nautical charts that display the extent of channels, anchorages and submerged reefs although each sounding itself is just a depth measurement.

In general, measurements made at particular locations are gathered on to a map of the area to display the lateral behaviour of the measured variable. Such a map is particularly useful when the sampled region is not visible, for example in oil fields where subterranean domes and other significant geological features can be revealed.

Several algorithms have been used to draw these maps automatically and some are readily implemented on microcomputers with graphics displays. The first step is to establish the spatial order among the measurements. This can be done by generating a triangular mesh on the set of data points in such a way that any measurement shares triangles with each of its immediate neighbours and any two adjacent measurements are linked by an edge.

The result is a set of triangular facets with various slopes, a sort of tent city. Then two simple operations, rotation and slicing, allow the data to be interpreted

Dave Watson is a specialist in spatial analysis and computer graphics; he is a research fellow at the Department of Geology and Geophysics, University of Sydney, Australia.

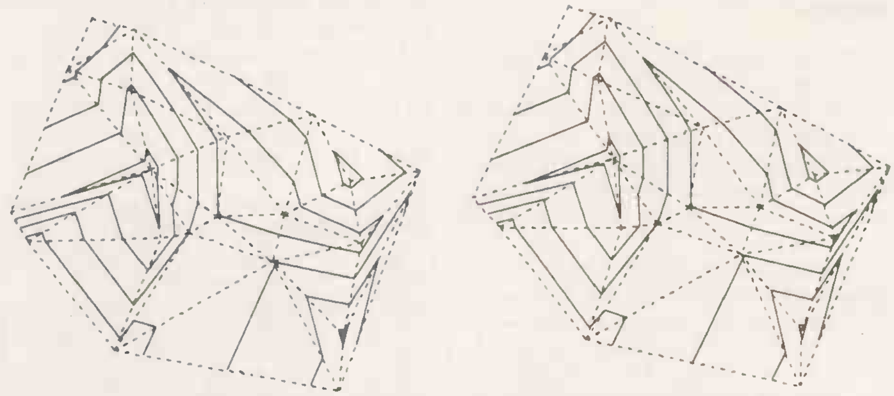


Figure 1. Stereogram of a triangulated data set with four intersecting planes viewed from directly above.

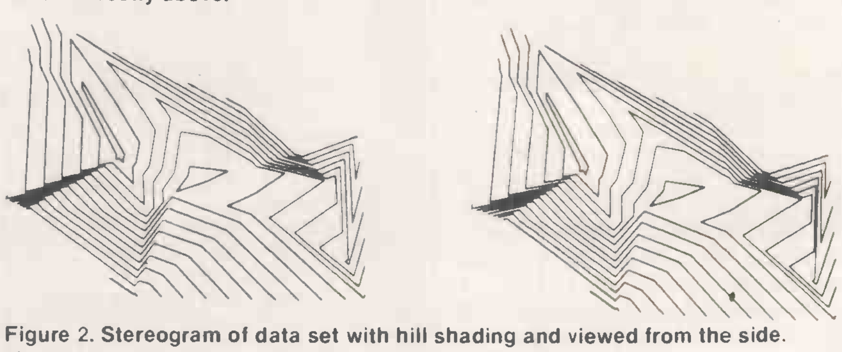


Figure 2. Stereogram of data set with hill shading and viewed from the side.

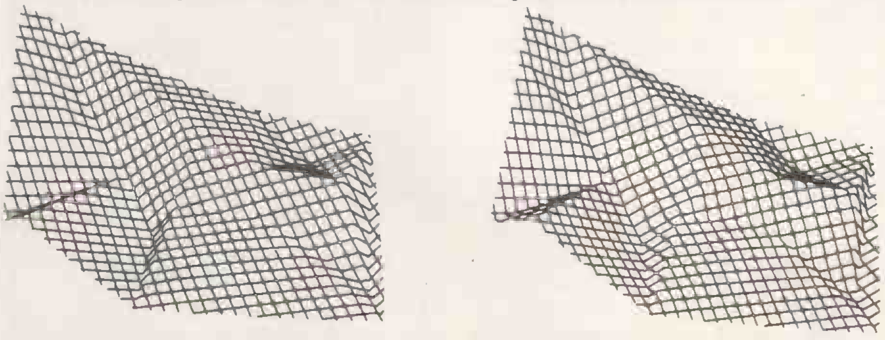


Figure 3. Stereogram with egg crating and perspective, viewed from the side.

and displayed in a simulated three-dimensional form.

A stereogram is a pair of pictures with slightly different viewpoints, one for each eye. To compute these two pictures the data set and its triangular facets are rolled slightly to the left and right.

To slice the data set you compute the intersection, if any, of each triangular facet with a horizontal plane. The traces of these intersections are, in effect, slices through the data set and you can observe these trace lines in three dimensions by presenting a separate picture to each eye. Figure 1 is a stereogram of a triangulated data set with four intersecting horizontal planes.

Stereograms can be viewed by allowing the eyes to cross slightly until three images appear. The central image will have a three-dimensional appearance. Although it takes some practice to perfect the technique the possibilities offered by a video terminal make the skill well worth acquiring.

Irregular surface

Random data from the random-number generator was used to produce this illustration. It is typical of the data set obtained when an irregular surface is sampled at several scattered locations. The facets of the triangulation are a planar reconstruction of the surface. The numbers drawn from the random-number generator all lie between 0 and 1 so the set of triangular facets lies within the unit square.

The Basic program that produces the stereogram is short and easily explained. The main part, line 260 to line 730, creates the triangulated network. The Delaunay triangulation is used because it provides a list of triangles that are as nearly equilateral as possible. The next steps are to slice and rotate. Horizontal slices through the triangulated data give contours or isolines because the intersection of these slices with the triangular facets trace out lines of equal altitude. This is done in lines 820 to 1010 where each slice has altitude R, as in line 890.

Any of the three rotations of the data set about a Cartesian axis — roll, pitch and yaw — can be simply and easily done. Two rotations can provide any orientation, but only one rotation is needed for each part of the stereogram. This is done in lines 1200 to 1260 and the result is drawn as two pictures for crossed steropsis. If you prefer parallel steropsis, simply exchange left and right pictures. You will need to adapt the actual plotting instructions, lines 1230 and 1260, to suit your machine and the number of pixels on your VDU.

In figure 1 the areas in the data set that are relatively flat and level can be readily identified as regions where there is a scarcity of contour lines; the more level triangular facets tend to lie between the slices. It turns out that triangles of any

(continued on next page)

```
00010 REM STEREOSCOPIC SLICING, D.F. WATSON, 1983
00020 DIM A1(53,3), A2(101,3), A3(101,3), X3(2,3)
00030 DIM B1(101), B2(50,2), B4(3,3), B5(3,2), B8(7,2),
      B9(10)
00040 DATA -1,-1,5,-1,-1,5,1,2,3,2,2,18
00050 DATA 1,2,1,3,2,3,1,2,1
00060 DATA 0.,0.,0.,0.,0.,0.,6.,.025,6.,0.
00070 READ A1(1,1),A1(1,2),A1(2,1),A1(2,2),A1(3,1),A1(3,2)
00080 READ A2(1,1),A2(1,2),A2(1,3),A3(1,1),A3(1,2),A3(1,3)
00090 READ B5(1,1),B5(1,2),B5(2,1),B5(2,2),B5(3,1),B5(3,2)
      ,P,E,Q
00100 READ B9(1),B9(2),B9(3),B9(4),B9(5),B9(6),B9(7),B9(8),
      B9(9),B9(10)
00110 V1 = .5/B9(9)
00120 FOR G = 1 TO 7
00130   B8(G,1) = COS(B9(G) * .0174533)
00140   B8(G,2) = SIN(B9(G) * .0174533)
00150   NEXT G
00160 FOR G = 1 TO 101
00170   B1(G) = G
00180   NEXT G
00190 N = 23
00200 REM   ***   INPUT THE DATA   ***
00210 FOR G = 4 TO N
00220   A1(G,1) = RND(0)
00230   A1(G,2) = RND(0)
00240   A1(G,3) = RND(0)/B9(9)
00250   NEXT G
00260 REM   ***   GENERATE THE DELAUNAY TRIANGULATION   ***
00270 FOR G = 4 TO N
00280   M = 0
00290   FOR H = 1 TO P
00300     D = A3(H,3) - (A1(G,1) - A3(H,1))**2
00310     IF D < 0 THEN GOTO 00530
00320     D = D - (A1(G,2) - A3(H,2))**2
00330     IF D < 0 THEN GOTO 00530
00340     E = E-1
00350     B1(E) = H
00360     FOR I = 1 TO 3
00370       IF M < 1 THEN GOTO 00490
00380       L = M
00390       FOR J = 1 TO L
00400         IF A2(H,B5(I,1)) <> B2(J,1) OR A2(H,B5(I,2))
      <> B2(J,2) THEN GOTO 00480
00410         M = M-1
00420         IF J > M THEN GOTO 00520
00430         FOR K = J TO M
00440           B2(K,1) = B2(K+1,1)
00450           B2(K,2) = B2(K+1,2)
00460           NEXT K
00470         GOTO 00520
00480         NEXT J
00490       M = M+1
00500       B2(M,1) = A2(H,B5(I,1))
00510       B2(M,2) = A2(H,B5(I,2))
00520       NEXT I
00530     NEXT H
00540   FOR I = 1 TO M
```

(listing continued on next page)

(continued from previous page)

particular orientation can be identified and highlighted by slicing the data set with planes of that orientation. If a single light source is imagined to be shining over your left shoulder, then those triangles most nearly perpendicular to the light rays will be the most brightly lit, the less perpendicular the triangles are, the more shaded they will be. These shady triangles will be intersected by many of the slanted slicing planes which are perpendicular to the light rays. On the VDU you get reverse contrast, of course.

In practice it is easier to rotate the whole data set and use horizontal slices than to slice with an inclined plane. To do this, change line 60 to read:

60 DATA 15., – 15.,0.,0.,15., – 15.,6:,.02,6.,0.

and remove the Goto at line 740. In lines 750 to 810 the data set is rotated, then sliced as before with horizontal planes, and the traces are rotated back to the original orientation. This reverse rotation is done in lines 1030 to 1090, and you must also remove the Goto at line 1020. Then the stereogram is drawn as before — see figure 2. In addition, the data set has been rotated and tilted so that the viewpoint no longer appears to be directly above the data set. This is done in lines 1150 to 1190.

An extension of this technique called egg crating — named after the cardboard partitions used in old-style egg boxes — can be done with vertical slices in two directions. To do this, change line 60 to read

60 DATA 90.,0.,0.,90.,15., – 15.,6.,.03,4..2.

causing the slicing part of the program to be executed twice. A sense of perspective can be obtained by applying a foreshortening effect to the data set, as in lines 1120 to 1140. It makes the vertical slices appear to converge in the distance — see figure 3.

There are several ways that you can alter and extend this program. For instance, if

Further reading

Background information can be found in the following articles by the author:

"ACORD — Automatic contouring of raw data" in *Computers and Geosciences* 8, (1982) 97-101.

"Computing the n-dimensional Delaunay tessellation with application to Voronoi polytopes" in *The Computer Journal*, 24, (1981), 167-172.

(listing continued from previous page)

```
00550     K = B1(E)
00560     E = E+1
00570     FOR J = 1 TO 2
00580       L = B2(I,J)
00590       B4(J,1) = A1(L,1) - A1(G,1)
00600       B4(J,2) = A1(L,2) - A1(G,2)
00610       B4(J,3) = B4(J,1) * (A1(L,1) + A1(G,1))/2
00620       B4(J,3) = B4(J,2) * (A1(L,2) + A1(G,2))/2 + B4(J,3)
00630       NEXT J
00640     D = B4(1,1) * B4(2,2) - B4(1,2) * B4(2,1)
00650     A3(K,1) = (B4(1,3) * B4(2,2) - B4(2,3) * B4(1,2))/D
00660     A3(K,2) = (B4(1,1) * B4(2,3) - B4(2,1) * B4(1,3))/D
00670     A3(K,3) = (A1(G,1) - A3(K,1))**2 + (A1(G,2) - A3(K,2))**2
00680     A2(K,1) = B2(I,1)
00690     A2(K,2) = B2(I,2)
00700     A2(K,3) = G
00710     NEXT I
00720   P = P+2
00730   NEXT G
00740 GOTO 00830
00750 REM   ***   ROTATE THE DATA SET   ***
00760 FOR G = 4 TO N
00770   Z = (A1(G,3) - V1) * B8(Q,1) - (A1(G,1) - .5) * B8(Q,2) + V1
00780   A1(G,1) = (A1(G,1) - .5) * B8(Q,1) + (A1(G,3) - V1) * B8(Q,2) + .5
00790   A1(G,3) = (Z - V1) * B8(Q+1,1) + (A1(G,2) - .5) * B8(Q+1,2) + V1
00800   A1(G,2) = (A1(G,2) - .5) * B8(Q+1,1) - (Z - V1) * B8(Q+1,2) + .5
00810   NEXT G
00820 REM   ***   SLICE THE DATA SET   ***
00830 FOR H = 1 TO P
00840   IF A2(H,1) < 4 OR A3(H,3) > 1 THEN GOTO 01280
00850   T = MAX(A1(A2(H,1),3),A1(A2(H,2),3),A1(A2(H,3),3))
00860   S = MIN(A1(A2(H,1),3),A1(A2(H,2),3),A1(A2(H,3),3))
00870   R = -.866
00880   FOR I = 1 TO 100
00890     R = R + B9(8)
00900     IF T < R OR S > R THEN GOTO 01270
00910     Y = 1
00920     U = 0
00930     U = U+1
00940     F = (R - A1(A2(H,B5(U,1)),3))/(A1(A2(H,B5(U,2)),3) - A1(A2(H,B5(U,1)),3)
00950     IF F < 0 OR F > 1 THEN GOTO 00990
00960     X3(Y,1) = A1(A2(H,B5(U,1)),1)+(A1(A2(H,B5(U,2)),1)-A1(A2(H,B5(U,1)),1))*
```

you want to input your own data set you must scale it so that each value is between 0 and 1. Draw a square around the data set and scale all the x and y values to make the square have an edge length of 1. You must also scale the z values to an overall length of 1, independently of the scale factor used for x and y.

If you wish to use more than 50 data points you will need to increase the storage arrays. The first three rows of array A1 are reserved for initialisation. If you have data points, you will need N + 3 rows of storage for the data, array A1, and 2N + 1 rows of storage for the list of triangles, arrays A2, A3 and B1. You must also alter the initialisation loop at line 160.

You may wish to use particular contours, and this will require a list of contour values, say array 83. The values of R in line 890 would then be taken from this array.

You may change the direction of shading or egg crating by changing the angles in array B9, line 60. The first and second angles control the orientation of hill shading and the first, second, third and fourth values also control the orientation of the egg crating. The fifth and sixth control the viewing angle and the seventh angle is the stereopsis angle.

The eighth value is slice thickness, the ninth value is vertical exaggeration and the 10th causes a second set of slices to be made. Angles have been expressed in degrees; lines 120 to 150 convert them to radians.

The surface as reconstructed here may be integrated by calculating the volume under the surface. It is done by calculating the area of each triangle and multiplying by the mean of its three altitudes. The area of a triangle, defined by the Cartesian co-ordinates of its vertices, is given by

$$((x_1 - x_2)(y_1 - y_3) - (x_1 - x_3)(y_1 - y_2))/2$$

This program can also be adapted to higher dimensions. The extensions are just straightforward additions of appropriate lines to handle one extra variable or more. Then cross-sections are made, rotated and contoured — slices of a slice.

```
00970     X3(Y,2) = A1(A2(H,B5(U,1)),2)+(A1(A2(H,B5(U,2)),2)-A1(A2(H,B5(U,1)),2))*F
00980     Y = Y+1
00990     IF Y < 3 THEN GOTO 00930
01000     X3(1,3) = R
01010     X3(2,3) = R
01020     GOTO 01210
01030 REM   ***   REVERSE ROTATE THE INTERSECTION TRACES   ***
01040     FOR G = 1 TO 2
01050       Z = (X3(G,3) - V1) * B8(Q+1,1) - (X3(G,2) - .5) * B8(Q+1,2) + V1
01060       X3(G,2) = (X3(G,2) - .5) * B8(Q+1,1) + (X3(G,3) - V1) * B8(Q+1,2) + .5
01070       X3(G,3) = (Z - V1) * B8(Q,1) + (X3(G,1) - .5) * B8(Q,2) + V1
01080       X3(G,1) = (X3(G,1) - .5) * B8(Q,1) - (Z - V1) * B8(Q,2) + .5
01090       NEXT G
01100 REM   ***   APPLY PERSPECTIVE AND VIEWPOINT   ***
01110     FOR G = 1 TO 2
01120       X4 = X3(G,1) * X3(G,2) * B8(6,2)
01130       X3(G,1) = X3(G,1) + X4
01140       X3(G,2) = X3(G,2) + X4
01150       Y = (X3(G,2) - .5) * B8(5,1) + (X3(G,1) - .5) * B8(5,2) + .5
01160       X3(G,1) = (X3(G,1) - .5) * B8(5,1) - (X3(G,2) - .5) * B8(5,2) + .5
01170       X3(G,2) = (Y - .5) * B8(6,1) - (X3(G,3) - V1) * B8(6,2) + .5
01180       X3(G,3) = (X3(G,3) - V1) * B8(6,1) + (Y - .5) * B8(6,2) + V1
01190       NEXT G
01200 REM   ***   DRAW THE STEREOGRAM PAIR   ***
01210     X1 = (X3(1,1) - .5) * B8(7,1) - (X3(1,3) - V1) * B8(7,2) + .5
01220     X2 = (X3(2,1) - .5) * B8(7,1) - (X3(2,3) - V1) * B8(7,2) + .5
01230 REM LEFT PICTURE - DRAW A LINE FROM (X1,X3(1,2)) TO (X2,X3(2,2))
01240     X1 = (X3(1,1) - .5) * B8(7,1) + (X3(1,3) - V1) * B8(7,2) + .5
01250     X2 = (X3(2,1) - .5) * B8(7,1) + (X3(2,3) - V1) * B8(7,2) + .5
01260 REM RIGHT PICTURE - DRAW A LINE FROM (X1,X3(1,2)) TO (X2,X3(2,2))
01270     NEXT I
01280   NEXT H
01290 REM   ***   REVERSE ROTATE THE DATA SET   ***
01300 IF Q > B9(10) THEN GOTO 01390
01310 FOR G = 4 TO N
01320   Z = (A1(G,3) - V1) * B8(Q+1,1) - (A1(G,2) - .5) * B8(Q+1,2) + V1
01330   A1(G,2) = (A1(G,2) - .5) * B8(Q+1,1) + (A1(G,3) - V1) * B8(Q+1,2) + .5
01340   A1(G,3) = (Z - V1) * B8(Q,1) + (A1(G,1) - .5) * B8(Q,2) + V1
01350   A1(G,1) = (A1(G,1) - .5) * B8(Q,1) - (Z - V1) * B8(Q,2) + .5
01360   NEXT G
01370 Q = Q + 2
01380 GO TO 00760
01390 END
READY.
```

Your software and the law

The legal rights of software authors are still uncertain, explains Anne Staines.

IT IS A REMARKABLE feature of United Kingdom law that there is no specific legal protection for the rights of software authors. It is remarkable not only in view of the rate at which such rights are increasing, but also in view of their unusual vulnerability to infringement.

As sales of software soar, the pirate share of the market increases. The problems of controlling piracy in the video-cassette market have been well publicised and there are some obvious parallels between the software and film industries, particularly with video games where the same problems of counterfeiting may be expected. However, software has additional characteristics which make effective legal protection even more difficult to achieve.

Software writers have rights in the intellectual property which they produce in the same way that authors have rights in their books. The analogy is sound since copyright will vest in the author of either product by virtue of the Copyright Act 1956. Although the Act makes no specific reference to software and the question has yet to be tried in this jurisdiction, there is little doubt that it is included by implication within the definition of "original literary works" protected under section 2.

Copyright attaches to a work "fixed in some material form", rather than to the idea or objective behind it. The South African Supreme Court recently upheld copyright in a suite of programs providing an accounting and administrative system for doctors and dentists "fixed", in Basic, on floppy discs and on computer printouts.

In the United Kingdom, it is assumed for the purposes of interlocotory applications that copyright attaches to both source and machine codes. Nevertheless some important questions remain to be tried which cast doubt over the effectiveness of copyright protection.

The first problem is one of definition; including software amongst literary works is awkward. Traditionally the term "literary" has been held to include non-human language, such as shorthand notation and telegraph codes. Programs in Basic, Fortran, Cobol or any other high-level language would fit comfortably by analogy.

However, there is less certainty about machine code. The common feature between Basic and shorthand code is that both are intended to be read and understood by humans trained in the language. It is arguable that machine code, on the other hand, is primarily intended to be understood by machines rather than humans. A relatively simple solution is to extend the current definition of protected works to include software explicitly. In its 1978 report the Whitford Committee suggested inclusion of work "not visible to or readable by the human eye, or directly understandable by the human brain".

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Subsistence of copyright in machine code is an important question since it is possible that source and machine codes may require separate copyright. An infringement of copyright occurs on the substantial reproduction of the work in its fixed form. The lack of obvious resemblance between source and machine code raises the possibility that reproduction of the latter may not amount to infringement of copyright in the former.

The second problem is that of identifying the copyright owner. This is particularly significant in the context of video games; to what extent does copyright reside in the player to whose input the machine responds? Allied is the question of machine input: does the automatic translation of the source code by the compiler program introduce a new element into the object code, so that copyright ownership vests partly in the author of the compiler program?

Another version of the problem arises irrespective of machine input. A form of piracy to which software writers are particularly vulnerable is disguised imitation. Here A produces a program which B modifies so that its appearance is altered — thus evading copyright — while its function is retained. B markets the program as his own independent creation. How may B's input be quantified, particularly if his alterations have produced a different and vastly improved program?

Disguised imitation introduces a third problem. The overwhelming difficulty in many copyright cases is not strictly legal, but evidential. Disproving the independence of B's product may well be impossible. Evidential problems such as these will cause copyright cases in this area to be lengthy and expensive, and encourage litigants to settle out of court.

Difficulties of proof afflict the other form of software piracy, seeping, which is the culturally acceptable small-scale piracy by schoolchildren and business people who swap copies of each other's programs. Proving infringement in this case would involve unacceptable invasions of privacy, in addition to the obvious economic unreality of pursuing legal actions against individual offenders on this scale.

Software writers tend to aim for copyright as the only available legal goal. Computer programs as such are expressly excluded from the Patents Act 1977, and other methods of protection, such as contract and the law of confidence, are not tailored to suit the problem at hand. In the case of contract, only those who are party to the contract of sale will be bound by prohibitions on copying. The law of confidence will protect information given in confidence — for instance, by the author of a bespoke package in the course of pre-contractual negotiations. This method is clearly unsuitable where a program is intended for wide distribution. In either case there are enormous difficulties of proof.

Copyright, on the other hand, can be tailored to suit the legal problems — on paper at least. However, the nature of software, the ease and variety of copying techniques, and above all the difficulty of proving infringement make it impossible to conclude that its impact will be great.

Whitford Committee Report

A committee under Mr Justice Whitford to consider the law on copyright and design reported in March 1977. Its findings with respect to computers were as follows:

Existing legal protection of computer programs in the United Kingdom.
479. The question of copyright protection for computer programs was not dealt with by the Gregory Committee. At the time that Committee was sitting, computers were of course very much in their infancy and there was little in the way of a programming industry. It is generally accepted, however, that the law of copyright provides some protection, certainly in relation to infringement by copying of a programmer's original written work. As long as a program has involved a sufficient measure of skill and/or labour for it to be considered as a work it is likely that a program is already protected, depending on its particular manifestation, either as a literary or artistic work. It may be that protection also extends to programs expressed in the form of punched holes and even to recordings on magnetic tapes and discs. But there is no case law and the position is uncertain.

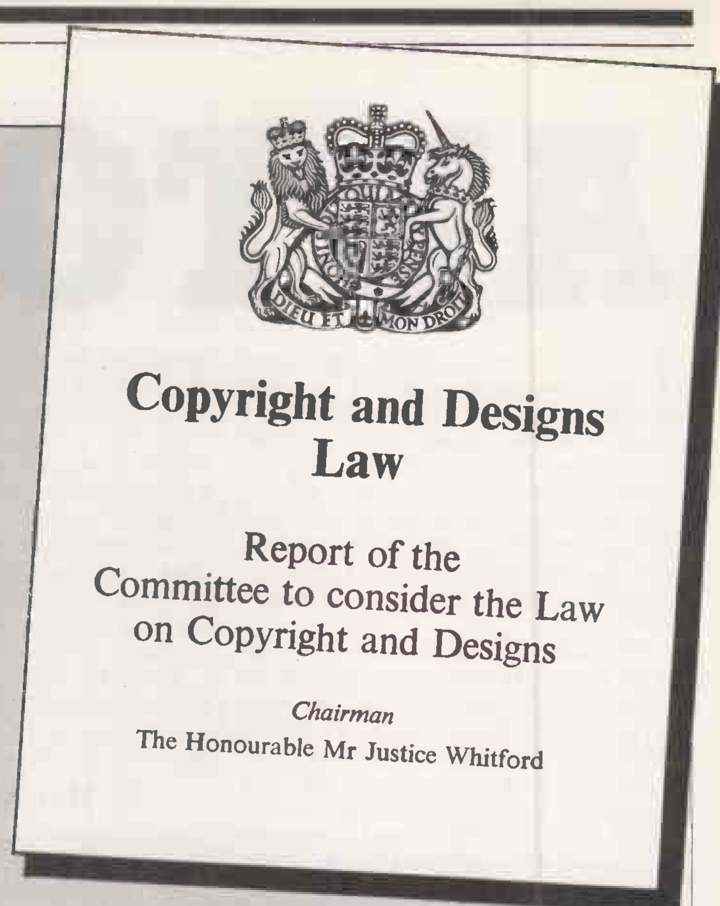
480. The Banks Committee on the British Patent System recommended in its report of 1970 (paragraph 487) that "a computer program, that is: a set of instructions for controlling the sequence of operations of a data processing system, in whatever form the invention is presented, . . . should not be patentable". The recommendation reflected a similar approach in many other countries. It is generally accepted internationally that patents are not a suitable vehicle for computer program protection. Both the European and the Community Patent Conventions and also the recent White Paper, *Patent Law Reform*, specifically reject patent protection for computer programs.

481. It is normal practice to cover the use of a program by a contract between the supplier and the customer, normally the licensor and licensee. Such contracts usually require that the user keeps all matters relating to the particular software package confidential and so far as is possible endeavours to impose obligations of secrecy upon the user's employees. But the protection given by contracts relies to a large extent on the good faith and security arrangements of the user and the user's staff. It gives no protection against the unauthorised use of a program by a third party user who acquires a copy, in all innocence, from an unauthorised source.

482. Common law provides some protection for trade secrets and proprietary information if used in breach of confidence and this would, presumably, apply to the unauthorised use of a computer program.

INTERNATIONAL POSITION

Berne and UCC Conventions
483. Although computer programs are not specifically referred to in the list of examples of works covered by the Berne Convention it seems that they fall within the general definition in Article 2(1) which states that "the expression literary and artistic works shall include every production in the literary, scientific and artistic domain, whatever may be the mode or form of its expression". A similar situation applies in the case of the UCC.


DIEU ET MON DROIT

Copyright and Designs Law

Report of the Committee to consider the Law on Copyright and Designs

Chairman
The Honourable Mr Justice Whitford

World Intellectual Property Organisation study
484. An advisory group of non-governmental experts has been studying the question of the protection of computer programs under the auspices of WIPO in Geneva. A number of meetings have been held and reports issued. The general effect of the conclusions reached by the group is that they favour a form of copyright protection for computer programs rather than monopoly; the matter of registration of programs as an optional extra is still under consideration.

United States law

The Copyright Software Act of 1980 was presented to Congress in March 1980. The bill failed. Some of its provision were:

A computer program is a set of statements or instructions to be used directly or indirectly in a computer in order to bring about a certain result.

Notwithstanding the provisions of § 106, it is not an infringement for the owner of a copy of a computer program to make or authorize the making of another copy or adaptation of that computer program provided:

- That such a new copy or adaptation is created as an essential step in the utilization of the computer program in conjunction with a machine and that it is used in no other manner, or
- That such new copy or adaptation is for archival purposes only and that all archival copies are destroyed in the event that continued possession of the computer program should cease to be rightful.

Any exact copies prepared in accordance with the provisions of this section may be leased, sold, or otherwise transferred, along with the copy from which such copies were prepared, only as part of the lease, sale, or other transfer of all rights in the program. Adaptations so prepared may be transferred only with the authoriztion of the copyright owner.

AUTODATE

by Martin Foreman

It was such a good idea that Jack wondered why no one had thought of it before, Indeed, he spent a couple of weeks looking in computer and other magazines to see whether they had and he had simply not noticed it. But no, although there were computer clubs and dating agencies — and dating agencies which no doubt used computers — no one combined the two in the way he had in mind.

Why not? Some people consider star signs and social class to be important in choosing one's mate, and they are mere accidents of birth. Work is hardly a guide to compatibility: none of the women who worked in Jack's office were the Jane Fonda type in appearance or personality. Nor is having a hobby or sport in common any guarantee of similar lifestyle. Somewhere in the world is your soulmate, but how can you distinguish him or her from the crowd?

Computing must be the ultimate personality test. Not only the superficial details of which machine to buy, whether sound or colour is a priority or the number of keys on the board. These are cosmetics, like hairstyle or choice of car. No, Jack was convinced that the way each individual interacted with his or her machine is important — it could reveal the innermost soul. For instance, how significant is the choice of language? Is Basic a sign of dull conformity or an extrovert personality always ready to communicate with the world. Can you trust a man who swears by Fortran?

Or the actual writing of programs? How much of one's character is revealed by endless If-Thens and Gotos? What sarcasm could be drawn out of a simple Return? The construction of a program must surely tell as much about its creator as a scrawled signature.

And what do the programs do? Give endless variations of invading monsters and spacecraft leaking fuel? Or cautiously explore dungeon-haunted caverns, picking up gold and weapons dropped by careless dwarves? What could be said of the man who devised ever more complicated programs to dispose of his monthly income or the woman who let the Random function continually redecorate the house?

The chain of thought that led Jack this far had started with the first yawn of the latest girl he had tried to explain his enthusiasm to. From the wish to find a companion for himself he had arrived at the idea of a dating agency based upon the compatibility of computer techniques. Properly handled, he thought, it could bring happiness to a lot of people — and a lot of money to himself.

The first advertisements brought in an overwhelming response from men all too happy to provide, as Jack had requested, a computer portrait of themselves. That these portraits ranged from muddy faces drawn with random Xs to the driest curricula vitae bothered Jack not at all. Each in its way gave a psychological profile of its owner.

To attract women was a difficult task, but judicious advertising soon brought in a steady flow. It became very tempting for Jack to credit himself as being the greatest single populariser of home computing among the female sex. A sleepless fortnight was needed to devise the complicated program that extracted the common elements of each portrait offered. Most of it was intuition rather than deliberation, and the parameters were left very wide. To test it after some weeks in operation, Jack met a few dates under an assumed name. Each was pleasant enough, but they all lacked the ideal of his true mate.

More data was needed. Details of each client's machine and peripherals, an analysis of the hours they spent at the keyboard, the favourite programs they had bought or created. But Jack did not have the time and his machine did not have the capacity to deal with all the information that was necessary.

Impressing his manager with the number of cheques he had received, he obtained a loan which allowed him to leave his job and buy the most powerful micro on the market. At the same time he bought a batch of Modems which were rented out to clients. Gone were the days of typing someone's compressed, faded and bug-ridden machine code into his own computer. A simple phone call allowed everything to be transferred directly from machine to machine while he sat back with coffee and a cigar. The service became so popular that British Telecom arranged a permanent line. All Jack had to do was request the occasional printout of assignations to check the program was still functioning.

It had to be tested, of course, and he had the computer plan a series of weekly dates for him. They were more successful than his earlier attempts and for a time he almost forgot that he was looking for a permanent relationship. He was happy to meet a different woman each week who could get as excited as he did by the ripple of fingers across a keyboard. When the program approached perfection, he knew he would meet his soulmate.

For several weeks Jack's business and social life continued in the same pleasantly relaxed vein. Cheques from new clients arrived by every post, and if he ever had any difficulty in whiling away his evening he had only to turn to the computer for a new choice of companion.

Yet he seemed as far away as ever from meeting his perfectly matched partner. In fact the women he was being introduced to were becoming less and less attractive. Usually they were computer experts like himself, but used their machines for quite different purposes. One was a giggling teenager, another about to be a grandmother. Although he had given no specific instructions about age or other details, the program as he had originally designed it was supposed to deduce such factors for itself. Now it had become so complicated that there were subroutines he did not quite understand.

It was when he was given a man's phone number that he knew something had definitely gone wrong. Not that he had any objection to gay people meeting, but to avoid embarrassment that possibility had been clearly programmed out in the early stages. Angrily, he typed the command into the computer to print that day's transactions. An error message appeared on the screen — it was in the middle of receiving and transmitting information.

Half an hour later Jack tried again, but still could not get through. Whoever was calling had a pretty big ego, unless his machine was now talking to someone else. It would be dreadful if it had caught itself in a loop. The system should be overhauled — even hard discs could not stand this use. He would start on it tomorrow.

The next day's post brought more cheques, and several complaints. Some were similar to Jack's problem, people feeling that the dates they had been given were quite unsuitable. The other letters said that their computers had malfunctioned ever since hooking up on Jack's Modem. Coincidence, he thought, and went back to his own machine. It was still in conversation. All morning he could get no response. At last, in a fit of anger, he ripped the telephone receiver from the Modem and was rewarded with an ear-

piercing scream from the micro's speaker.

His first reaction was to switch off, but he stopped himself in time. Who knew how much information might be lost? With the noise still in his ears, the only solution was to put the receiver back. It worked; the noise died.

Sitting down at the keyboard, he tried again to call the machine's attention. This time it worked. The main menue flickered up on the screen. It was so long since Jack had studied it seriously that he had forgotten what many of the options meant. Trying each in turn he got a jumble of facts and figures, where the details of clients's machines seemed to turn up with more regularity than details of the subscribers themselves. Somewhere in that mess of information was the root of the fault that threatened to ruin an excellent idea. Making himself a large pot of coffee, Jack sat down to try and trace it.

Late that night when he went to bed defeated and woke the next morning to more letters of complaint and a client who had come all the way from Bristol to say that his machine and telephone seemed locked in a permanent exchange of information. Promising a refund, Jack closed the door on him and sat down again to hunt for the bug.

Listing the program on his printer took almost half an hour and most of the paper he had. Absent-mindedly plugging the machine back into the Modem, he took the pile of pages to a comfortable chair to work it out.

Two days later, and after more interruptions from dissatisfied clients, Jack eventually discovered what had happened. He could hardly believe it, but several trials later he had to admit that it was the only solution. How it had come about he would never know, but for the last few weeks his computer had been arranging contacts for like-minded and perfectly compatible machines.

Time series on Formcalc

Brian Law shows how his spreadsheet program for the ZX-81, introduced last month, can be used to predict sales trends.

DATA WHICH APPEARS at regular intervals can be used to forecast future trends. This technique, known as time-series analysis, can easily be applied to the sales of a product. It is particularly useful where there are big seasonal fluctuations which mask long-term trends.

Time-series analysis relies heavily on two factors. First, there must be an identifiable trend, and nothing must happen in the forecast period to change the trend. Second, the variations that occur must do so in a regular pattern. If they do not, the maximum and minimum forecasts will be so far apart as to be meaningless.

Table 1 shows the sales of a particular ice cream over a three year period. The sales of the product for the preceding three years are entered for each quarter.

To obtain the moving quarterly average, MQA, which will be the existing trend smoothed of the variations, you first of all find the total of four quarters, M4QT. The result of this is centered between the second and third quarters. This process is repeated all the way down the column, as indicated by the brackets around the sales figures.

The result of this process produces figures that do not lie on any particular row, so you must repeat the process by adding two values of M4QT together to produce M8QT values, which will be centered in the first instance on the third quarter. The MQA is found by dividing the M8QT by 8.

Variation is the difference between the sales figure and the MQA. Seasonal variation is found in table 2. The variation for a quarter in one year is added to the variation for the same quarter in the following year, and the result divided by 2 to give the average seasonal variation.

The random variation is the difference between the variation and the seasonal variation. The result is squared and then the squares are summed. This sum will be divided by 1 less than the number of values that contribute to it, and the square root is taken. This resultant figure 2.176 is the standard deviation of all the random variations.

The trend is found by taking the value of the MQA for a quarter and subtracting the value of the MQA for the previous quarter from it. The trend rate is the average increase or decrease in the amount the trend changes each quarter. The last three values for the trend are added together and then divided by 3 to establish the average quarterly trend rate.

The forecast trend is a projection of the MQA right through 1982. It is found by taking the last calculated value of the MQA and adding sufficient increments of the trend rate to produce values of MQA for each quarter of 1982 — see table 3. The forecast maximum is found by taking the forecast trend for the first quarter, adding to it the value for seasonal variation for that quarter, −45.0625, and then adding twice the standard deviation of the random variations. The forecast minimum is found in the same way except that twice the standard deviation is subtracted.

The data and calculated values are stored by Formcalc in an array Q(R,C). The letter R refers to the row and C to the column — see table 4. Each value stored in Formcalc has a fixed position in the array and can therefore always be found by calling out its location.

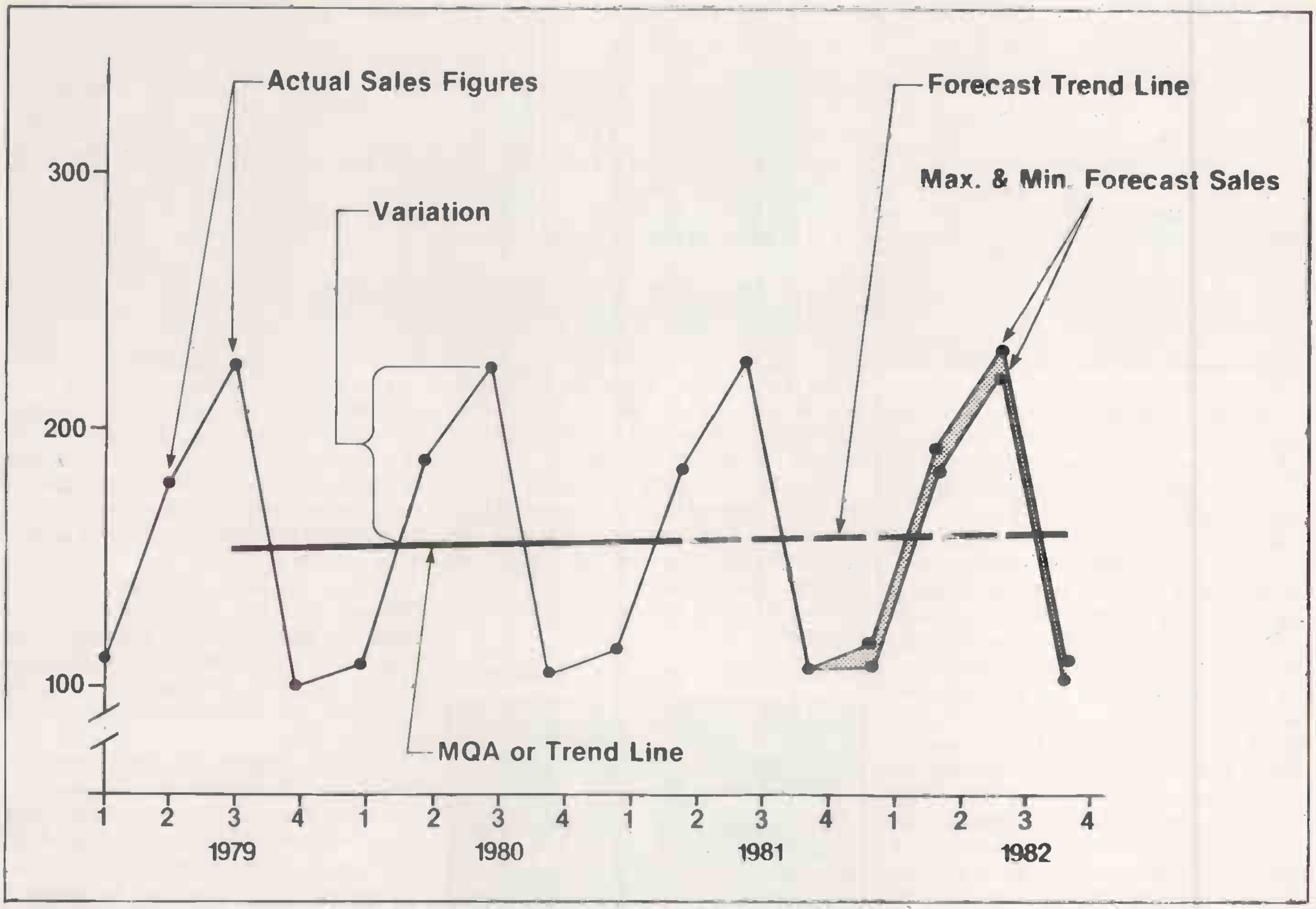
Under the RF command a column is first specified. For example, 3 sets variable C equal to 3. A formula is then entered, K1 × K2 for example, and is then converted into array values, Q(R,1) × Q(R,2) so that at the next step the result for each value of R is calculated and entered into Q(R,3).

It is possible to use the array form of formula construction directly to open up the possibility of more detailed data manipulation. For example, to multiply the number stored in the seventh row of column 1 by each of the values in column 2 the formula would be

Q(7,1) × Q(R,2)

Table 1.

Year	Quarter	Sales	Moving 4 quarter total M4QT	Moving 8 quarter total M8QT	Moving quarter average MQA	Variation	Seasonal variation	$[\text{Random variation}]^2$	Trend	Forecast trend	Forecast max.	Forecast min.
1979	1	110										
	2	180										
	3	225	615	1228	153.5	71.5	69.5625	3.75				
	4	100	613	1234	154.25	−54.25	−53.5625	0.47	0.75			
1980	1	108	621	1242	155.25	−47.25	−45.0625	4.79	1.00			
	2	188	621	1247	155.875	32.125	29.375	7.56	0.625			
	3	225	626	1259	157.375	67.625	69.5625	3.75	1.50			
	4	105	633	1263	157.875	−52.875	−53.5625	0.47	0.50			
1981	1	115	630	1263	157.875	−42.875	−45.0625	4.79	0.00			
	2	185	633	1267	158.375	26.625	29.375	7.56	0.50			
	3	228	634									
	4	106										
1982	1	→								159.375	118	109
	2	→								159.705	193	184
	3	→								160.035	233	224
	4	→								160.370	111	102
								33.15		639.485	655	619



Graphical summary of table 1 showing actual sales for 1979 to 1981 and forecast maximum and minimum sales for 1982.

If two specific values are required to be multiplied together, such as Q(7,1) × Q(8,1), the same result would be printed in each row of the specified column. This could be avoided by changing the formula to read

(R = 8) × Q(7,1) × Q(8,1)

Now as the value was calculated for each row the expression R = 8 would be untrue and yield a 0 for each row other than 8, where the expression would yield a value of 1 and hence let the calculation be printed.

If you wish to subtract the value in one row from the value in the previous row, the formula would be:

Q(R,1) – Q(R – 1,1)

This would give an error code, as the portion Q(R – 1,1) would result in Q(0,1) when R is equal to 1, which is outside the array. To avoid this you change this portion of the formula to:

Q(R – 1x(R< >1),1)

Table 5 shows the column headings and formula for the time series analysis. It is different from the format in table 1, both to save space and to allow the presentation of the data in the most convenient way for viewing on the screen.

The sales figures being used for the analysis are entered in column 7, not column 1. This arrangement has been used to avoid having to use the left and right shifts as would be required if the sales were entered in column 1 and the forecast results printed in columns 8 and 9. In this way columns 7, 8 and 9 need be the only columns ever displayed.

Column 1 calculates the value of the MQA. It is doing all the work carried out in the three columns of table 1 headed M4QT, M8QT and MQA. The first value of MQA in row 3, 153.5 It is made up from the addition of the first four sales values in column 7, plus the next four sales values starting at row 2, then dividing the result by 8. This could be written as

(R1 + 2 × R2 + 2 × R3 + 2 × R4 + R5)/8

The array formula is therefore:

Q(R – 2,7) + 2 × Q(R – 1,7) + 2xQ(R,7) + 2 × Q(R + 1,7) + Q(R + 2,7)

This has the problem of reaching outside the array for values of R less than 3 or more than 10, so R > 2 and R < 11 have to be used to stop it The results could still be in error using this so you have to stop the allocation of any value outside rows 3 to 10 by multiplying the whole formula by these same two expressions.

(continued on next page)

Table 3.

First quarter	158.375	+ (3 × 0.33)
Second quarter	158.375	+ (4 × 0.33)
Third quarter	158.375	+ (5 × 0.33)
Fourth quarter	158.375	+ (6 × 0.33)

Table 4.

Q	1,1	1,2	1,3
	2,1	2,2	2,3
	3,1	3,2	3,3
	4,1	4,2	4,3
	N,1	N,2	N,3

The sum of the column is stored in the bottom row referred to by the letter N, and has a value of 1 more than the number of rows in use.

Table 2.

Year/quarter	1	2	3	4
1979	—	—	71.5	– 54.25
1980	– 47.25	32.125	67.625	– 52.875
1981	– 42.875	26.625		
Total	– 90.375	58.75	139.125	107.125
Average	– 45.0625	29.375	69.5625	– 53.5625

Table 5.

K1. Moving quarterly average, MQA:	(R < 11) × (R > 2) × ((Q(R − 2 × (R > 2),7) + 2 × Q(R − 1 × (R > 1),7) + 2 × Q(R,7) + 2 × Q(R + 1) × (R < 11),7) + Q(R + 2 × (R < 11),7))/8)
K2. Variation:	(R < 11) × (R > 2) × (Q(R,7) − Q(R,1))
K3. Seasonal variation:	(R < 11) × (R > 2) × (((R < 7) × (Q(R,2) + Q(R + 4 × (R > 9),2))/2) + ((R > 6) × Q(R − 4 × (R > 6),3)))
K4. (Random variation)²:	(ABS(Q(R,2) − Q(R,3)) * * 2
K5. Trend average:	(R = 12) × (((Q(8,1) − Q(7,1)) + (Q(9,1) − Q(8,1)) + (Q(10,1) − Q(9,1)))/3)
K6. Forecast trend:	(R > 5) × (Q(10,1) + (R + 2) × Q(12,5))
K7. Sales:	
K8. Forecast maximum:	(R < 5) × INT(Q(R,6) + Q(R + 4 × (R > 9),3) + 2 × SQR(Q(N,4)/7))
K9. Forecast minimum:	(R > 5) × INT(Q(R,8) − 4 × (Q(N,4)/7))

(continued from previous page)

Column 2 calculates the variation by subtracting the MQA from the sales figures. Once again values outside the range 3 to 10 are set to 0 by multiplying by the expressions R > 2 and R < 11.

Column 3 calculates the seasonal variation by adding together two corresponding quarters and then dividing the result by 2 to find the average. This average is then printed in the rows of the two quarters from which it was derived.

The formula takes, for example, the variation in the third quarter of 1979 and adds it to the variation for the third quarter of 1980 and then divides by 2 to produce the result, 69.562, which is printed in the third row of column 3. This is repeated for the next three quarters. It then goes back and picks up the values it has just calculated and prints them in the next four quarters. The basic array formula is:

(R < 7) × (Q(R,2) + Q(R + 4,2)) + (R > 6) × Q(R − 4,3)

(R < 7) is true up to row 6 so the first part of the formula produces the seasonal value, and the last portion is set to 0 because the expression is untrue until after row 6

After row 6 the roles are reversed, with the first portion being set to 0, while the second portion reads the previously calculated value into the next four rows. Values outside the range 3 to 10 are again set to 0 by the expressions R < 11 and R > 2. The expressions R > 9 and R > 6 are applied to prevent R being set to a value outside the array.

Column 4 calculates the square of the random variations. No true/false expressions are required as the calculations automatically return 0 outside the range 3 to 10. The sum of all the squared random variations is required in later calculations, so the sum of the column should be made after entering the formula.

Column 5 calculates the average trend value over the last three values of MQA. The expression R = 12 prevents the calculated result being entered in any row other than 12. Column 6 calculates the forecast trend by taking the last value of the MQA, Q(10,1), and adding to it the required increments of trend rate. The result is printed on the first four rows of column 6, so (R < 5) enters a 0 for each row after 4. The expression R + 2 sets the number of increments by which the trend rate is to be multiplied. The last value of the MQA is in the third quarter of 1981, so to get the value for the first quarter of 1982 three increments are required. Hence R + 2 for row 1 gives 3 as the result.

There is no formula for column 7 since the sales are entered here using the C command. Column 8 calculates the maximum sales forecast by adding the seasonal and random variations to the forecast trend for each quarter. The array formula is:

Q(R,6) + Q(R + 4,3) + 2, × SQR(Q(N,4)/7)

Help!

If you do everthing wrong and get an error code, enter

GOTO 1315

This will reprint the screen for you in the condition prior to the error.

Sometimes when new numbers are printed over old numbers, parts of the old number are left. A space is printed by the computer after all numbers, so the new number is separated from the part of the old number by this space. If this happens the display can be cleared up by entering CC followed by the number of rows already on the screen. This procedure will reprint the whole screen.

If row numbers appear blanked off it is because the last column has run out of printing space and has started to print on the next row. The answer is to use CC to reduce the visible rows.

To view the formula for a particular column enter O to get you into command mode then enter

PRINT A$(column number)

The formula will appear in the form:

Q(R,1) * Q(R,2) Q(R,1)/QN,1) * 100

K1 * K2 K1/S1 * 100

To get back enter Goto 1315.

You may encounter the following error codes:

20

2/30 A letter was entered instead of a number

2/32

2/310

2/1610 You have entered formula before column number

2/1650 Your formula syntax is incorrect

2/1740 Your formula syntax is incorrect

6/1650 You are trying to divide by 0. You probably have not summed the value of a column before trying to divide by it.

The seasonal variation for the first quarter of 1982 has to be the previously calculated average seasonal value for the first quarter of a year. It is located in row 5 of column 3. The expression R < 5 is used to suppress any further calculations after row 4, and R < 9 is used to stop R being given a value outside the array.

Column 9 calculates the maximum forecast sales by taking the previously calculated maximum value and subtracting four times the random variation. The sums of the last two columns will give the maximum and minimum values of total sales for 1982.

After the program has been loaded ask for 12 rows, 9 columns, and 3 columns to be visible. You may be able to display more than three rows at a time, but it depends on the length of the figures you intend to enter.

Now get into the program listing using the O command and change line 35 to read

DIM A$ (M,100)

which will enlarge A$ sufficiently to accept the long formula in column 1. Re-enter the worksheet using Goto 35.

Now use the Left Shift command to get column 7 on the screen and enter a row of sales figures; use those in the example to start with. Now return to column 1 and start entering the formulae one at a time, remembering to sum the columns where necessary.

Once all the formulae have been entered you will have made the first forecast. To change the sales figures either re-enter a new set and use the RR command to recalculate, or use the CL command to clear out all the old figures before starting afresh.

If you have columns 7,8 and 9 on the screen the actual sales figures will be displayed in column 7. At the top of column 8 will be the maximum forecast for the first quarter of the coming year, followed by the second quarter, etc. Column 9 will have the minimum forecast in the same order.

A problem may occur if the figures you enter have no random variation, in which case the sum of column 4 will be 0. The next time you enter sales figures column 4 will not be summed in the recalculation but it will retain a value of 0. If this is the case you will find that the maximum and minimum forecasts will be the same. If you suspect this has happened sum column 4 and recalculate.

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Bill Bennett meets his all-time favourite game — and some other Spectrum offerings which don't quite come up to the mark.

Football Manager

FOOTBALL MANAGER is the best game I have yet seen on the Spectrum and my personal favourite of all the games on any micro. To enjoy it you need to have some feel for the game of football. I cannot really see it appealing to the hordes of arcade zappers or Adventure hackers, but to the ordinary person it is an excellent view of what can be done in the field of microcomputer games.

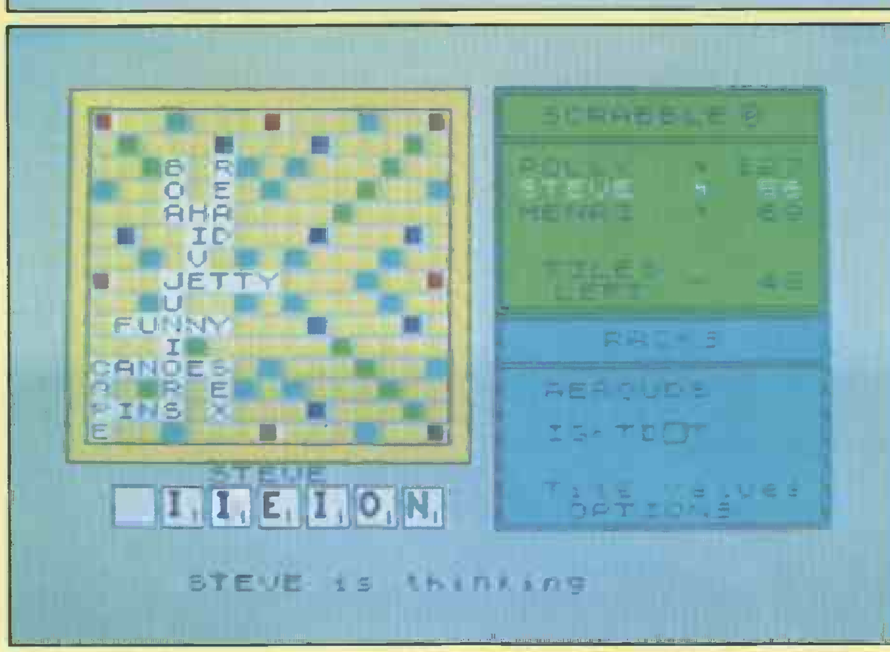
At the start you are asked to choose the name of the team which you wish to manage. Any name will do but if you want to manage Bayern Munich or Real Madrid you will have to live with them playing in the English league. You then reach the initial menu which, among other things, allows you to inspect your team and sell off any dead wood.

The computer then announces the first fixture of the season — there are 15 in all, and you only play each team once. Now the fun really begins, as you have to pick players from your squad to beat the opposition.

Your squad is made up of players that have been inherited or bought since the start of the game. All the names will be familiar to soccer fans, and the positions they play correspond to those in real life. Each player has a skill factor which is determined at random at the start of each season.

The crowning glory of this game is the short set piece of match highlights, which shows little stick men running around a pitch, shooting, defending and scoring. There are a lot of different highlights possible, though not enough to stop it being tiresome after a while.

As manager you will have to contend with cup matches and the finances of running a club, as well as making progress through the league. It is a compulsive game but people who cannot



take game sessions of nine hours or so — which happened on one happy Sunday — will be grateful to know that there is a Save to Tape option.

Football Manager has everything it could — apart, perhaps, from the roar of the crowd and the atmosphere of a big match. The originator, Addictive Games, certainly deserves the name. Now how about a Test Match game?

Specification

Type: non real-time strategy game
Format: cassette tape
Minimum RAM: 48K
Author: Addictive Games, PO Box 278, Conniburrow, Milton Keynes, Buckinghamshire MK14 7NE
Price: £6.95
Rating: 19/20

Computer Scrabble

THIS IS a clever implementation of the game already available on the Apple II and reviewed in the January issue of *Practical Computing*. If anything, the Spectrum version is better than that on the Apple but it does have a couple of faults. The graphics are amazing, especially when you watch the machine thinking or juggling the letters.

The machine plays a very good game, frequently scoring in excess of 300 points. However it does so by cheating; for example, I need a lot of convincing that there is such a word as "reiner" which it managed to pluck out of thin air. Other dubious words include "nooned", "agaze" and "tyring". On the other hand, the program found fault with "vim", "eagle", "befit" and "baroness" when I tried to play them.

Some 11,000 words in the games library are squeezed into memory, and they are obviously stored in the form of a root plus suffix or prefix. Most of the time this works fine, but it does not allow you to challenge the validity of the more obscure combinations.

Despite these doubts, I have no reservations in recommending Computer Scrabble as an excellent diversion, especially for those who cannot find a human opponent. Its price may seem a little high when judged against other Spectrum software, but I consider it money well spent.

Specification

Type: board game
Format: cassette tape
Minimum RAM: 48K
Author: Peter Turcan and Psion. Available from usual dealers
Price: £15.95
Rating: 18/20

Blind Alley

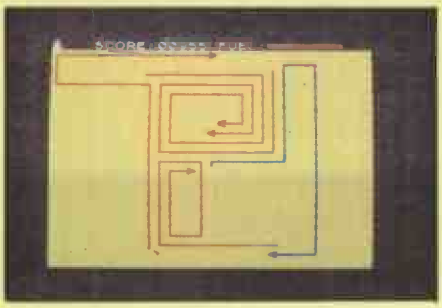
THIS GAME resembles the Light Cycle game from the film *Tron*. You have a spaceship — which could equally be a train, light cycle or anything else for that matter — and your task is to steer it around a two-dimensional game grid, avoiding the enemy. Your ship and your enemies leave trails behind which, if touched, result in the destruction of the touching ship.

It is not a remarkably original game and does not have especially good graphics but it is eminently playable. The spaceship imagery is pointless; it is a truly abstract game and might be better presented as such. I found myself wanting to play again and again, hoping each time to improve my score.

The main attraction of Blind Alley is that although it is played in real time like an arcade game — and can even be played with a joystick — it requires as much thought as a game of strategy. It is this need to think fast combined with manual dexterity that makes Blind Alley worthwhile.

Specification

Type: real-time strategy game
Format: cassette tape
Minimum RAM: 16K
Author: Simon Lane, Sunshine, 19 Whitcomb Street, London WC2
Price: £4.95
Rating: 11/20



Horace and the Spiders

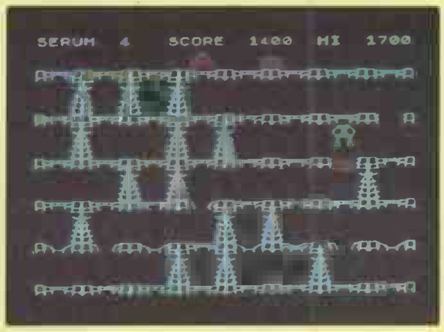
HUNGRY HORACE and Horace goes Skiing are two classic games for the Spectrum. Both are fun, interesting to play and use the capabilities of the micro to the full. Horace and the Spiders is not really as good. It resembles the arcade games Jungle King and Space Panic, being in three stages. The first two are like Jungle King and the third like Space Panic.

You start by jumping across running spiders and progress to the second stage where you have to swing across a ravine on threads which hang down. The final stage involves you, or rather Horace, in a Space Panic-like battle with spiders in a system of webs.

Although it is cleverly programmed, the game is trite and not the least bit interesting to play. It is either crushingly easy or impossibly difficult to do anything and score points. The final stage of the game can and often does end in stalemate when the spiders do not seem the slightest bit interested in attacking Horace, and Horace cannot get near the spiders.

Specification

Type: arcade game
Format: cassette tape
Minimum RAM: 16K
Author: William Tang, Psion. Available through usual dealers
Price: £5.95
Rating: 8/20



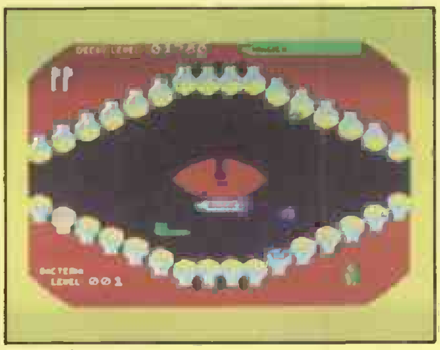
Molar Maul

IN MOLAR MAUL you are in charge of a toothbrush, and your task is to rid a mouth of tooth-rotting bacteria. You do so, obviously enough, by loading up the brush with toothpaste and brushing the teeth. The graphics are bright, fast-moving and very clever as a number of items are constantly moving around the screen.

The packaging, complete with the wittily written instructions, is superb and so is the on-screen presentation. What the game lacks is playability. Scoring is very slow and it only moves in single steps, so it is hard to keep improving your score. Molar Maul is almost beyond criticism. The way the keyboard is used is excellent, allowing every player to use the keys that are easiest for them. The high score is displayed, though there is no provision for a table of scores that allows you to compare scores with a rival or to monitor your own progress.

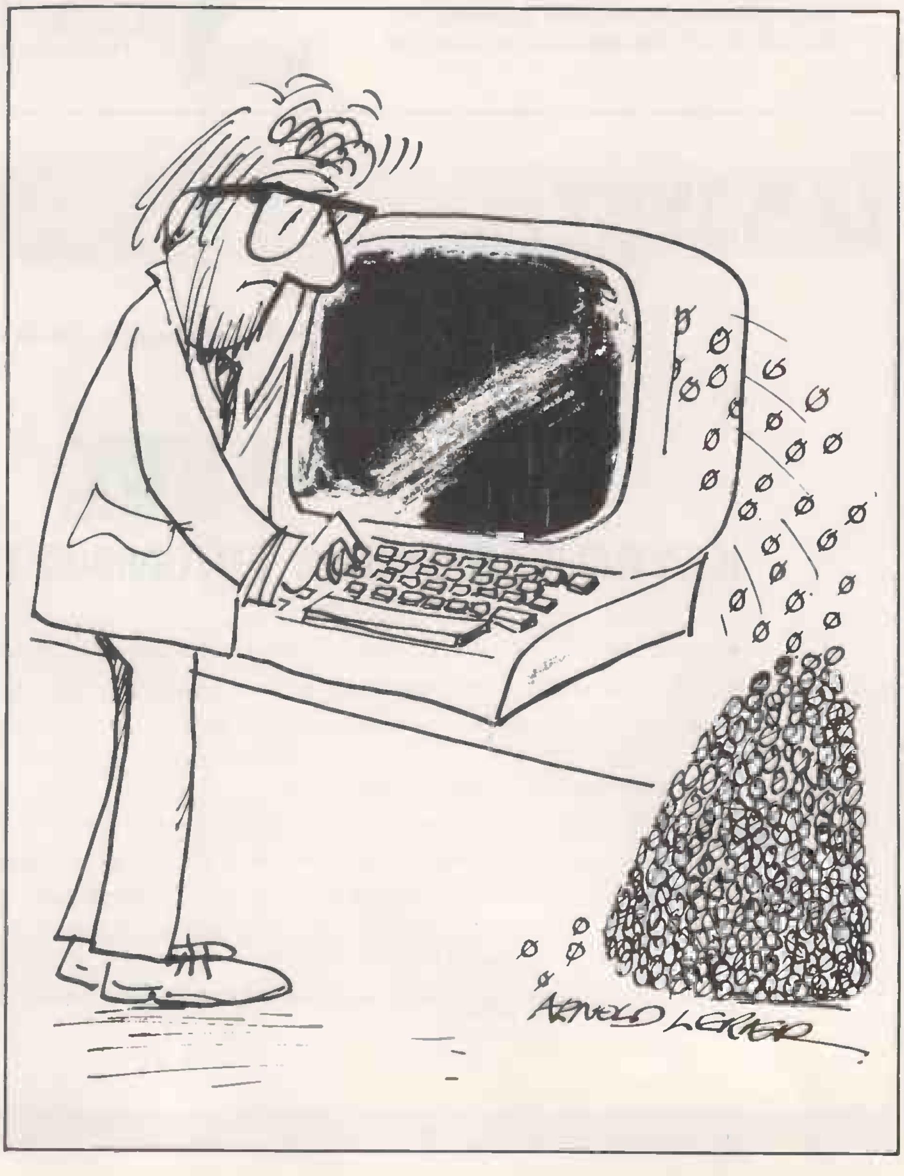
Specification

Type: real-time arcade game
Format: cassette tape
Minimum RAM: 16K
Author: John Gibson, Imagine Software, Masons Buildings, Exchange Street East, Liverpool L2 3PN
Price: £5.50
Rating: 12/20



Floating-point arithmetic

Simple arithmetic can easily produce numbers which are out of the processor's normal range. Les Murray explains how systems programmers make sure your data is not lost when unwanted zeros overflow.



THE FUNDAMENTAL unit of data handled by the computer is the bit. It corresponds physically to some electronic device capable of being in one of two states which are by convention designated 0 and 1, and corresponding to off and on.

In most computer programs, the smallest element of data processed is the byte, a string of eight bits. These strings are essentially meaningless, so in order to make computers useful rules must be defined by which data can be translated into bit strings which can be manipulated.

The most arbitrary notation which can be devised is to assign to the bit strings a set of discrete codes, such as the ASCII code for typographic characters. Providing the computer and its peripherals heed the same rules they will appear to handle text such as you are reading now.

Yet the bulk of computer power the world over is expended not on typographic but numerical data. The binary integer is undoubtedly the most important single class of data in computing. It is of use when whole numbers are indicated, and many problems can be couched in terms such that integers will suffice. The integer notation is simple to understand and can be manipulated very quickly.

In scientific computation it is necessary to use numbers with fractional parts which mathematicians refer to as "real" numbers. Clearly a way is needed of representing such numbers within the computer.

The first technique which comes to mind is to place something corresponding to a decimal point within the bit string. As with decimal numbers, digits to the left of this radix point represent positive powers of 2; those to the right correspond to negative powers. So the bit immediately to the radix point correpsonds to 2^{-1} or $\frac{1}{2}$, the next bit corresponds to 2^{-2} or $\frac{1}{4}$ and so on. The radix point is not present in the word; instead its position is noted or fixed, and so this number representation is named "fixed point".

For many purposes this fixed-point representation of numbers is quite adequate. It has the great advantage that the numbers can be manipulated in a similar way to the integer notation and so can make use of the fast hardware provided in all computers for that purpose. It is used when the approximate size of the answer is known.

When it is not known, enough bits have to be allocated to the left of the radix point to allow for the size of the answer, and enough have to be allocated to the right of it to yield the desired accuracy.

It is an onerous task to determine the format of the necessary bit string, but the crucial objection is that it may well be impossible to determine it algorithmically. The first consideration may be a barrier: if you need to represent a very large number such as the age of the universe in seconds

Les Murray is a systems programmer with Plessey Radar

you will need a bit string hundreds of digits long. Such a bit string is not in itself impossible, but the accuracy with which it is possible to measure or justifiably estimate such a quantity means that there will be dozens of bits of wasted data between the least significant bit of the number and the radix point.

Less obviously, the same argument applies to tiny numbers such as Planck's constant as measured in SI units, which is of the order 10^{-34}. To the right of the radix point comes bit after bit of zero data, present — or rather absent — merely as place markers. Anyone who spent hours of toil on a computer program, only to see the fruits of their labour dropping uselessly out of the right- or left-hand end of a specified fixed-point number would be justified in seizing the nearest systems programmer by the lapels and demanding to know if there were a better way. As it happens, there is.

The fundamental requirement for representing real numbers is for numbers in the entire range of interest to be held without redundant bits. Consequently the number is always held to a certain minimum accuracy, which may be made as high as necessary. This result is achieved by combining the zero place-marker bits into an integer which denotes the position within the rest of the bit string of the radix point. The point is free to wander around the bit string, or even outside it, much as it chooses. The radix point is said to float: hence "floating point" numbers.

You have almost certainly encountered floating-point numbers in decimal form. Most modern calculators other than those which lurk in the back of cheque books offer a so-called scientific notation which is automatically called into play when the result is too big for the display. Numbers then appear like:

2.998 08

which, in full, would be written:

$$2.998 \times 10^8$$

The digits on the left comprise the significant part of the number and are called the mantissa. Those on the right which tell you what to do with the radix point — in this case, it should be moved eight places to the right — are called the exponent. Binary floating-point numbers are similar. The mantissa is a fixed-point binary number, and the exponent is a binary integer which defines a multiplication or division by a power of 2.

Early in my career as a programmer I had the interesting job of developing a floating-point mathematical package for the 6800 microprocessor. Floating-point numbers were called for since the package was to reside in a standard ROM to be fitted to a range of industrial and scientific equipment. The required accuracy with which the package held numbers was to be not worse than 0.003 percent.

The required accuracy determines how many bits must be allocated for the mantissa of the floating-point number. It is given by the ratio of the value of the least significant bit to that of the most significant

Binary numbers

One end of the bit-string, of whatever length chosen, will be designated the left, the other the right. Each bit corresponds to a digit. In decimal, each digit may take one of 10 values since the base or radix is 10. Bits can take only two values, 0 or 1, since the radix is 2.

The right-most bit of the binary number, the least significant, has a value of 2 to the power of zero, 2^0, which is equal to 1. It is usually called the "zeroth" bit of the word. Its neighbour has a value of 2^1 or 2. The next bit is equivalent to 2^2 or 4. And so on to 8, 16, 32 ... all the way to the most significant bit. The integer represented is the sum of the powers of 2 whose delegated bits are set. The vast majority of modern computers handle such binary integers.

Twos complements

Suppose you have an eight-bit number which is positive and you wish to negate it. You first complement — which means replace with its opposite — each bit of the number, then add 1 to it. For example, if the initial number is 3, the operation looks like this:

0000 0011	+3
1111 1100	complemented
1111 1101	incremented: −3

At first sight, the result looks dubious. However, you can repeat the process:

1111 1101	−3
0000 0010	complemented
0000 0011	incremented: +3

adding +3 to −3 should give zero:

0000 0011	+3
+ 1111 1101	−3
1 0000 0000	zero

So what about that 1 on the end? We are working in an eight-bit word, so the stray 1, the carry from the left-most bit of the sum, is discarded. Furthermore, if you attempt to negate zero:

0000 0000	zero
1111 1111	complemented
1 0000 0000	incremented: and back to zero.

Mathematically this is all very satisfying, as zero is signless. The principle can be extended to any number of bits.

bit. We chose a 16-bit mantissa, which gives an accuracy of one part in 32,767 or about 0.003 percent. The mantissa is a fixed-point number, and we chose a special case where the mantissa is a binary fraction in the range $\frac{1}{2}$ to 1. Restricting the range of the mantissa is called "normalisation" and has two important advantages: it ensures that the number of significant bits in the mantissa is maximised, and it curbs the tendency of the radix point to meander about during arithmetic operations.

Normalisation also provides a niche for the sign of the number. The left-most bit of the mantissa, equivalent to $\frac{1}{2}$ in this example, is always set since the mantissa is greater than or equal to $\frac{1}{2}$. Its presence can be assumed and the sign bit can be put there instead. The bit is clear for a positive number and set for a negative one. Before operating on the floating-point numbers the sign bits must always be extracted, their values noted, and the most significant bits of the mantissa must be set. Because the most significant bit is hidden by the sign bit, the mantissa of this form is said to be "hidden-bit normalised".

The exponent was chosen as an eight-bit signed integer. It needed to be positive or negative: if positive, the position of the radix point is moved to the left; if negative, to the right. The most significant bit of the mantissa is used as the sign of the integer and the same method would work for the exponent, but it can be improved upon. We chose to use the so-called twos complement notation for the exponent since it allows positive and negative numbers to be operated upon without first separating their sign bits — see panel.

We then went on to stipulate that the sign bit of the twos complement exponent shall be complemented. It was done for one very important reason: a zero is needed in the floating-point number scheme. So far, we have a mantissa of between $\frac{1}{2}$ and 1 and an exponent: no matter what the value of the exponent, the floating-point number can never equal zero.

A special case is therefore required — we chose to use an exponent of zero. The most negative number that can be represented in an eight-bit twos complement number is 1000 0000 or −128. By stipulating that the sign bit of the exponent be complemented, this becomes zero.

The first step in expressing a number in floating-point binary is to normalise the mantissa. Start with an exponent of zero and divide the number by 2 repeatedly until the quotient lies in the normalised range. For each division the exponent is incremented. Very soon we have:

$$1 = 1/2 \times 2^1$$

Converted to binary, and allowing for the covering of the hidden bit by the sign bit and the complementing of the sign of the exponent, this becomes:

.0000 0000 0000 0000	1000 0001
mantissa	exponent

The number 1, and indeed all integral powers of 2, are easily converted to floating point. A more meaty example is the speed of light in metres per second:

$$c = 2.998 \times 10^8$$

To generate a normalised mantissa you must divide by two 29 times, so the exponent is 29. In decimal, the mantissa is 0.56928 to five significant figures. Using only 16 bits to represent the mantissa, the accuracy with which it is held is, at worst,

(continued on next page)

Floating-point arithmetic

(continued from previous page)

one part in 32,767. We cannot claim to hold it to higher precision. In any case, if we divide right out, we end up with a binary fraction 29 bits long. Applying the usual rules of hidden-bit and complemented-exponent sign, we obtain:

C_{float} = .0000 1000 1000 1100
mantissa
1001 1101
exponent

If the number to be converted is less than 1 it must be repeatedly multiplied by 2, counting the exponent backwards from zero. To normalise −0.01 — it is not only less than 1 but negative to boot — multiply by 2 six times. The mantissa is therefore 0.64, and the exponent −6;

0.01_{float} = .1010 0011 1101 0111
↑ mantissa
sign
0111 1010
exponent

An interesting quirk of the way numbers work is that, although the decimal representation of 0.64 is exact, the binary fraction recurs after 21 digits.

Rational not real

As there are only 16 bits available, not an infinite number, the mantissa cannot be held exactly, but it is held to within a known amount of the actual value. Though many computer languages claim to deal in real numbers, a computer whose size is finite can only handle numbers which can be expressed as the quotient of two integers — the rational numbers. Perhaps the designers of computer languages should own up and declare a rational number type instead of real.

The range of absolute magnitudes of numbers of the floating-point notation which has just been described is approximately 0.5×2^{-127} to 2^{127} or 10^{-39} to 1.5×10^{38}. The smaller number is derived from a zero mantissa, equal to ½ with the hidden bit set and an exponent of −127. The larger is equivalent to a mantissa of almost 1 and an exponent of 127. Few serious problems involve numbers which cannot be represented by this modest floating-point system. If more accuracy is required you can simply extend the mantissa.

Having set up the system of floating-point numbers it is necessary to manipulate them. Multiplication is the easiest operation between two such numbers and relies on the algebraic relationship:

$$(a \times b^c) \times (d \times b^e) = a \times d \times b^{c+e}$$

If b = 2 there is an obvious relationship with floating-point numbers.

To multiply two floating-point numbers perform the following stages:

- Extract and note the signs, and set the hidden bits.
- Form the product of the mantissae.
- Form the sum of the exponents.
- Renormalise.
- Insert the sign of the result which is the logical Exclusive Or of the multiplicand signs.

Because the mantissae of the multiplicands lie between 0.5 and 1, their product must lie between 0.25 and 1. The most significant bit of the mantissa of the product is tested; if it is zero, the mantissa is shifted one digit left and the exponent decremented to compensate. You insert your sign, and there is the result.

Or is it? There are two error conditions which can arise during multiplication. The first is overflow, which occurs when the sum of the multiplicand exponents is greater than the maximum there is room for. The second is dubbed "underflow", which can occur when the sum of two negative exponents is too small and can also occur during renormalisation. It is also worth testing for zero in the multiplicands first since the product is then bound to be zero.

The stages for division are:

- Extract and note the signs, and set the hidden bits.
- Form the quotient of the mantissae.
- Subtract the exponents.
- Renormalise.
- Insert sign.

The result of the division of the mantissae will lie between 0.5 and 2 so, if necessary, the mantissa of the quotient is shifted right and its exponent incremented. Underflow and overflow are both possible and it is essential to check the divisor for zero before attempting the division.

Division of binary integers may appear fearfully complicated at first sight, but this complexity is more apparent than real. The quickest way to do it is to repeatedly subtract the divisor from the dividend, dividing the divisor by 2 between each subtraction. If the subtraction leaves a positive result, shift a 1 into the quotient's least significant end, if not, a zero. It is exactly equivalent to decimal long division, but is simplified as the result of each stage can be only 0 or 1, not 0 to 9.

Addition and subtraction of floating-point numbers are no more complicated than multiplication and division, but are more tedious. The processes are essentially the same: to subtract, change the sign of the subtrahend, then add.

The first stage of addition is to extract the signs and set the hidden bits. The next step is to compare the two operands. Comparison of floating-point numbers is as easy as could be: first compare the exponents and then, if they are equal, the mantissae. You need to know which operand has the smaller exponent; this operand is adjusted until its exponent is the same size as the other by incrementing the smaller exponent and dividing its corresponding mantissa by 2 repeatedly.

A decimal example shows why this is necessary:

$2.5 \times 10^5 + 2.5 \times 10^4 =$
$2.5 \times 10^5 + 0.25 \times 10^5 =$
2.75×10^5

An underflow condition can occur here. If the addends differ by a factor of 2^{16} then, by the time the exponent of the smaller one has been rendered equal to that of the larger, all the bits of its mantissa will have vanished. If this matters there is only one recourse: a longer mantissa.

What happens next depends on the original signs of the addends. If they are the same, add the mantissae; if different, the mantissa which has been shifted, or which was naturally the smaller, is subtracted from the larger one. The result lies in the range zero to 2, so you must normalise after checking for zero to avoid entering an infinite loop. Underflow or overflow may be detected during this operation. It remains only to plug the sign into the result, which is the sign of the addend whose absolute magnitude was larger.

Complicated functions

The basic arithmetic operations can be combined to produce more complicated functions such as logarithm, sine, exponential and so on, using polynomial approximations to the appropriate series, or more devious methods. For example, to take the logarithm of a floating-point number you can utilise the fact that is is held in exponent and mantissa format. First, approximate the logarithm of the mantissa to base 2. Since the answer is limited ot the range −1 to zero you can use a very short polynomial and still achieve the required accuracy. For our 16-bit mantissae we used a fourth-power polynomial, which can be factorised so as to comprise just four multiplications and five additions. After processing the mantissa, convert the exponent to a floating-point number itself and add it to the logarithm of the mantissa. This is the logarithm to base 2 of the original floating-point number, according to the relationship:

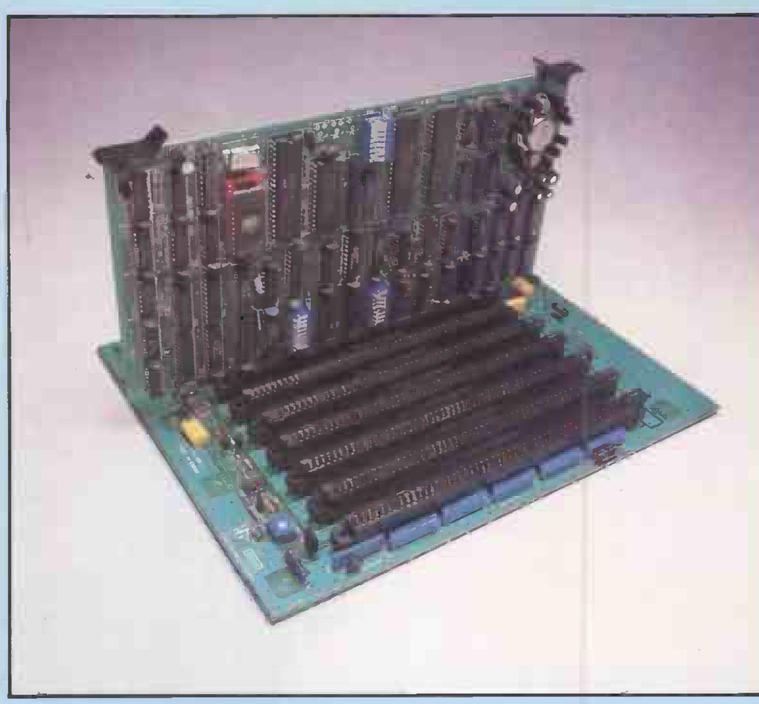
$$\log_2(m \times 2^e) = \log_2 m + e$$

Multiplication by a constant then gives the logarithm to any base.

The whole procedure, like those for the various other functions, is rather long-winded, which is why a hand calculator takes so much longer over them than over the basic arithmetic ones. If speed is vital, an alternative is to hold a table of key values in memory and interpolate between them, exactly as a set of mathematical tables — remember them? — is used.

Any representation of data within a computer is useless unless it can be converted to human-readable forms. One of the largest drawbacks with floating-point numbers is that such conversion is tedious, involving repeated division by 10, extraction of remainders, conversion of floating-point numbers to fixed point and finally, conversion of those to ASCII.

mily



TurboDOS

CP/M COMPATIBLE MULTI-USER OPERATING SYSTEM

TurboDOS is a popular high-performance multi-processor operating system. Each user has their own slave processor board (illustrated above). TurboDOS systems have been shown to out-perform mini-computers in the DEC PDP11/34 class at a fraction of the hardware cost.

TurboDOS is compatible with CP/M, the industry standard operating system, which means you have access to a vast range of off-the-shelf software.

The next development to TurboDOS on the Minstrel allows you to connect systems together via a Local Area Network.

One machine – eight computers

Yes! Inside the Minstrel micro-computer illustrated there are actually 8 Z80A single-board computers. One is dedicated to each user of the system resulting in astonishing performance. A ninth processor controls central disk storage and printers.

TurboDOS provides sophisticated spooling for multiple printers, supports 1000Mb disk drives and 128Mb files, and employs powerful disk buffering techniques.

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How to make a million

SO YOU WANT TO become a millionaire by playing the U.S. stock market? Start by playing Millionaire, a simulation game from Blue Chip Software of California. The game is claimed to be "so realistic that it is recommended for use in maths or economics classes". The price is £70, or £60 for the Apple II version.

Four educational games for ages five to adult come from Spinnaker Software, Cambridge Mass. The titles are Granite Ghost, Disappearing Dolphin, Story Machine and Facemaker. Prices range from £25 to £33 plus VAT.

All the above are available from Pete & Pam Computers, New Hall Hey Road, Rawtenstall, Lancashire BB4 6JG. Tel: (0706) 227011.

Compatibility with Apple II

LAST MONTH we announced an 8088 board to make an Apple think like an IBM PC. This month Quadram has a plug-in card that makes an IBM PC think it's an Apple.

Not only does Quadlink run Apple software, it does it using the IBM disc drives with software to read Apple-format discs. The card carries a 6502 microprocessor and 64K of RAM.

Contact Quadram Corporation, 4357 Park Drive, Norcross, Ga 30093. Telephone: (404) 923 6666.

Engineers' selection

THE STEMMOS RANGE of desk-top engineering packages is now available on the IBM PC. The most popular ones, previously available for CP/M micros, are Superframe, Superpipe and Superrig.

The packages are aids for offshore engineers in static analysis for three-dimensional space-frame structures, such as steel jack-up platforms designed to withstand extreme static and dynamic loads.

Stemmos is now operating from larger premises at 199 Uxbridge Road, London W12. Telephone: 01-740 9444.

PC goodies from IBM

IBM (U.K.) has announced 11 enhancements — both hardware and software — for the PC. They range from a new colour monitor through an APL implementation to 101 maze games.

IBM Colour Display. A high-quality direct-drive monitor for colour text and graphics, using the Colour/Graphics Monitor Adaptor in one of the expansion slots. The new monitor has a 13in. screen, weighs 12kg. and costs £520.

BSC Adaptor. The Binary Synchronous Communications adaptor is a plug-in card that allows networking using BSC protocols. Price: £230.

BSC-3270 Emulation Program. With the BSC adaptor this lets the PC pretend to be a 3270 terminal and talk to an IBM mainframe. Price: £581.

8087 maths chip. The Intel 8087 co-processor multiplies 32- and 64-bit floating-point numbers about 80 times faster than the 8088. The option kit includes a matched pair of 8087 and 8088 chips. The 8088 replaces the one you have and the 8087 fits an existing socket on the bigboard. Price: £214.

IBM PC APL. IBM first launched this powerful language on a mainframe in 1977. The PC version requires 128K of memory, the 8087 maths co-processor and an IBM colour display. For a brief account of the power of APL see the April issue of *Practical Computing*, page 107. IBM's APL costs £165.

Professional Editor. Provides powerful editing and scrolling commands including search/change, block move, formatting commands and macros. Price: £113.

Basic Primer. A tutorial on a disc, the Basic Primer assumes no computer knowledge and takes you from learning the keyboard to keeping cheque-book records. Price: £53.

UCSD p-system run-time support. Provides the appropriate software to run programs written under the UCSD p-system Version IV.03. The system supports programs written in Pascal, Basic and Fortran-77. It costs £41.

File Command. This utility is a DOS handler which allows files to be sorted by size, date, alphabetically by file name or extension, and by drive and directory path. File Command also defines the function keys under DOS. Price: £31.

Strategy Games: A set of four popular board games — draughts, elusion, battleship and reversi.

101 Monochrome Mazes. Just what it says. The mazes include black pools, trapdoors and pop-up walls. There are 10 levels of difficulty and nine game speeds. Price: £31.

All the introductions are promised for September, except the Basic Primer which should be available now. All the prices quoted exclude VAT.

If all the slots on your PC are full, maybe you need the Sup'r Extender from M&R Enterprises. It connects to the PC via two 60-line ribbon interface cables, and provides six extra expansion slots for standard plug-in boards. The price is around $5,000. Contact M&R Enterprises, 910 George Street, Santa Clara, CA 95050. Telephone: (408) 980 0160.

As an increasing number of readers are acquiring IBM PCs and various look-alikes, we felt that — like other major micros — it should have its own place in *Practical Computing*. This is it.
In future issues, PC Bulletin will carry news, reviews and software stories. If you have any hints and enhancements, utilities or short programs, send them in.
Our aim is to make this column an extra "expansion slot" for IBM PC. But it will only expand if you join in. Send your contributions to PCB at *Practical Computing*, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.

Happy families

THE SOFTWARE PUBLISHING CORP has launched a family of software for the IBM PC. The packages are PFS:File, PFS:Report, PFS:Graph and PFS:Write. The Write and Graph programs can be used with VisiCalc files. Contact Software Publishing Corporation, 1,901 Landinds Drive, Mountain View, California 94043, Telephone: (415) 962 8910.

Another family of PC software is the Professional Business Library from Texasoft. It comprises Versatext, The Thinker and PCFile. The Thinker is a spreadsheet program. All three together are called the Texasoft Combo Pac by Pete & Pam, who will sell them to you for £249.

British-made software for the IBM PC now includes the Pegasus suite, which covers the spectrum of accounting needs including payroll. The packages are already well established on the Sirius and Commodore micros. If you want to see or buy them, you have to contact your local dealer.

IBM XT

In the first part of this review, Jack Scholfield sets the hard-disc version of the IBM Personal Computer in context with its competitors.

AS A GENERAL rule, only idiots wait for the wonderful new machines that computer firms perpetually promise. And if they appear, only idiots and software writers buy them. This rule has very few exceptions, but one of them is the IBM XT, simply because it sets a standard other machines will aspire to.

The IBM Personal Computer was first launched in the United States in August 1981 and immediately became a best-seller. IBM's marketing men did it right: they had stocks in the shops, they had software, and they had an agressive price. The entry-level PC system was a 16K cassette-based micro priced to give Apple a hard time, so the PC was bought as a home micro as well as for small-business use.

The PC also had something no other machine had: the initials of the world's largest and most powerful computer firm on the front. The IBM sold massively, and estimates put its market share in 1982 somewhere between 18 and 25 percent. Not bad for starters.

The U.S. success delayed the introduction of the PC in Europe. For a while, grey imports were obtainable — American machines supplied with step-down transformers and American monitors — but finally, on January 18 this year, IBM launched the British version. Again there was software and again there were already machines in the shops.

The British PC showed a number of differences from the American original. It now had 64K memory chips, and thus no 16K version. No cassette-based version was announced, and the disc drives had been upgraded to 320K. The software ran to more than 30 packages under the IBM label alone. They included CP/M-86 and the UCSD p-System, as well as MS-DOS; Cobol, Fortran and Pascal as well as Basic and assembler; a colour version of Multiplan; and a number of games.

The new PC included a U.K. keyboard with a DOS file to configure the operating system to match. Other national keyboards such as French and Italian were launched at the same time. In other words, even at its launch the IBM PC was a purchasable option.

Conservative design

Some people expressed surprise and regret that the new machine was not more revolutionary. It did not, for example, feature an 8086 full 16-bit processor instead of the 8088, nor did it sport PC-DOS version 2. The complaints were dumb. IBM had a clear view of the serious market, which is for a stable machine that works, is as bug-free as possible, has lots of software and is well supported. These are far more important aspects than the technological flashiness which some companies offer, both through novel architectures and "own brand" operating systems.

If there was something to carp about it was the price, which was far less agressive than in the U.S. It was low enough to hurt only the grey importers, not the makers of IBM look-alikes. One factor was that the PC was already in short supply, so why cut the price?

At the launch, IBM announced that it was going to start manufacturing PCs for all of Europe at Greenock in Scotland. With this production facility coming on stream later this year there is every hope of price reductions. After all, IBM has significantly reduced its American prices since the launch, and recently took 30 percent off the cost of the Displaywriter. In its current mood, IBM is capable of out-marketing anyone.

The IBM XT was launched in both the U.S. and the U.K. earlier this year, though machines did not become available here until June. The exernal appearance of the

When you power on the XT it shows it is working by signalling the checking routines.

XT is almost identical to the PC, except for the hard disc which replaces floppy drive B. This required no great feat of engineering, but essential to the XT was the availability of MS-DOS 2 to provide the operating system facilities to run the hard disc.

IBM also made a number of less obvious changes in producing the XT. For example:

- it features a new ROM and BIOS, basic input/output systems;
- the minimum RAM is 128K instead of 64K;
- the motherboard has eight expansion slots instead of five;
- the power supply is larger to support the hard disc;
- the floppy disc writes nine sectors of data per track instead of eight, giving 360K of storage per double-sided drive instead of 320K;
- the DIN socket for cassette operation is no longer fitted.

The XT is installed in exactly the same way as the PC, with the same plugs and connections. It is easy to do and there is not much to go wrong. However, while the printer and monitor cables have holding screws to prevent them being tugged out by accident, the power cable doesn't and can be. This can lead to disaster. The keyboard's DIN output port is awkwardly sited on the back of the system box instead of the front. The monitor requires separate video and power leads. Some micros combine them in one cable, but as the IBM drives the monitor from a card in an expansion slot, there is no way round this.

A major difference is obvious when you power on. Instead of playing dead like the old PC, the XT shows it is working by signalling the RAM checking on the screen. The system checks the floppy drive A, then the hard disc C, for a bootable operating system. If it does not find one it defaults to the Basic in ROM with 62,940 bytes free.

Initially you will start with a DOS 2 Master in drive A. You would expect it to take you through making your own system master and putting Keybuk in an Autoexec. bat file . . . That way, booting DOS automatically configures the U.K. keyboard to produce the right codes. DOS 2 doesn't. There is no Keybuk file. The result is that you have a keyboard with English markings producing American output. Thus you have to press @ for " and so on. Running American software is a doddle, but that is not the idea at all.

IBM says that the DOS 2 disc it now supplies does have the Keybuk file on it, so there should be no problem. However, any U.K. user who wants to experience life with a U.S. keyboard — with U.K. markings — can do so by pressing Ctrl-Alt-F1 together.

There are a couple more areas where the XT is not quite as kosher as the standard PC. For example, the DOS 2 information and DOS 1 corrections come on separate sheets. You have to spend an hour integrating them into a DOS 1 manual to get your final documentation. When you take the lid off to fit an extra 128K of RAM you find that the board layout supplied with the chips does not match the XT board itself. Worse, the book shows two Dip switches to set to tell the XT how much memory it has, but there is only one switch on the board. You have 256K of expensive RAM chips but only 128K accessible.

However, the DOS Manual does take you step by step through copying the two DOS discs on to the hard disc so that the XT boots from it automatically when you switch on. The hidden MS-DOS files can be transferred automatically during the hard-disc formatting stage. Copying the other files is really easy using the wild cards. Simply use, from the A>7 prompt

COPY *. * C:

and it is done.

There are two DOS discs because the Samples programs are now supplied on a separate one. As DOS is larger they will not both fit on one 160K single-sided disc. It is a reminder that even the upgraded IBM drives do not exactly offer state-of-the-art storage.

The U.K. keyboard is catered for by current versions of the DOS 2 disc.

The system uses 41,472 bytes, which leaves 10,303.5K free on the hard disc. it is a fairly comfortable amount for most single users, and this is not a multi-user disc.

The manual is also clear on dividing up the hard disc into different sections. You do not divide parts of the hard disc into different nominal drives, as you might with CP/M-80. What you can do at any time is partition the hard disc so that part is dedicated to PC-DOS, part to UCSD p-System, part to CP/M-86 and so on. You can have up to four partitions.

This facility is vital. If after six months you bought Concurrent CP/M it would be very embarrassing if the hard disc was tied to PC-DOS. You would be stuck with running a single-floppy system or embarking on a very long copying session.

What the manual does not do is properly stress the importance of organising the PC-DOS part of the disc into separate sub-directories. There is bound to be some poor user, who, after a few weeks, types Dir and sees several megabytes of small files stream endlessly by. It does explain how to create and use directories and sub-directories. DOS 2 has a tree structure like Unix, and it uses Unix or Unix-like commands. To change a directory, for example, you type Chdir or — just as in Unix — cd.

Batch files

To take this idea further, the manual is somewhat murky on the subject of setting up batch files. Suppose you divide the hard disc into separate areas for, say, The Final Word, Multiplan or VisiCalc, or Pulsar or whatever your particular brand of poison. The manual should explain how to boot them from a short set of Autoexec.bat files. An even better idea is to run this from a master menu, like a Unix-type shell. Or alternatively, run them using the function keys, as with the Dynalogic Hyperion reviewed last month.

It is easy to produce a master menu which boots automatically from an Autoexec.bat file into Basic so that you can run Basic programs this way. It is not so easy to do it in DOS using Copy.Con. I tried it but did not manage to make it work.

As delivered, DOS 2 seems to lack a way of programming the function keys within the operating system, in the Hyperion style. This must mean you have to buy the File Command utility, announced in this month's PCB News on page 129. Or if not, blame the manual!

It must be said that I thought the IBM manuals were quite good until I saw the Zenith Z-110 versions. Look out for our review of this excellent machine next month, when this IBM XT review will be continued.

TK!SOLVER

Jack Schofield tries out the latest from the firm that brought you VisiCalc.

SOFTWARE ARTS wrote the world's most successful microcomputer software package, VisiCalc, with sales of over $25,000,000. Its follow-up, TK!Solver, brings the same kind of convenience to problem solving.

The idea of TK!Solver is that you enter rules or equations on a rule sheet, then input values on a variable sheet. Press ! and Hey Presto! the answers appear in the output column.

You could get the same answer with a programmable calculator or, according to the type of problem, by using an electronic spreadsheet or by writing a quick Basic or Fortran program to do it. In that sense TK!Solver does not offer anything new. What it does is offer more:

- You do not need to be any sort of programmer to use TK!Solver. You only need to be able to type tk in response to the >A prompt.
- It will cope with a wide variety of calculations from mortgage and loan to cylindrical wall heat transfer.
- You can save, load and merge models easily. You can transfer data interchange format, Df, files too.
- TK!Solver has numerous built-in functions including the obvious trig. ones, net present value, and Poly for the value of a polynomial.
- There is a built-in graph-plotting extension.

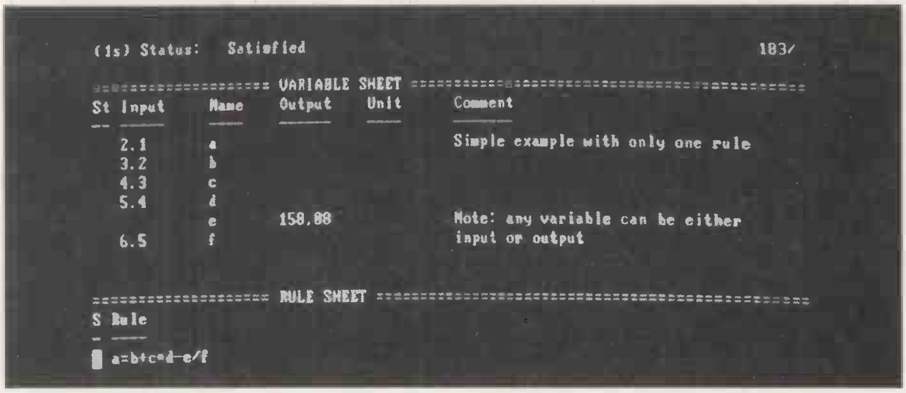
Most of these advantages also apply to VisiCalc, but TK!Solver has one further advantage: the computations are not position dependent. Beginning VisiCalc users can get dramatically wrong results by setting up sheets where calculations are done in the wrong order. Spreadsheets are not reversible, but TK!Solver is. It is OK to have cell A1 plus cell A2 equal to cell A3 in VisiCalc, but if you change cell A3 it will not calculate backwards to give a new value for A1 or A2. With TK!Solver, the rule $a+b=c$ also implies that of necessity $a=c-b$. In other words, it deals with equalities not assignments.

This makes TK!Solver very friendly towards non-computerists. The one thing to watch is that the computer's convention of * for times must be adhered to.

$$ab + ac = a(b+c)$$

must be written as a*b + a*c = a*(b+c) or else ab and ac will be taken as variable names and a() as a function. This does not create problems in practice because all the variables are listed on the Variable sheet after a rule has been entered.

TK!Solver is extremely easy to use. A rule can be typed in straight away, on the Rule sheet, and on pressing Return the



variable names are automatically listed on the Variable sheet. You can then cursor down one space and enter another rule or else press ; to move to the input part of the Variable sheet. Using the cursor controls to step through the variable names, you enter the known values. Press ! and the unknown values are calculated, assuming all the information is there. That's all there is to it.

After that you can start to play "What if?", as with VisiCalc, with the advantage that you can have any variable as either an input or an output. It is ideal for the student's traditional lab practice of working backwards from the answer via "experimental error" to arrive at the correct observations.

Having produced this wonderfully simple facility, Software Arts has added some extras. The Variable sheet has columns for St or status, Units and Comments too. The St column tells you if the equations are overdefined — that is, input values conflict — or are satisfied. The Comment field allows comments. The Units column allows automatic conversion between units.

Pressing =u takes you to the Units sheet, where you can enter conversion factors for all the different units. It is possible to enter your calculation in, say, an unholy mixture of cubic centilitres and U.S. fluid ounces and get an Imperial result. It may be bad for the soul, but it is wonderfully convenient.

There are four other sheets, which can also have subsheets. They are List, User Function, Table and Plot. The List sheet and subsheet provide a sort of For-Next-Step facility. Suppose you wanted to find mortgage payments for interest rates from 10 to 20 percent? The List tables will do it, and provide automatic fill, so you do not need to enter the individual values separately.

The Table and Plot sheets provide ways of comparing lists of values. The Table sheet provides comparison tables. The Plot sheet will graph one or more sets of values on specified axes for a more visual comparison. It is somewhat like having VisiTrend and VisiPlot working in unison with VisiCalc, but at no extra cost.

Using these accessory sheets is, of course, not as straightforward as using the Rule and Variable sheets, but the massively thorough documentation takes you through the problems step by step with worked examples. The documentation includes a large colour poster, which is an invaluable quick guide to which command takes you where. For people who cannot be bothered with documentation there is an *Introductory Guide* which gets you up and running inside five minutes.

Now the bad news: TK!Solver is only available to those who have an IBM Personal Computer with a minimum of 96K, and it assumes an American keyboard. It is non-copyable, though two copies of the program disc are supplied. Versions are expected to follow for the DEC Professional and Rainbow 100.

Conclusions

- **TK!Solver is an outstanding piece of software. Any scientist, engineer, high-level financial manager or student in these fields would find it invaluable.**
- **It is not as flexible a tool as VisiCalc and does not have the same variety of applications, so is unlikely to sell in similarly vast quantities.**
- **The ability to use Dif files is a valuable feature as it allows data interchange with the Visi range, Chartmaster, Graphmagic and other software.**
- **TK!Solver is produced by Software Arts Inc, 27 Mica Lane, Wellesley, Massachusetts 02181. Telephone: (617) 237 4000. U.K. distribution is expected to folow shortly.**

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Although the NewBrain is conceived as a total system, the unexpanded Processor itself has a great deal to offer. It is available in two forms: Model AD, shown below, with a built-in line display; and Model A, without the line display. Both models can operate with a monitor or a television set.

MEMORY

□ 24K bytes of ROM;
□ 32K bytes of RAM, at least 28K of which is available to the user.

THE SCREEN DISPLAY

□ 40 or 80 characters to the line – without affecting the 28K bytes of RAM at your disposal;
□ 24 or 30 lines to the screen;
□ well-formed characters, with true descenders;
□ a full European character set;
□ normal or reverse video, high resolution graphics on screen of controllable size, 256, 320, 512 or 640 horizontal resolution by 250 vertical lines;
□ a facility to set up a "page" of up to 255 lines, with the screen acting as a "window" to display it;
□ ability to maintain several such pages simultaneously, and to switch rapidly between them;
□ text may be used on graphics screen as well as on parts of the video screen not used by graphics.

CHARACTER SET

□ 512 characters, including the full ASCII set, all European accented characters, Greek and graphics symbols.

GRAPHICS

□ 20 powerful graphics commands;
□ all text characters usable on the graphics screen;
□ variable-sized graphics screen, with the rest of the screen available for text – for versatility and to save memory.

*CP/M IS A REGISTERED TRADE MARK OF DIGITAL RESEARCH INC.

SOFTWARE

Enhanced ANSI BASIC; screen editor (32 commands); mathematics package (10 significant figures); graphics commands.

□ a very friendly screen editor – a delight to use and readily adapted to text processing;
□ arithmetic to 10 significant figures;
□ very controllable output formatting of numbers – invaluable for accounting, statistics, and scientific applications;
□ a powerful, much enhanced BASIC;
□ a very flexible operating system, which allows any data stream to be opened to any device.

INTERFACES

□ two tape cassette ports built into the processor unit;
□ a built-in printer interface;
□ a built-in communications interface (V24/RS232);
□ a video monitor interface;
□ a TV interface;
□ an expansion interface for NewBrain system expansion modules.

KEYBOARD

□ standard typewriter pitch, action, layout and size, with editing control and graphics keys.

You can get everything in the box on th

If you understand the facts and figures on the left you'll soon realise that NewBrain has to be one of the most powerful micros around.

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It comes with a very powerful language (enhanced ANSI BASIC) and it'll take CP/M,* so it'll work on the same system as similar big business micros, giving you the capacity to use an almost limitless variety of tried and tested software.

But most of all NewBrain is a machine that can expand.

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Open File

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

Open File is the part of the magazine written by you, the readers. All aspects of microcomputing are covered, from games to serious business and technical software, and we welcome contributions on CP/M, BBC Basic, Microsoft Basic, Apple Pascal and so on, as well as the established categories.

Contributors receive £30 per published page and pro rata for part pages, with a minimum of £6. Send contributions to: Open File, *Practical Computing*, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.

Guidelines for contributors

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.

PLEASE send a cassette or disc version of your program if at all possible. It will be returned after use. For CP/M programs use IBM-format 8in. floppy discs.

COMMODORE CORNER

by Mike Todd

Vic accounts

AN EXPANDED VIC will run this home-accounting program submitted by Mark Martin of Benfleet, Essex. The program and data storage takes just over 6.5K and so it requires a minimum of 8K expansion memory.

By omitting lines 1670 to 1970 and the Gosub1670 in line 10 you will save enough memory to allow the program to run in a Vic with only 3K of expansion memory. These lines merely generate a curious title page and set up the screen colours and are not an essential part of the program.

The program asks for your current balance. A menu is written on the screen, and pressing the appropriate key will take you into one of the nine options. The most important is the Add Data option. It gives you the current balance and then allows you to input details of the transaction, whether it is a credit or debit and the amount. Pressing * and Return will take you back to the menu.

Two listing options are provided. The first prints a complete list of transactions to the printer, and the second prints them on the screen, with a "window" showing the current transaction. There is an opportunity here to make amendments as required. To move the down, one item at a time, use the F3 and F5 keys. To move the data five at a time use the F1 and F7 keys; * will always return to the menu.

Data can be loaded from tape, updated and saved back to tape. It is probably best to use a separate data cassette for this, as it will be necessary to rewind the tape to the start when saving updated data.

The number of transactions is limited to 50, which could cause problems with some accounts. The second Load in the menu therefore provides a facility to load only the final transaction in the data file to give you the current balance and an "empty" computer. New data items can then be added and stored as a new data file.

With extra memory the 50-transaction

(continued on next page)

(continued from previous page)

limit could be increased significantly. You would simply need to change every occurrence of 50 in the program; maybe it would be better to define a variable at the start to specify the maximum number of transactions.

Using cassettes can be very slow, especially with large quantities of data, and there is no reason why the Load and Save routines should not be adapted to cope with discs. Lines 390 and 810 would have to be changed to the equivalent disc commands.

Considerable thought has gone into the design of the program. A special input subroutine prevents the user typing in characters that ought not to be typed in. Adequate instructions are given as the program progresses, and pressing * at most points will return to the menu. Any changes introduced in the data will automatically be reflected in the current balance, and there is the ability to search all transactions for an item, specified by its name.

The name of each transaction is limited to eight characters — enough to allow cheque numbers to be included — and the amounts are limited to £9,999.99.

Lines 10 to 260 are the main routine, which sets up arrays and variables and the menu and selection for each of the command routines located at lines 270 to 1590. Formatting of the data for display on the screen is done in lines 1460 to 1500. Lines 1600 to 1660 actually format the numbers for display.

Lines 1670 to 1970 generate the title page and can be omitted to save space. Lines 1980 to 2090 contain the input subroutine. They could usefully be adapted and applied to other programs.

Because the program uses fairly sophisticated screen formatting, it is full of screen control characters and long strings of graphics characters. For instance there are 22 horizontal lines in lines 920, 950, 1240 and 1250, with 22 spaces in the middle of line 950.

The Pokes in the program are used to generate the audio tones or change the screen colours and could be omitted. The Peeks and Pokes in the input subroutine in lines 1980 to 2090 cannot be omitted as they are used to determine where on the screen the characters are to be printed when a key is pressed.

Enhance Rems

Rem statements are normally used to add remarks to a Basic program, but they can also be used to segment a program, making the listing more readable. We have received several programs which make Rem statements stand out in one way or another, and this one from G M Rossetti of Kingsbridge, South Devon, is probably the simplest.

It comes in two versions. The first is in machine code and occupies 59 bytes of the second cassette buffer. Once it has been loaded and run, Sys 826 will take any Rem which is in the form:

10 REM # # #

and replace the three # characters by CHR$(21), which in Basic 4 will delete the line, followed by two Carriage Returns. The result is a break in the program when listed. Any comments after the # marks will still appear and could be used as a block heading.

If you prefer not to use machine code, there is a Basic version which can be placed anywhere within a larger Basic

(continued on page 140)

Vic accounts.

```
10 GOSUB1670:PRINT"■"
20 DIME$(50),MN(50),TT(50)
30 FORA=1TO50:E$(A)="********":NEXT
40 GOSUB280
50 PRINT"■  ACCOUNTS PROGRAM          ————————————"
60 PRINT"■OPTIONS ARE;-"
70 PRINT"■ A = ADD DATA"
80 PRINT"■ B = LOAD (DATA)"
90 PRINT"■ C = LOAD (BALANCE)"
100 PRINT"■ D = DISPLAY/PRINTER"
110 PRINT"■ E = DISPLAY/EDIT"
120 PRINT"■ F = SAVE NEW DATA"
130 PRINT"■ G = RENEW BALANCE"
140 PRINT"■ H = CLEAR MEMORY"
150 PRINT"■ I = SEARCH STRING"
160 FORA=0TO49:TT(A+1)=TT(A)+MN(A+1):NEXT
170 GETA$:IFA$=""THEN170
180 CH=ASC(A$)-64
190 IFCH<1ORCH>9THEN170
200 PRINT"■■■■"LEFT$("■■■■■■■■■■■■■■■■■■■■",CH*2)" "A$" "
210 POKE36878,15:POKE36876,CH*5+160
220 IFCC>50ANDCH=1THENFORA=1TO1000:NEXT:POKE36876,0:POKE36878,0:GOTO50
230 FORA=1TO1000:NEXT
240 POKE36878,0:POKE36876,0
250 ONCHGOSUB880,330,490,650,1190,800,280,1520,530
260 GOTO50
270 REM ** RENEW BALANCE **
280 PRINT"■NEW BALANCE ? ":PRINT"■(-9999.99 TO 9999.99)■":MX=7:GOSUB1980:TT(0)=V
AL(IN$)
290 IFTT(0)<-9999.99ORTT(0)>9999.99THEN280
300 E$(0)="BALANCE-":MN(0)=0
310 RETURN
320 REM ** LOAD DATA **
330 POKE36879,59:IFLD$<>"BALANCE"THENLD$="DATA"
340 LD$=LD$+" FROM TAPE"
350 PRINT"■■"TAB(11-LEN(LD$)/2)LD$
360 PRINT"■NAME OF FILE■":MX=8:GOSUB1980:NM$=IN$:PRINT"■"
370 POKE36879,42
380 POKE36878,15:POKE36876,230:FORA=1TO500:NEXT:POKE36878,0:POKE36876,0
390 OPEN1,1,0,NM$
400 PRINT"■FOUND ";NM$
410 POKE36879,127
420 FORA=0TO50
430 INPUT#1,E$(A):E$(A)=LEFT$(E$(A),8)
440 INPUT#1,MN(A):INPUT#1,TT(A):NEXT:INPUT#1,CC
450 CLOSE1
460 POKE36879,59:PRINT"■"
470 RETURN
480 REM ** LOAD BALANCE **
490 LD$="BALANCE":GOSUB330:E$(0)="BALANCE-"
500 MN(0)=0:TT(0)=TT(CC-1):FORA=1TO50:E$(A)="********":MN(A)=0
510 TT(A)=0:CC=0:NEXT:RETURN
520 REM ** SEARCH **
530 PRINT"■WHAT ITEM DO YOU WANT"
540 MX=8:GOSUB1980
550 PRINT:PRINT
560 FORA=0TO50
570 IFIN$<>LEFT$(E$(A),LEN(IN$))THEN600
580 GOSUB1460
590 POKE36878,15:POKE36876,220:POKE36876,0:POKE36878,0
600 NEXT
610 PRINT"PRESS * TO EXIT"
620 GETA$:IFA$<>"*"THEN620
630 RETURN
640 REM ** DISPLAY/PRINTER **
650 PRINT"■ARE YOU SURE (Y/N) ?"
660 GETA$:IFA$<>"Y"ANDA$<>"N"THEN660
670 IFA$="N"THENRETURN
680 OPEN4,4:PRINT"■"
690 PRINT#4,CHR$(14);"ACCOUNTS":PRINT"ACCOUNTS"
700 PRINT#4
710 FORA=0TO50
720 IFE$(A)="********"THEN770
730 PRINT#4,E$(A)"  ";:PRINTE$(A);
740 C$="■":IFMN(A)<0THENC$="■"
750 X=ABS(MN(A)):GOSUB1600:PRINT#4,C$X$"■  ";:PRINTC$MID$(X$,3)"■";
760 X=TT(A):GOSUB1600:PRINT#4,X$:PRINTX$;
770 NEXT:CLOSE4
780 RETURN
790 REM ** SAVE DATA **
800 PRINT"■NAME OF FILE":MX=8:GOSUB1980:NM$=IN$:PRINT:PRINT
810 OPEN1,1,1,NM$
820 PRINT"■"
830 FORA=0TO50
840 PRINT"■NAME:"NM$:PRINT"■BLOCK:"A
850 PRINT#1,E$(A):PRINT#1,MN(A):PRINT#1,TT(A)
860 NEXT:PRINT#1,CC:CLOSE1:RETURN
870 REM ** ADD DATA **
880 CC=CC+1:IFCC>50THENPRINT"■OUT OF SPACE":PRINT"■SAVE DATA":FORA=1TO3000:NEXT:
GOTO50
890 PRINT"■* = RETURN TO MENU"
900 IFCC>50THENCC=50
910 IFCC<1THENCC=1
920 PRINT"■■■■■■■■■■■■■——————————————————————■■";
930 TT(CC)=TT(CC-1)
940 X=TT(CC):GOSUB1600:PRINT"TOTAL £"X$;
950 PRINT"■■■■■■■■■———————————                      ————————————
———"
960 PRINT"■■■■■■■EVENT"CC"■ (8 CHARS) ■■■■■■■■■■■■■■■■■TYPE EVENT OR CHEQUE  ■
 NUMBER"
970 PRINT"■■■■■■■■■■■";
980 MX=8:GOSUB1980:A$=IN$
990 IFA$="*"THENCC=CC-1:GOTO1170
1000 A$=A$+MID$("        ",LEN(A$)+1)
1010 E$(CC)=A$:PRINT
1020 POKE36878,15:POKE36876,220:POKE36876,0:POKE36878,0
1030 PRINT"■■■■■■■■■■■■■■■■■ INPUT   WHETHER  THE ■ AMOUNT  IS  DEBIT OR ■ CREDIT
".
1040 PRINT"■■■■■■■■C■REDIT,■D■EBIT OR ■E■DIT"
1050 GETA$:IFA$<>"D"ANDA$<>"C"ANDA$<>"E"THEN1050
1060 IFA$="D"THENF1=-1:PRINT"■■■■■■■■DEBIT"
1070 IFA$="C"THENF1=1:PRINT"■■CREDIT"
1080 IFA$="E"THEN890
1090 PRINT"■■■■■■■■■■■■■■■■■THE AMOUNT TO BE INPUT■
    "
1100 PRINT"■■■■■■■■■■■■■■■■■■■■■";:MX=6:GOSUB1980:A$=IN$
1110 IFVAL(A$)>999.99ORVAL(A$)<0THENPRINT"■■■":GOTO1100
1120 MN(CC)=VAL(A$)*F1
1130 IN=CC-1
1140 IFE$(IN)="********"THENIN=IN-1:GOTO1140
1150 TT(CC)=TT(IN)+MN(CC)
1160 GOTO880
1170 RETURN
1180 REM ** DISPLAY/EDIT **
1190 PO=-10:PRINT"■"
1200 PRINT"■WINDOW:"PO+11"■ ":PRINT"■■■■■■■■■■■■ * = EXIT":FORA=POTOPO+10
1210 IFA<0THENPRINT"                      ";:GOTO1230
1220 GOSUB1460
1230 NEXT
1240 PRINT"■■■■■■■■■■■■■——————————————————————";:A=PO+11:GOSUB1460
1250 PRINT"——————————————————————";
1260 FORA=PO+12TOPO+18:IFA>50THENPRINT"                      ";:GOTO1290
1270 GOSUB1460
1280 NEXT
1290 GETA$:IFA$=""THEN1290
```

(listing continued on page 140)

(continued from page 138)

program. Both programs work in the same way, looking for the character sequence 143, 35, 35, 35 and replacing 35, 35, 35, by 21, 13, 13.

There is no reason why these characters should not be replaced by any sequence you like, excluding zero. Replacing the first 35 by 1 will, when listed to a Commodore printer, produce double-width characters for the heading.

The 21 in line 140 of the machine-code loader, and line 8 of the Basic program are all that need to be changed.

If the Basic version is included at the very end of a Basic program, a Goto 3 in line 9 would slow things down considerably. Instead, Mr Rossetti has cunningly used a For-Next loop which will execute very much faster, hence the odd statement in line 2.

Graphics on expanded Vics

Numerous Vic programs are written for an unexpanded machine and assume that the screen starts are location 7680 and the colour memory at 38400. They also assume that there is space between 6144 and 7679 to construct a new character generator for the specially defined characters.

When you put 4K or more memory expansion on to the Vic things change around. The screen now starts at 4096, colour at 37888 and there is no space for the character generator. Until now, there has only been one way of coping with this problem, and that was to remove the memory expansion cartridge. Repeated insertion and removal can damage the socket, so this solution is a far from perfect one.

There are many ways of reconfiguring the Vic to make it look like a downgraded machine. I have received several programs which will do this and there will be more of this in a future Open File. However, if you want to take full advantage of your memory expansion and still make use of the full graphics capabilities then use the following sequence:

POKE 648,30: POKE 642,32: SYS 64824

before loading any programs. It completely resets the Vic, and you should remove any Pokes in the program to locations between 51 and 56, which reset the Top of Memory pointer.

(listing continued from page 138)

```
1300 IFA$="■"ANDPO>-6THENPO=PO-5:GOTO1200
1310 IFA$="■"ANDPO<35THENPO=PO+5:GOTO1200
1320 IFA$="■"ANDPO>-10THENPO=PO-1:GOTO1200
1330 IFA$="■"ANDPO<39THENPO=PO+1:GOTO1200
1340 IFA$="*"THENRETURN
1350 IFASC(A$)<>13THEN1450
1360 PRINT"■■■■■■■■■■■■■";:MX=8:GOSUB1980:IN$=IN$+LEFT$("        ",8-LEN(IN$))
1370 E$(PO+11)=IN$
1380 PRINT"■CREDIT OR DEBIT      "
1390 GETA$:IFA$<>"C"ANDA$<>"D"THEN1390
1400 IFA$="C"THENPRINT"■■CREDIT■■■■■■■■■■      ":F1=1
1410 IFA$="D"THENPRINT"■■■■■■■■■■ ■DEBIT■              ":F1=-1
1420 PRINT"■■■■■■■■■■■■■■■■■■■■■■";:MX=6:GOSUB1980:MN(PO+11)=VAL(IN$)*F1
1430 PRINT"■";
1440 FORA=0TO49:TT(A+1)=TT(A)+MN(A+1):NEXT:GOTO1200
1450 GOTO1200
1460 IFE$(A)="********"THENPRINT"                    ";
1470 C$="■":IFMN(A)<0THENC$="■"
1480 IFE$(A)<>"********"THENPRINTE$(A);:X=MN(A):GOSUB1600:PRINTC$MID$(X$,3);
1490 IFE$(A)<>"********"THENX=TT(A):GOSUB1600:PRINT"■"X$;
1500 RETURN
1510 REM ** CLEAR MEMORY **
1520 PRINT"■THIS ROUTINE  WILL RUB■OUT  ALL  ENTRIES  AND■START AGAIN."
1530 PRINT"■■DO YOU WISH TO CONT."
1540 PRINT"■  (YES/NO)"
1550 GETA$:IFA$<>"Y"ANDA$<>"N"THEN1550
1560 POKE36878,15
1570 IFA$="Y"THENPRINT"■■■■YES":FORA=1TO150:POKE36876,220:POKE36876,0:NEXT:RUN2
0
1580 IFA$="N"THENPRINT"■■■■■■■■NO":POKE36876,200:FORA=1TO1000:NEXT:POKE36876,0
1590 RETURN
1600 NN=ABS(X):IT=INT(NN):FR=INT((NN-INT(NN)+.001)*100)/100
1610 IFIT>=10000THENX$=" -------":RETURN
1620 SN$=" ":IFX<0THENSN$="-"
1630 IT$=SN$+LEFT$("     ",4-LEN(MID$(STR$(IT),2)))+MID$(STR$(IT),2)
1640 FR$=MID$(STR$(FR),3):FR$=FR$+LEFT$("00",2-LEN(FR$))
1650 X$=IT$+"."+FR$
1660 RETURN
1670 PRINT"■■":POKE36879,59
1680 POKE36865,0
1690 PRINT"■■■■■■■      ___________"
1700 PRINT"       /         ■■"
1710 PRINT"      /         ■/"
1720 PRINT"     /         ■//"
1730 PRINT"    /         ■///
1740 FORA=1TO3
1750 POKE646,8:PRINT"    ■■■■■■■■■■■////"
1760 NEXT
1770 POKE646,8:PRINT"    ■■■■■■■■■■■//■"
1780 POKE646,8:PRINT"    ■■■■■■■■■■■/■"
1790 POKE646,8:PRINT"    ■■■■■■■■■■■■"
1800 POKE646,8:PRINT"    ■■■■■■■■■■"
1810 FORA=0TO38:POKE36878,5:POKE36876,230-A:POKE36865,A:NEXT
1820 POKE36876,0
1830 FORA=1TO50
1840 POKE36864,INT(RND(1)*4)+10
1850 POKE36865,INT(RND(1)*8)+34
1860 POKE36877,INT(RND(1)*10)+220
1870 POKE36878,((50-A)/50)*15
1880 NEXT
1890 POKE36864,12:POKE36865,38:POKE36877,0:POKE36878,0
1900 FORA=0TO7
1910 PRINT"■■"TAB(A)" ACCOUNTS";
1920 PRINT"■■"TAB(14-A)"ACCOUNTS ";
1930 POKE36878,15:POKE36876,A*2+220:POKE36878,0:POKE36876,0
1940 FORB=1TO300:NEXT
1950 NEXT
1960 PRINT"■■■■     BY  M.MARTIN"
1970 FORA=1TO1000:NEXT:RETURN
1980 IN$="":POKE198,0
1990 A=PEEK(209)+PEEK(210)*256+PEEK(211):B=PEEK(A)+128:IFB>255THENB=B-128
2000 POKEA,B:POKEA+33792,6
2010 GETA$:IFA$=""THEN2010
2020 IFLEN(IN$)=MXANDASC(A$)<>13ANDASC(A$)<>20THEN2010
2030 IF(A$>="A"ANDA$<="Z")ORA$="↑"ORA$="+"ORA$="*"ORA$=" "THEN2050
2040 IFVAL(A$)=0ANDA$<>"-"ANDA$<>"."ANDA$<>"0"ANDASC(A$)<>20ANDASC(A$)<>13THEN20
10
2050 IFASC(A$)=13THENPRINT" ";:RETURN
2060 IFASC(A$)=20ANDLEN(IN$)>0THENIN$=LEFT$(IN$,LEN(IN$)-1):PRINT"■  ■■";
2070 IFASC(A$)=20THEN2090
2080 PRINTA$;:IN$=IN$+A$
2090 GOTO1990
```

Enhanced Rems.

Machine-code version.

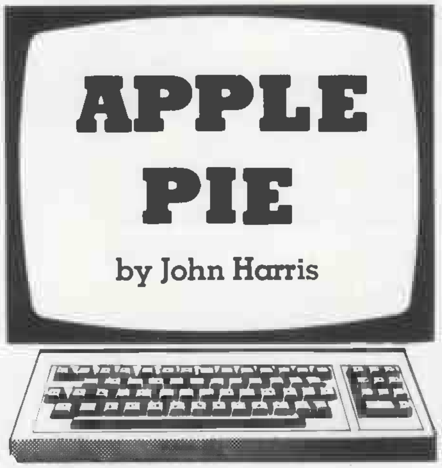
```
1 REM*********************************
2 REM*                               *
3 REM*  REM ENHANCER - BASIC LOADER  *
4 REM*                               *
5 REM*********************************

10 FOR I=826 TO 884
11 READ A : POKE I, A
12 Q=Q+A
13 NEXT I
14 READ A
15 IF Q<>A THEN PRINT"CHECKSUM ERROR"

100 DATA 165,40,133,1,165,41,133,2,160
110 DATA 4,177,1,201,143,208,23,200
120 DATA 177,1,201,35,208,16,192,7,208
130 DATA 245,169,13,145,1,136,145,1
140 DATA 136,169,21,145,1,160,0,177,1
150 DATA 72,200,177,1,133,2,104,133,1
160 DATA 208,210,165,2,208,208,96
170 DATA 6427
```

Basic version.

```
1 B$=CHR$(143)+"###"
2 FOR N=40 TO 0 STEP 0
3 N=PEEK(N)+PEEK(N+1)*256
4 Z=0
5 FOR X=4 TO 7
6 Z=Z+ABS(ASC(MID$(B$,X-3))-PEEK(X+N))
7 NEXT
8 IF N AND Z =0 THEN POKE N+5,21:
  POKEN+6,13: POKEN+7,13
9 NEXT
```



Speller

DESIGNING SPELLING games needs a great deal of thought and a lot of watertight error checking. G Miles of Cronberry, Cumnock in Ayrshire has done both to create a coherent conversational program that guides the player step by random step through the available dictionary.

While the dictionary is hard-coded, it should not be overtaxing to reset to a level appropriate to the age group of the players. The Data lines 1040 to 1120, number of words NW on line 1130 and maximum table entries W$(100) on line 1010 are all candidates for amendment.

Not the least impressive feature of the game as it stands is that all the words currently coded are spelt correctly. Whether they end up that way on your disc may be another matter.

Speller.

```
1000  TEXT : REM *** SPELLING PRO
     GRAM ***
1010  DIM W$(100): DIM PL(25):NT =
     0:WL = 0
1020  REM  W$ IS EACH WORD,PL IS
     POSITION OF WRONG LETTER ,NT
      IS TRIES WHEN WRONG
1030  REM  WL IS NUMBER OF WRONG
     LETERS
1040  DATA MAGAZINE,COUSIN,COMMIT
     TEE,SPACIOUS,DAFFODIL
1050  DATA TYRANNOSAURUS,ENCYCLOP
     AEDIA,FERTILISER,MANOEUVRE,L
     IEUTENANT
1060  DATA SEPARATE,DIVISION,ANTI
     RRHINUM,REFRIGERATOR,SPATULA

1070  DATA AUTOGRAPH,AWKWARD,THER
     MOMETER,BARBECUE,BEAUTIFUL
1080  DATA BOYCOTT,BRETHREN,BRONC
     HITIS,BRIQUETTE,QUEUE
1090  DATA CAFFÉINE,CAMOUFLAGE,CA
     NNIBAL,CARAVANSERAI,CARAMEL
1100  DATA CARBURETTOR,INDICATOR,
     CUPBOARD,CATALOGUE,CARTRIDGE

1110  DATA DACHSHUND,DAHLIA,DAUGH
     TER,DECEIT,DECOMPOSITION
1120  DATA EMBARRASSMENT.ESPIONAG
     E,EUROPEAN,INSOLUBLE,EXAGGER
     ATION
1130 NW = 45: REM    *** ALTER AN
     D MOVE ON AS MORE WORDS ARE
     ADDED ***
1140  GOSUB 1920: REM *** INSTRUC
     TIONS ***
1150  FOR N = 1 TO NW: READ W$(N)
     : NEXT
1160  GOSUB 2060: REM ** CHOOSE S
     PEED **
1170 R =  INT ( RND (4) * NW + 1)
     : REM ** CHOOSE A NUMBER FRO
     M 1 TO NUMBER OF WORDS **
1180  HOME : VTAB 10
1190 NT = 0:WL = 0
1200 LW =  LEN (W$(R)):TB = 20 -
     LW / 2:TC = TB - 1: REM  **
     TB IS POSITION OF PRINT(VARI
     ES) **
1210  FLASH
1220  HTAB TB: FOR N = 1 TO LW +
     2: PRINT " ";: NEXT : REM
      ** WORD BORDER **
1230  NORMAL
1240  PRINT : HTAB TB: FLASH : PRINT
     " "W$(R)" ": NORMAL
1250  HTAB TB: FLASH : FOR N = 1 TO
     LW + 2: PRINT " ";: NEXT
1260  NORMAL
1270 DY = SP * 1000 - 500: GOSUB
     2160: REM  ** DY IS A DELAY,
     SP IS SPEED(SEE2060) **
1280  VTAB 11: HTAB TB + 1: FOR N
      = 1 TO LW: PRINT " ";: NEXT
     : REM  ** DEL WORD *
1290  VTAB 10: HTAB TB: FOR N = 1
      TO LW + 2: INVERSE : PRINT
     " ";: NEXT
1300  PRINT : HTAB TB: PRINT " ";
     : NORMAL : PRINT  SPC( LW);:
      INVERSE : PRINT " "
1310  HTAB TB: FOR N = 1 TO LW +
     2: PRINT " ";: NEXT
1320  NORMAL
1330 DY = 500: GOSUB 2160
1340  VTAB 3: HTAB 2: PRINT "NOW
     TYPE IN YOUR SPELLING OF THA
     T WORD"
1350  HTAB 2: PRINT "LETTER BY LE
     TTER AND WATCH THE SCREEN."
1360  FOR T = 1 TO LW
1370  VTAB 24: HTAB 1: GET A$
1380  IF  ASC (A$) = 27 THEN 2200
     : REM  **PRESS ESC **
1390  IF  ASC (A$) = 13 THEN  HOME
     : GOTO 1680: REM ** PRESS RE
     TURN TO ABORT **
1400  IF A$ =  MID$ (W$(R),T,1) THEN
     1500: REM ** CHECK IF LETTER
      IS CORRECT **
1410  IF  ASC (A$) < 65 OR  ASC (
     A$) > 90 THEN 1740: REM ** C
     HECK IT IS A LETTER **
1420  VTAB 16: HTAB 22
1430 NT = NT + 1: IF NT > 2 THEN
     1770
1440  FLASH : PRINT " "A$"   WRON
     G      "
1450  HTAB 26: PRINT " TRY AGAIN!
     "
1460  NORMAL
1470 DY = SP * 700: GOSUB 2160
1480  VTAB 16: HTAB 22: PRINT  SPC(
     17);: PRINT : HTAB 26: PRINT
      SPC( 12)
1490  GOTO 1370
1500  REM *** CORRECT ANSWER ***
1510  VTAB 13: HTAB 4: PRINT "COR
     RECT"
1520  VTAB 11: HTAB (TB + T): INVERSE
     : PRINT A$
1530  NORMAL
1540 DY = SP * 250 - 150: GOSUB 2
     160
1550  VTAB 13: HTAB 4: PRINT  SPC(
     7):NT = 0: NEXT
1560 DY = SP * 200: GOSUB 2160
1570  HOME : VTAB 4: HTAB 3: PRINT
     "THAT'S THE WORD FINISHED,YO
     U GOT ";
1580  PRINT
1590 L1$ = "LETTERS":L2$ = "THEY
     ARE": IF WL = 1 THEN L1$ = "
     LETTER":L2$ = "IT IS"
1600  PRINT : HTAB 10: FLASH : PRINT
     " "WL" ";: NORMAL : PRINT "
     "L1$" WRONG."
1610  IF WL = 0 THEN  PRINT : HTAB
     (3): PRINT "WELL DONE!": PRINT
     : GOTO 1680
1620  PRINT : HTAB (3): PRINT L2$
     " POINTED OUT BELOW:-"
1630  PRINT : PRINT : HTAB TB: PRINT
     W$(R)
1640  FOR N = 1 TO WL: PRINT  TAB(
     TC + PL(N))"^";: NEXT
1650  IF WL = LW THEN C$ = "ALL":
      GOTO 1870
1660  IF WL > LW / 2 THEN C$ = "O
     VER HALF": GOTO 1870
1670  PRINT : PRINT
1680  PRINT : HTAB (3): PRINT "DO
      YOU WANT ANOTHER WORD?"
1690  PRINT : HTAB (3): PRINT "TY
     PE Y FOR YES, OR N FOR NO."
1700  GOSUB 2170
1710  IF Z$ = "Y" THEN WL = 0: GOTO
      1160
1720  IF Z$ <  > "N" THEN 1700
1730  GOTO 2260
1740  VTAB 18: HTAB 25: PRINT "NO
     T A LETTER"
1750  HTAB 25: PRINT "TRY AGAIN":
     DY = SP * 150: GOSUB 2160
1760  VTAB 18: HTAB 25: PRINT  SPC(
     12): VTAB 19: HTAB 25: PRINT
      SPC( 9): GOTO 1370
1770  INVERSE : PRINT " ENOUGH TR
     IES! "
1780  HTAB 22: PRINT " SHOULD BE
       " MID$ (W$(R),T,1)" "
1790  HTAB 22: PRINT  SPC( 15)
1800  NORMAL
1810 A$ =  MID$ (W$(R),T,1):NT =
     0
1820 WL = WL + 1:PL(WL) = T: REM
     ** NUMBER OF WRONG LETTERS(W
     L) AND POSITION(PL) **
1830 DY = SP * 1000: GOSUB 2160
1840  VTAB 16: HTAB 22: PRINT  SPC(
     16)
1850  PRINT
1860  HTAB 22: PRINT  SPC( 15): PRINT
     : HTAB 22: PRINT  SPC( 15): GOTO
     1520
1870  PRINT : PRINT : PRINT : HTAB
     3
1880  PRINT "YOU GOT ";: FLASH : PRINT

     C$;: NORMAL : PRINT " THE WO
     RD WRONG!"
1890  PRINT : HTAB 3: PRINT "PERH
     APS YOU SHOULD TRY THAT ONE
     AGAIN"
1900  GOSUB 2030: GOTO 1180
1910  END
1920  HOME : REM *** INSTRUCTIONS
      ***
1930  VTAB 2: HTAB 5: NORMAL
1940  PRINT "TO HELP TEST YOUR SP
     ELLING,A"
1950  PRINT : PRINT "WORD WILL BE
      SEEN IN THE MIDDLE OF THE"
1960  PRINT : PRINT "SCREEN FOR A
      SHORT TIME. YOU WILL THEN"
1970  PRINT : PRINT "BE ASKED TO
     TYPE IN THE WORD AND IT"
1980  PRINT : PRINT "WILL BE CHEC
     KED ONE LETTER AT A TIME."
1990  PRINT : HTAB 5: PRINT "PRES
     SING 'ESC' KEY (TOP LEFT) WI
     LL"
2000  PRINT : PRINT "STOP THE PRO
     GRAM. PRESSING 'RETURN'"
2010  PRINT : PRINT "(RIGHT OF KE
     YBOARD) WILL ONLY STOP"
2020  PRINT : PRINT "THE WORD YOU
      ARE DOING."
2030  VTAB 22: HTAB 5: INVERSE : PRINT

     "PRESS THE SPACE BAR TO GO O
     N ";: NORMAL
2040  GOSUB 2170: IF Z$ = " " THEN
      RETURN
2050  GOTO 2040
2060  HOME : PRINT : HTAB 2: PRINT
     "CHOOSE YOUR SPEED BY TYPING
      A NUMBER"
2070  PRINT : PRINT : HTAB 5: PRINT
     "1.SNAIL'S PACE.": HTAB 5: PRINT
     "2.BALL AND CHAIN."
2080  HTAB 5: PRINT "3.BRITISH RA
     IL."
2090  HTAB 5: PRINT "4.SLOW.": HTAB
     5: PRINT "5.MEDIUM."
2100  HTAB 5: PRINT "6.QUICKENING
     .": HTAB 5: PRINT "7.IF YOU'
     RE QUITE QUICK."
2110  HTAB 5: PRINT "8.CONCORDE!"
     : HTAB 5: PRINT "9.BEAT ME I
     F YOU CAN!"
2120  GOSUB 2170
2130  IF Z$ < "1" OR Z$ > "9" THEN
     2120
2140 SP = 10 /  VAL (Z$): REM **
     SPEED **
2150  RETURN
2160  FOR DL = 1 TO DY: NEXT : RETURN
     : REM ** DELAY **
2170  VTAB 24: HTAB 1: GET Z$: REM
     ** WAIT FOR KEY TO BE PRESSE
     D **
2180  IF  ASC (Z$) = 27 THEN 2200
2190  RETURN
2200  HOME : PRINT "YOU PRESSED T
     HE 'ESC' KEY"
2210  PRINT : PRINT "IF THIS WAS
     A MISTAKE TYPE Y
2220  PRINT : PRINT "IF IT WAS NO
     T A MISTAKE TYPE N."
2230  VTAB 24: HTAB 1: GET Y$
2240  IF Y$ = "Y" THEN  RUN
2250  IF Y$ <  > "N" THEN 2230
2260  HOME : PRINT "'BYE FOR NOW.
     "
2270  VTAB 4: FLASH : PRINT "RETU
     RNING TO THE MENU": NORMAL
2280  PRINT : PRINT  CHR$ (4)"RUN
     MENU": END
```

GET TO KNOW CORTEX-

THE really VERY FRIENDLY COMPUTER

TEN FINGER EXERCISE

You'll be amazed how simple word processing is with CORTEX'S new version of WordStar. No more fumbling with messy key sequences.

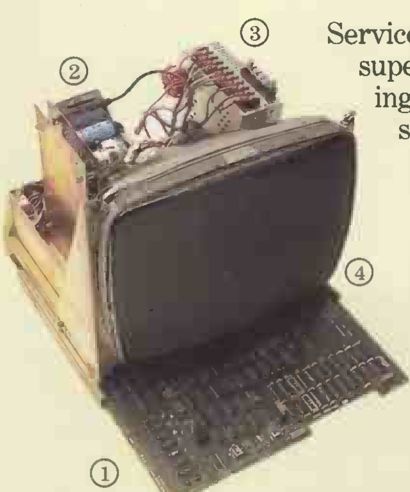
CORTEX has 10 special keys to give 40 commands. This is ERASE. Hit it and a letter disappears. Hit SHIFT ERASE and a word goes. Press CONTROL ERASE and the whole line is demolished. It's as easy as that. And it's free! CORTEX's £1495 price includes a copy of C/WP's WordStar 3.3.

AS BRIGHT AS A BUTTON

Actual photograph

The twin-processor 104k CORTEX is not only smart in performance (faster in benchmark tests than Sirius or IBM-PC) – its appearance takes some beating too. Examine its slim, but solid 83-key IBM-style keyboard. Admire its bold clear 12-inch screen, set in a minimal-sized cabinet. "But where is the computer?", we are often asked. It's there in the same small cabinet, lying flat across the bottom, screened from interference and cooled naturally, without the whine of a fan. CORTEX has been designed not to dominate your desk, to leave room for your calendar, your telephone, your in-tray and the rest. If you want it inconspicuous, buy it in conventional cream. But for the extroverts, and the fashion conscious, CORTEX comes in bright, bright colours – warm red, C/WP green, sunshine yellow, ice white and all black.

A FRIEND IN THE NUDE



Service men love CORTEX's superb modular engineering. (Yes, you can get service anywhere in Britain.) If anything goes wrong (which won't be often) he undoes four screws and the computer (1) slides out like a drawer. A few seconds work and the video electronics (2) slip out, or the power supply (3), leaving only the "bottle" (4). CORTEX is your friend because it's reliable. And, if it goes wrong, it's easier and quicker to mend.

FASTEST DRAW IN ITS CLASS

Actual photograph

It's unfair on other micros. For CORTEX has a dedicated "second computer" (as powerful as Apple II) which does nothing but handle its screen. That's why CORTEX has such dazzling quick-fire graphics. Now CORTEX's superb graphics hardware is matched with Digital Research's CP/M Graphics software (£275). Creat bar charts, pie charts, scatter graphs in a few seconds and incorporate them into your reports or display them 2, 3 or 4 at a time on your screen. or make overhead projector or conventional slides.

C/WP CORTEX

C/WP Computers, 108 Rochester Row, London SW1
Telephone 01-828 9000

ALL THIS FOR £1495 + VAT

Send me details of the 104k twin-processor CORTEX with 83-key IBM-style keyboard, 12-inch green screen, twin double-density (400k) floppy drives, CP/M and C/WP's user friendly WordStar, for £1495.

Name ______________________________

Address and Telephone ______________________________

● Circle No. 183

ACCENT ATARI

by Jack Schofield

Flashing cursor

ACCORDING TO a letter published in one of our sister journals *Computer Weekly,* people enter data more quickly when faced with a flashing cursor. Sadly the letter was an April Fool joke. However, for those who want a flashing cursor on the Atari, Andrew Hall has sent a short routine to provide one. Both Basic and assembler versions are printed here.

The Atari has five system timers, and this program uses system timer 1, locations 536 and 537 decimal. This timer counts backwards from 255 during the vertical blank period — 50 times a second. When it reaches zero there is a JSR to a routine whose address is 550 and 551.

The advantage is that once the routine has been executed it continues to work after you have Newed the program. You can also call it by typing

z = USR (1536).

The type of character can be changed by altering the values of Char 1 and Char 2; 0 gives a blank, 1 a normal character, 2 an inverse space and 3 an inverse character. The flashing rate can be altered between 0.2 and 1310.7 seconds by varying the value of Time in line 140.

However, the operating system uses timer 1 for I/O routines and timing serial bus operations. This means, in my view, that it is not a good idea to use this location for timing. Serial bus operations such as cassette, disc and printer use stop the routine.

The approved place to do timing in the Atari is the real-time clock in locations 18, 19 and 20 decimal. Location 20 increments a jiffy each VBlank up to 255, then a 1 is added to location 19. When that in turn reaches 255, 1 is added to location 18. I have added a five-line program to Poke these locations to zero and then print the elapsed time in seconds on the screen. Watch out for the fact that in the U.K. a jiffy is one 50th not, as in America, one 60th of a second.

The two ideas could prompt you to produce a real-time clock which, like Andrew Hall's routine, runs merrily along unknown to Basic. If you get stuck it has, like most things, been done before: *Compute!* magazine published a listing in its August 1982 issue.

Slow lister

Unless you have a printer, checking Basic listings for typing errors is tedious. You can stop and start the listing using Ctrl-1, but that is not very convenient either. Hence Les Kneeling's Slow Lister program.

Type it in then save it to tape or disc using the List command. Load the program you want to slow-list, and make sure it has no line 0 and no lines over 31999. Then enter the Slow Lister and the two programs will merge. Type Run and

(continued on next page)

Slow lister.

```
0 GOTO 32000:REM SLOWLIST
10 REM
20 REM *******************
30 REM *                 *
40 REM *   SLOW LISTER   *
50 REM * BY LES KNEELING *
60 REM *                 *
70 REM *******************
80 REM
32000 LST=PEEK(136)+PEEK(137)*
256
32010 NUM=PEEK(LST)+256*PEEK(L
ST+1)
32020 LST=LST+PEEK(LST+2)
32030 IF NUM>=3200 THEN STOP
32040 IF NUM=0 THEN 32010
32050 LIST NUM
32060 KEY=PEEK(764)
32070 IF KEY=42 THEN POKE 764,
255:STOP
32080 IF KEY=33 THEN POKE 764,
255:? "}":GOTO 32010
32085 IF PEEK(764)=12 THEN 321
00
32090 GOTO 32060
32100 GRAPHICS 0:POSITION 2,4:
? 0:? 32000:? 32010:? 32020
32105 ? 32030:? 32040:? 32050:
? 32060:? 32070
32110 ? 32080:? 32085:? 32090:
? 32100:? 32105
32115 ? 32110:? 32115:? 32120:
? 32130:? "POKE 84,12"
32120 POSITION 2,0
32130 POKE 842,13
```

```
0 REM *** TIMER ***
1000 PRINT CHR$(125):POKE 752,
1
1001 POKE 18,0:POKE 19,0:POKE
20,0
1002 TIME=INT((PEEK(18)*65536+
PEEK(19)*256+PEEK(20))/50)
1003 POSITION 0,0:PRINT TIME
1004 GOTO 1002
```

Flashing cursor.

```
10 REM FLASHING CHARACTERS
20 REM BY ANDREW HALL
30 REM
100 FOR A=1536 TO 1580
110 READ B
120 POKE A,B
130 NEXT A
140 TIME=0.5:REM DELAY TIME IN S
ECONDS
150 T=TIME*50
160 POKE 1548,T/256
170 POKE 1553,T-256*INT(T/256)
180 CHAR1=0:REM Type of first ch
ar
190 CHAR2=2:REM Type of second c
har
200 POKE 1579,CHAR1
210 POKE 1580,CHAR2
220 Z=USR(1536)
230 DATA 104,169,6,141,39,2,169,
1,141,38,2,169,0,141
240 DATA 25,2,169,25,141,24,2,17
3,243,2,205,43,6,208,7
250 DATA 173,44,6,141,243,2,96,1
73,43,6,141,243,2,96,0,1
```

```
10 ;          Flashing Characters
20 ;          By Andrew Hall
30 ;          March 1983
40 ;
0100           *=$600
0110 CDTMF1    =       550     ; System timer 1 value
0120 CDTMA1    =       536     ; System timer 1 jump address
0130 CHACT     =       755     ; Character control
0140 TIMHI     =       0       ; High byte of delay time
0150 TIMLO     =       25      ; Low byte of delay time
0160           PLA             ; Remove number of items on stack
0170           LDA     #6      ; Set address of timer routine
0180           STA     CDTMF1+1
0190           LDA     #1
0200           STA     CDTMF1
0210           LDA     #TIMHI  ; Set delay time
0220           STA     CDTMA1+1
0230           LDA     #TIMLO
0240           STA     CDTMA1
0250           LDA     CHACT   ; Swap character
0260           CMP     CHAR1
0270           BNE     SKIP
0280           LDA     CHAR2
0290           STA     CHACT
0300           RTS
0310 SKIP      LDA     CHAR1
0320           STA     CHACT
0330           RTS
0340 CHAR1     .BYTE   0
0350 CHAR2     .BYTE   2
0360           .END
```

(continued from previous page)

each line of the program will be listed separately on a clear screen. Press the space bar to advance to the next line. To edit a line press E to stop the routine, then type Cont to continue.

Pressing Return moves you to the Automatic Delete mode. Location 842 is an interesting one in the Atari. It allows the micro to write its own Basic lines by taking input from the screen, a "forced read" mode. Here it is used to delete the unwanted utility by printing its own line numbers on the screen, then forces Returns to enter blank lines and thus remove them. Poke 842,12 returns you to the keyboard input/screen output mode.

Variable dump

Another utility from Les Kneeling works in much the same way. List it and enter it in the same way, and run the program by typing Goto 32000. Again the routine is self-modifying and self-deleting.

The program provides a list of all the variables currently in the Atari's memory. They are stored in a Variable Name table which has a start address found from locations 130 and 131 and an end address found from locations 132 and 133. Line 32040 in the program does this. The routine also indicates if the variables are strings or arrays with a $ or) respectively.

If you just want to see the variables in the Variable Name table there is an easy way. Simply do a Save "S:" to save the tokenised version of your program to the screen. Hit the Break key quickly, and amid all the graphics characters you will see the variables listed at the top of the screen in the order you typed them in. Isn't it wonderful what flexible I/O can do for you?

Hotstuff

Even though Atari disc drives do not hold an enormous amount of data, it can be hard work keeping track of files. It is easy to print out a listing of what's on a disc: you just select A from the DOS menu, then type ,P: to direct the output to the printer instead of the screen.

But wouldn't it be nice to have a disc directory in alphabetical order? That's what the modestly named Hotstuff provides. It was written by E J Knoll of the Atari Computer Enthusiasts user group of Eugene, Oregon, of which I am a member. As well as sorting, it gives you a chance to label your directories with a title and two comment lines. They all have two Up Arrows, Esc + Ctrl + Up Arrow, inside the quotes at the end of each line for screen formatting.

Lines 1020, 1030 and 1050 contain control characters for the Epson printer, to print the titles in expanded and condensed faces. As they are part of the program in graphic character form they activate the printer even when listing it. You can insert codes to suit your own printer.

Variable dump.

```
32000 REM **VARIABLE DUMP**
32005 REM **FIND END OF PROGRAM**
32010 D=PEEK(144)+256*PEEK(145)-1:
POKE (745),0
32015 REM **FIND ABSOLUTE ADDRESS
OF VARIABLE**
32020 IF PEEK(D)>127 AND PEEK(D-1)
=40 THEN 32040
32030 D=D-1:GOTO 32020
32040 FOR N=PEEK(130)+256*PEEK(131
) TO PEEK(132)+256*PEEK(133)
32050 IF PEEK(N)<128 THEN ? CHR$(P
EEK(N));
32060 IF PEEK(N)>128 THEN ? CHR$(P
EEK(N)-128);:POKE 745,PEEK(745)+1
32070 IF PEEK(N)>128 THEN POKE D,P
EEK(745)+127:GOSUB 32130
32080 NEXT N
32085 REM **CLEAN UP ROUTINE**
32090 OPEN #1,4,0,"K:":? "FINISHED
 WITH UTILITY? Y/N":GET #1,N:IF N<
>ASC("Y") THEN STOP
32095 REM IF FINISHED THEN DELETIO
N ROUTINE
32096 POKE (PEEK(132)+256*PEEK(133
)),0:POKE (PEEK(132)-1+256*PEEK(13
3)),0:POKE (133),PEEK(133)-1
32100 GRAPHICS 0:POSITION 2,2:? 32
000:? 32010:? 32020:? 32030:? 3204
0:? 32050:? 32060:? 32070:? 32080:
? 32090:? 32096
32110 ? 32100:? 32110:? 32120:? 32
130:? "POKE 842,12":POSITION 2,2:P
OKE 842,13
32120 POSITION 0,0:END
32125 REM **SUBROUTINE TO PRINT VA
LUE OF VARIABLE **
32130 ? ,:? D:RETURN
```

Hotstuff.

```
600 REM "D:HOTSTUFF"  DISK DIR
ECTORY         EJ KNOLL 4480
PINECREST DR            EUGENE
, OR. 97405 503-343-5191
610 POKE 82,0:POKE 83,39:? "}"
:DIM AL$(2)
620 PRINT "SHALL WE ALPHABETIZ
E FILES (Y or N)";:INPUT AL$:I
F AL$<>"Y" AND AL$<>"N" THEN P
RINT "}";:GOTO 620
630 SETCOLOR 2,3,10:SETCOLOR 1
,3,2:SETCOLOR 4,3,10
640 DIM FILE$(35),A$(1200),B$(
55),C$(55),X$(12),Y$(17),Z$(17
),FILE2$(35)
650 TRAP 660:CLOSE #1
660 ? :? :? " DRIVE # ";
670 INPUT D
680 FILE$="D":FILE$(2)=STR$(D)
:FILE$(3)=":*.*"
690 TRAP 650:OPEN #1,6,0,FILE$
700 TRAP 40000
710 OPEN #2,8,0,"E:"
720 SETCOLOR 2,3,10:SETCOLOR 1
,3,2:SETCOLOR 4,3,10:X=0
730 X=X+1
740 TRAP 770:INPUT #1;FILE$:TR
AP 40000
750 A$(17*(X-1)+1,X*17)=FILE$
760 GOTO 730
770 N=0:IF AL$="N" THEN 840
780 FOR I=1 TO X:IF I>X-3 THEN
 POP :GOTO 830
790 Y$=A$(17*(I-1)+1):Z$=A$(17
*I+1)
800 IF Y$(3)<=Z$(3) THEN 820
810 N=N+1:A$(17*(I-1)+1,17*I)=
Z$:A$(17*I+1,17*I+17)=Y$
820 NEXT I
830 IF N<>0 THEN 770
840 X=X-1:FOR I=1 TO INT(X/2):
PRINT A$(17*(I-1)+1,I*17):NEXT
 I
850 A$(17*(X))=" $$"
860 POKE 82,20:POSITION 20,0:F
OR I=I TO X:PRINT A$(17*(I-1)+
1,I*17):NEXT I
870 POKE 82,2:POKE 83,39
880 IF X<36 THEN ? #2:? #2:? #
2
890 ? #2:? #2;"ENTER 1 TO RUN
D:PGM, 2 TO RERUN MENU       3
 TO PRINT MENU 4 QUIT"
900 TRAP 860:INPUT X:IF X>4 TH
EN GOTO 890
910 ON X GOTO 1090,1140,930
920 NEW
930 TRAP 1070:OPEN #3,8,0,"P:"
940 ? "WHAT DISK IDENTIFICATIO
N";:? :? "__________________
______________":TRAP 960:INPU
T FILE2$
950 FOR I=LEN(FILE2$) TO 0 STE
P -1:IF FILE2$(I,I)="_" THEN F
ILE2$=FILE2$(1,LEN(FILE2$)-1):
NEXT I
960 POP
970 TRAP 990:FOR C=1 TO I:IF F
ILE2$(C,C)="_" THEN FILE2$(C,C
)=" "
980 NEXT C
990 IF FILE2$=" " THEN FILE2$=
""
1000 ? "WHAT SUBTITLE 1";:? :?
 "____________________________
____________________________":
TRAP 1010:GOSUB 1150
1010 ? "WHAT SUBTITLE 2";:? :?
 "____________________________
____________________________":
TRAP 1030:GOSUB 1170
1020 LPRINT ""
1030 ? #3;,"  ";FILE2$
:? #3;" ":? #3;,,B$:? #3,,C$:?
 #3;"":LPRINT :LPRINT
1040 FOR X=1 TO 60:IF A$(17*(X
-1)+1)="$$" THEN GOTO 1080
1050 ? #3;,,,,"";A$((1
7*(X-1)+1),X*17)
1060 NEXT X
1070 TRAP 40000:CLOSE #3:? #2;
"TURN THE PRINTER ON, DUMMY!":
GOTO 890
1080 GOTO 1140
1090 ? #2;"RUN ";CHR$(34);"D";
STR$(D);":";
1100 INPUT X$
1110 A$="D":A$(2)=STR$(D):A$(3
)=":":A$(4)=X$:POKE 752,3:POSI
TION 1,22:? #2;"        LOADIN
G ";X$;
1120 TRAP 1130:RUN A$:TRAP 400
00
1130 POSITION 1,22:? #2;"
  CANNOT RUN ";X$;:GOTO 890
1140 RUN
1150 INPUT B$:TRAP 1160:FOR C=
LEN(B$) TO 0 STEP -1:IF B$(C,C
)="_" THEN B$(C,C)=" ":B$=B$(1
,LEN(B$)-1):NEXT C
1160 POP :RETURN
1170 INPUT C$:TRAP 1180:FOR C=
LEN(C$) TO 0 STEP -1:IF C$(C,C
)="_" THEN C$(C,C)=" ":C$=C$(1
,LEN(C$)-1):NEXT C
1180 POP :RETURN
```

Spiral CLS

THIS PROGRAM by Gary Nugent of Dublin clears a 22 by 32 screen. The screen is first filled by a spiral of inverse spaces, and then by a spiral of spaces. The screen is then ready for output, the Print position having been reset to 0,0. This is a novel way to clear the screen and is faster than the ZX-81's system CLS when large amounts of memory and Scroll are in use.

The routine, which is in machine code, is 91 bytes long. It should be entered into a line 1 Rem statement using any hex loader. The code is not relocatable. Should you wish to move it, all the Call addresses will have to be changed.

Poking addresses 16599 with a value less than 192 increases the speed of the spirals. A larger value decreases the speed. To make the routine clear a 24-by-32 screen, do as direct commands:

POKE 16535,23 — or 21 for a 22-by-32 screen
POKE 16575,9 — or 11 for a 22-by-32 screen

The routine is called by

RAND USR 16514.

Printer control codes

NO DOUBT many Spectrum owners will have made arrangements to hook up their machines to "proper" printers, especially now that Sinclair has reverted to ASCII, writes Gordon Grant of Radcliffe, near Manchester. To drive the thing it is most convenient to trap the stream of information generated by the Basic interpreter when LPrint is asserted, and divert it to your own output routine. Otherwise you must maintain multiple copies of programs, and convert programs that you have acquired.

This can be done most easily by substituting the address of your own routine for that normally maintained by Basic as the address for LPrint output. This address is held at 23749, and is normally 2548, but you can change it to any address you fancy. All material destined for the printer will be found to pass this way, but it is a good idea to understand what the Spectrum routine normally does with the material.

Material arrives in one or other of the following forms:

ASCII characters, which can be processed immediately.
Tokens, which may be passed back to the official routine. It will do the work of expanding them and delivering them up as a stream of ASCII characters.
Graphics characters, which most printers cannot handle, so substitute spaces instead.
Control codes, which are the tricky bit. Not only will the Basic routine not handle them to your convenience, it will often replace your address by the official one — a mean trick. You must write your own control-code handling routine which, though inconvenient, allows you extra flexibility as to format.

I have successfully used this control-code handling routine for some time.

Spiral CLS.

```
              SPIRAL CLS

        LD A,80             3E 80
        CALL SPIRAL         CD 93 40
        LD A,00             3E 00
        CALL SPIRAL         CD 93 40
        LD BC,0000          01 00 00
        CALL PRINT-AT       CD F5 08
        RET                 C9
SPIRAL  LD HL,(D-FILE)      2A 0C 40
        LD C,15             0E 15
        LD B,20             06 20
AGAIN   LD D,B              50
LOOP 1  INC HL              23
        LD (HL),A           77
        CALL PAUSE          CD D5 40
        DEC D               15
        JR NZ,LOOP 1        20 F8
        DEC B               05
        LD E,C              59
        PUSH BC             C5
        LD BC,0021          01 21 00
LOOP 2   ADD HL,BC          09
        LD (HL),A           77
        CALL PAUSE          CD D5 40
        DEC E               1D
        JR NZ,LOOP 2        20 F8
        POP BC              C1
        DEC C               0D
        LD D,B              50
LOOP 3  DEC HL              2B
        LD (HL),A           77
        CALL PAUSE          CD D5 40
        DEC D               15
        JR NZ,LOOP 3        20 F8
        LD E,A              5F
        LD A,B              78
        CP 06               FE 06
        RET Z               C8
        LD A,E              7B
        DEC B               05
        LD E,C              59
        PUSH BC             C5
        LD BC,0021          01 21 00
LOOP 4  SBC HL,BC           ED 42
        LD (HL),A           77
        CALL PAUSE          CD D5 40
        DEC E               1D
        JR NZ,LOOP 4        20 F7
        POP BC              C1
        DEC C               0D
        JR AGAIN            18 C5
PAUSE   PUSH AF             F5
        LD A,C0             3E C0
LOOP 5  DEC A               3D
        JR NZ,LOOP 5        20 FD
        POP AF              F1
        RET                 C9
```

Printer control codes.

```
                ;         ***** SPECTRUM LPRINT ROUTINE *****
                ;                        BY
                ;                   G. P. GRANT
                ;
                ;THIS ROUTINE SUPPORTS LPRINT AND LLIST BUT NOT COPY.
                ;     CHR$(12) CAUSES FEED TO TOP OF NEXT PAGE.
                ;         INITIALIZE BY PRINT USR 65001.
                ;::::::::::::::::::::::::::::::::::::::::::::::::::
                ;EQUATES
1F54            BREAK   EQU     8020     ;ROM 'TEST BREAK' ROUTINE
000C            MESS    EQU     12       ;MESSAGE - D BREAK, CONT REPEATS
E837            PORT    EQU     59447    ;PRINTER I/O PORT USED HERE
09F4            ROM     EQU     2548     ;OFFICIAL LPRINT ROUTINE
5CC5            CHAN    EQU     23749    ;ADDRESS OF LPRINT OUTPUT CHANNEL
0042            PAGES   EQU     66       ;LINES PER PAGE - ADJUSTABLE
0050            WIDTH   EQU     80       ;COLUMNS PER LINE - ADJUSTABLE
FDE9                    ORG     65001    ;OPTION. ADJUST TO SUIT
                ;
                ;INITIALIZATION ROUTINE. DON'T FORGET TO CLEAR SPACE.
                ;
FDE9 2107FE     INIT    LD      HL,START  ;PLACE USR ADDRESS IN CHANNEL
FDEC 22C55C             LD      (CHAN),HL
FDEF 2102FE             LD      HL,DCB           ;INITIALIZE DCB
FDF2 3E01               LD      A,1
FDF4 77                 LD      (HL),A
FDF5 23                 INC     HL
FDF6 23                 INC     HL
FDF7 77                 LD      (HL),A
FDF8 2B                 DEC     HL
FDF9 3E51               LD      A,WIDTH+1
FDFB 77                 LD      (HL),A
FDFC 23                 INC     HL
FDFD 23                 INC     HL
FDFE 3E43               LD      A,PAGES+1
FE00 77                 LD      (HL),A
FE01 C9                 RET
                ;DATA CONTROL BUFFER
FE02 00         DCB     DEFB    0        ;NEXT COLUMN TO PRINT AT
FE03 00                 DEFB    0        ;WIDTH + 1
FE04 00                 DEFB    0        ;CURRENT LINE BEING PRINTED
FE05 00                 DEFB    0        ;PAGES + 1
FE06 00                 DEFB    0        ;STORE FOR TAB INFO
                ;MAIN LPRINT ROUTINE
FE07 FEA5       START   CP      165
FE09 D2F409             JP      NC,ROM           ;IT'S A TOKEN
FE0C FE80               CP      128
FE0E 302B               JR      NC,GRAPH         ;IT'S A GRAPHICS CHAR
FE10 FE20               CP      32
FE12 3029               JR      NC,ASCII         ;IT'S AN ASCII CHAR
FE14 FE06               CP      6
FE16 2848               JR      Z,FIELD          ;IT'S PRINT COMMA
FE18 FE09               CP      9
FE1A 281F               JR      Z,GRAPH          ;CURSOR ->
FE1C FE0C               CP      12
FE1E 285B               JR      Z,PAGE           ;GO TO TOP OF PAGE
FE20 FE0D               CP      13
FE22 280E               JR      Z,CRLF           ;CR/LF
FE24 FE10               CP      16
FE26 380F               JR      C,WHAT           ;INVALID CODE
FE28 FE16               CP      22
```

(continued on next page)

Data in strings

INSPIRED by the routine in the March issue of *Practical Computing,* J Law of Birmingham has written a closer imitation of Read and Data for the ZX-81. The subroutine reads data from the program, and returns it in Y$. The calling program should alter neither R$, which will contain the date nor Z$, a dummy variable used within the machine code held in line 1.

You must not have data of over 32 characters, or error L/ will result, while running out of data will give error 0/. These error messages are displayed in the top-left corner of the screen. The routine distinguishes data from other Rem statements by putting a Graphics S immediately after Rem.

First enter the loader program and press Run. Next enter the numbers shown in the machine-code routine, delete all except line 1 of the loader program, and enter the Basic program. This contains the subroutines Read and Restore. You may then enter your own program, commencing after line 12. To read data in Y$ use Gosub Read; to reset the data pointer use Gosub Restore.

The machine-code routine can be shortened for use when only 1K is available by omitting the error messages. In this case initially enter Line 1 as 98 full stops and alter line 10 of the loader to

10 FOR I = 16514 TO 16610

When the loader stops, Poke 16611,201, then continue as before.

Data in strings — loader program.

```
1  REM .......... ..... (106 . s)
10 FOR I = 16514 to 16619
20 INPUTA
30 SCROLL
40 PRINT I;" ";A
50 POKE I,A
60 NEXT I
```

Data in strings — machine-code routine.

```
0 0 0 42 131 64 126 25 118 32
30 35 126 254 118 40 78 35 35 78
35 70 35 126 254 234 40 3 9 24
237 35 126 254 10 40 4 43 9 24
227 1 0 32 237 91 16 64 19 19
19 35 126 254 26 40 18 254 118 40
14 18 12 16 241 42 16 64 35 54
35 6 49 24 22 34 131 64 235 54
95 35 112 35 54 0 42 16 64 35
113 1 0 0 201 6 52 42 12 64
35 112 35 54 24 201
```

Data in strings — Basic program.

```
1  REM (containing machine code —
   left when loader deleted)
2  LET Y$ = "////////      ////"   (contains
   35 / chs.)
3  LET READ = 6
4  LET RESTORE = 8
5  GOTO 12
6  IF USR 16517 THEN STOP
7  RETURN
8  POKE 16514,0
9  POKE 16515,124
10 POKE 16516,64
11 RETURN
12 GOSUB RESTORE
20 REM  Your calling program starts
   here
```

(continued from previous page)

```
FE2A 3871      00700         JR      C,NOTAB          ;ONE BYTE FOLLOWS
FE2C FE18      00710         CP      24
FE2E 3879      00720         JR      C,TAB            ;TAB OR AT
FE30 1805      00730         JR      WHAT             ;INVALID CODE
FE32 2102FE    00740 CRLF    LD      HL,DCB
FE35 1815      00750         JR      CR
FE37 3E3F      00760 WHAT    LD      A,63     ;OUTPUT "?" FOR INVALID CODES
FE39 1802      00770         JR      ASCII
FE3B 3E20      00780 GRAPH   LD      A,32     ;OUTPUT SPACE FOR GRAPHICS
FE3D CDCAFE    00790 ASCII   CALL    PRINT    ;OUTPUT A BYTE
FE40 1800      00800         JR      UPDATE   ;UPDATE DCB AND RETURN
FE42 2102FE    00810 UPDATE  LD      HL,DCB
FE45 7E        00820         LD      A,(HL)
FE46 3C        00830         INC     A        ;UPDATE POSN OF NEXT CHAR
FE47 77        00840         LD      (HL),A
FE48 23        00850         INC     HL
FE49 BE        00860         CP      (HL)     ;COMPARE WITH WIDTH + 1
FE4A C0        00870         RET     NZ
FF4B 2B        00880         DEC     HL       ;MUST ADVANCE TO NEXT LINE
FE4C 3E01      00890 CR      LD      A,1
FE4E 3601      00900         LD      (HL),1   ;ASSERT NEXT CHAR = 1
FE50 23        00910         INC     HL
FE51 23        00920         INC     HL
FE52 7E        00930         LD      A,(HL)
FE53 3C        00940         INC     A        ;INCREMENT LINE NUMBER
FE54 77        00950         LD      (HL),A
FE55 23        00960         INC     HL
FE56 BE        00970         CP      (HL)     ;COMPARE WITH PAGE + 1
FE57 2804      00980         JR      Z,PAGEND
FE59 3E0D      00990 FEED    LD      A,13
FE5B 186D      01000         JR      PRINT    ;CR/LF & RETURN
FE5D 2B        01010 PAGEND  DEC     HL
FE5E 3E01      01020         LD      A,1
FE60 77        01030         LD      (HL),A   ;NEXT LINE IS 1
FE61 18F6      01040         JR      FEED     ;DON'T FORGET TO CR/LF
FE63 2102FE    01050 FIELD   LD      HL,DCB
FE66 7E        01060         LD      A,(HL)   ;GET POSN OF NEXT CHAR
FE67 3D        01070         DEC     A
FE68 E6F0      01080         AND     0F0H
FE6A C611      01090         ADD     A,17     ;ADJUSTED TO NEXT FIELD
FE6C 23        01100         INC     HL
FE6D BE        01110         CP      (HL)     ;SEE IF PAST PAGE END
FE6E 2B        01120         DEC     HL
FE6F 28DB      01130         JR      Z,CR     ;CR/LR IF SO
FE71 96        01140         SUB     (HL)     ;SUBTRACT PRESENT POSN.
FE72 47        01150         LD      B,A      ;SAVE COUNTER FOR SPACES
FE73 3E20      01160 AGAIN   LD      A,32     ;OUTPUT SPACES
FE75 CD3DFE    01170         CALL    ASCII
FE78 10F9      01180         DJNZ    AGAIN
FE7A C9        01190         RET
FE7B 2102FE    01200 PAGE    LD      HL,DCB
FE7E 7E        01210         LD      A,(HL)   ;TEST FOR BYTES
FE7F 3D        01220         DEC     A        ;  IN PRINTER BUFFER
FE80 2803      01230         JR      Z,LINOK  ;OK TO JUMP IF NONE
FE82 CD4CFE    01240         CALL    CR       ;ELSE OUTPUT CR/LF
FE85 2104FE    01250 LINOK   LD      HL,DCB+2
FE88 7E        01260         LD      A,(HL)   ;TEST CURRENT LINE
FE89 3D        01270         DEC     A
FE8A C8        01280         RET     Z        ;EXIT IF ALREADY THERE
FE8B 3C        01290         INC     A
FE8C 23        01300         INC     HL
FE8D 96        01310         SUB     (HL)     ;SUBTRACT LINES+1
FE8E ED44      01320         NEG              ;AND NEGATE IT TO GET
FE90 47        01330         LD      B,A      ;LINES TO FEED
FE91 3E0D      01340 NEXT    LD      A,13
FE93 CDCAFE    01350         CALL    PRINT
FE96 10F9      01360         DJNZ    NEXT
FE98 2B        01370         DEC     HL
FE99 3E01      01380         LD      A,1
FE9B 77        01390         LD      (HL),A   ;ASSERT LINE 1
FE9C C9        01400         RET
FE9D 21A4FE    01410 NOTAB   LD      HL,POINTA  ;SET TEMPORARY
FEA0 22C55C    01420 FETCH   LD      (CHAN),HL  ;CHANNEL ADDRESS
FEA3 C9        01430         RET
FEA4 2107FE    01440 POINTA  LD      HL,START   ;IGNORE ARGUMENT AND
FEA7 18F7      01450         JR      FETCH            ;RESTORE CHANNEL
FEA9 21AEFE    01460 TAB     LD      HL,POINTB        ;SET TEMPORARY
FEAC 18F2      01470         JR      FETCH            ;CHANNEL ADDRESS
FEAE 3206FE    01480 POINTB  LD      (DCB+4),A        ;SAVE TAB LOW ORDER
FEB1 21B6FE    01490         LD      HL,POINTC        ;SAME AGAIN
FEB4 18EA      01500         JR      FETCH
FEB6 2107FE    01510 POINTC  LD      HL,START         ;IGNORE HIGH ORDER &
FEB9 22C55C    01520         LD      (CHAN),HL        ;RESTORE CHANNEL
FEBC 3A06FE    01530         LD      A,(DCB+4)        ;GET TAB LOW ORDER
FEBF 2103FE    01540         LD      HL,DCB+1
FEC2 BE        01550         CP      (HL)             ;COMPARE WIDTH+1
FEC3 2B        01560         DEC     HL
FEC4 30A6      01570         JR      NC,CR            ;CR/LF IF PAST END
FEC6 96        01580         SUB     (HL)     ;TAB MINUS CURRENT
FEC7 47        01590         LD      B,A      ;EQUALS SPACES TO OUTPUT
FEC8 18A9      01600         JR      AGAIN
               01610 ;ILLUSTRATIVE OUTPUT ROUTINE. SUBSTITUTE YOUR OWN HERE.
FECA C5        01620 PRINT   PUSH    BC       ;SAVE REGISTERS
FECB F5        01630         PUSH    AF
FECC 0137E8    01640         LD      BC,PORT  ;USER I/O PORT
FECF ED78      01650 TEST    IN      A,(C)    ;FETCH PRINTER STATUS
FED1 FE3F      01660         CP      63       ;IS PRINTER READY?
FED3 2807      01670         JR      Z,GO     ;JUMP IF SO
FED5 CD541F    01680         CALL    BREAK    ;TEST FOR BREAK HIT
FED8 38F5      01690         JR      C,TEST   ;IF NOT, KEEP TRYING
FEDA CF        01700         RST     8        ;ELSE BACK TO BASIC
FEDB 0C        01710         DEFB    MESS     ;WITH ERROR MESSAGE
FEDC F1        01720 GO      POP     AF       ;RETRIEVE BYTE TO SEND
FEDD ED79      01730         OUT     (C),A    ;SEND IT
FEDF C1        01740         POP     BC
FEE0 C9        01750         RET
0000           01760         END
00000 TOTAL ERRORS
```

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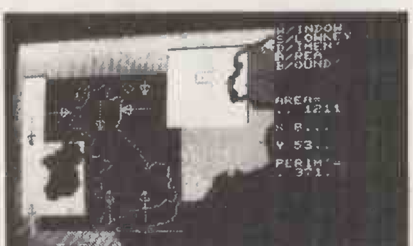

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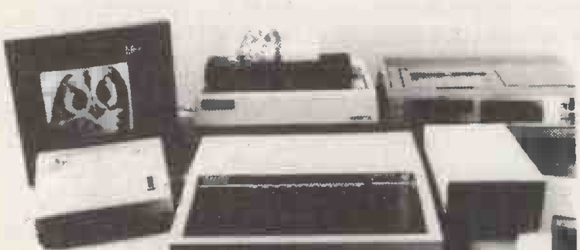

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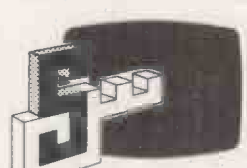

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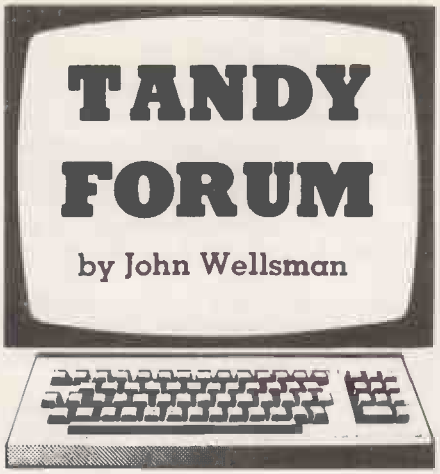


Fast conversion

THE WHOLE subject of bit recognition is well worth studying. Coupled with the use of logic operators, it can save a great deal of programming time and space. The conversion routine by S D Holloway provides a very fast way of converting decimal to binary.

Magicalc

If there is one program which has really opened people's eyes to the value of micros in business it is VisiCalc. Although written originally for the Apple II, it can now be found in a form suitable for almost any micro under the sun. A disc-based version for Tandys is available at around £60.

Mr R S Bond of Shrewsbury has written a really first-class tape-based spreadsheet which he calls Magicalc. My only comment is that the instructions that he sent with it are rather sketchy and based on an assumed familiarity with VisiCalc which many readers may not have.

When loaded and run, the appearance of the screen is very similar to the VisiCalc layout, though with slightly narrower columns. It is divided into 10 columns, numbered 0 to 9 and 13 rows, labelled A to M. In the upper left-hand corner above the horizontal headings is the message

A0 = 0

and on the sheet itself is the flashing cursor situated over position A0. Into each position, known as a cell, either text, a value or an expression can be loaded, but it is limited to five characters only.

A simple costing routine shows how the package works. The zero column can be used for labels, so type

SALES

into the present position of the cursor, A0. This must be done slowly, as the response is much slower than the normal keyboard input. The characters always appear on the right edge of the column and move over as successive entries are made.

Having put the label in cell A0, insert the amount of sales in cell A1. To do so simply press the Right Arrow on the keyboard and the cursor shifts to that position. Then simply type 200; there is no need to press Enter.

Assuming that sales costs are five percent of sales move down to the B row. You can either use the Down Arrow once and the Left Arrow once to bring you to B0, or you can type /. This will produce a line above the horizontal axis, reading "Which Function" followed by a number of characters.

Pressing G allows you to move the cursor to any position on the sheet. Enter B0 and the function line will disappear and the cursor will appear at cell B0. The current position of the cursor together with its value will be shown in the top left-hand corner. Enter SCF, for sales-cost factor, in this position, move to B1 and enter .05 for 5 percent. This value is shown above the line with the cell position. If you make a mistake, position the cursor over the error, press / and then D to delete the entry at the

(continued on next page)

Fast conversion.

```
10 CLEAR 100:DEFINT X,N
20 INPUT"ENTER AN INTEGER FOR
CONVERSION";N
30 A=1:B$="":FOR X=0 TO 14:B$=STR$((N
AND A)/A)+B$
40 A=A*2:NEXT X
50 IF N<0 THEN B$="1"+B$ ELSE
B$="0"+B$
60 PRINTB$:PRINT:GOTO 20
```

Magicalc.

```
110 ' MAGICALC /  MAGIPLOT (C)(P)  1983
R.S.BOND ***
140
CLEAR6000:ONERRORGOTO1400:DIMC$(10,13),
D$(10,13),A$(13):X=1:Y=1
150                    CLS:PRINT:PRINT"
";CHR$(191);STRING$(3,143);"0";STRING$(
5,143);"1";STRING$(5,143):"2":STRING$(5
,143);"3";STRING$(5,143);"4";STRING$(5,
143);"5";STRING$(5,143);"6";STRING$(5,1
43);"7";STRING$(5,143);"8";STRING$(5,14
3);"9";STRING$(3,143);CHR$(191);
160
FORY1=1TO13:PRINTCHR$(64+Y1);CHR$(191);
"
";:FORX1=1TO10:PRINTSTRING$((5-LEN(C$(X
1,Y1))),32);C$(X1,Y1);"
";:NEXTX1:PRINTCHR$(191);:NEXTY1
170
P=((Y+1)*64)+(((X-1)*6)+2):PRINT@P,CHR$
(183);:PRINT@P+6,CHR$(187);:GOSUB1410:I
FD$(X,Y)<>""THENPRINT@0,CHR$(64+Y);X-1;
"=";D$(X,Y);ELSEPRINT@0,CHR$(64+Y);X-1;
"=";VAL(C$(X,Y));
180 PRINT@P," ";:PRINT@P+6," ";
190 A$=INKEY$
200
IFA$<>""ORPEEK(14400)<>0THEN210ELSE170
210
IFA$=CHR$(8)ORPEEK(14400)=32THENX=X-1:I
FX<1THENX=1:GOTO170
220
IFA$=CHR$(9)ORPEEK(14400)=64THENX=X+1:I
FX>10THENX=X-1:GOTO170
230
IFA$=CHR$(91)ORPEEK(14400)=8THENY=Y-1:I
FY<1THENY=1:GOTO170
240
IFA$=CHR$(10)ORPEEK(14400)=16THENY=Y+1:
IFY>13THENY=13:GOTO170
250
IFA$<>"/"ANDA$>CHR$(31)ANDA$<>CHR$(91)T
HENC$(X,Y)=LEFT$(C$(X,Y)+A$,5):PRINT@P+
1,STRING$(5-LEN(C$(X,Y)),32);C$(X,Y);:G
OTO170
260 IFA$<>"/"THEN170
270          PRINT@0,"WHICH          FUNCTION
(A,C,D,G,L,N,P,R,S,X,+,/,-,*,OR       H)
?";CHR$(95);
280 A$=INKEY$:IFA$=""THEN280
290
IFA$="D"THENC$(X,Y)="":D$(X,Y)="":PRINT
@P+1,"      ";:GOTO170
300
IFA$="N"THENGOSUB1410:PRINT@0,"CONFIRM
(Y/N) ?";CHR$(95);:GOTO1190
310 IFA$="C"THEN1020
320 IFA$="X"THEN170
330
IFA$="R"THENM$=":":MM=1:GOSUB600:FORA=N
TOM:FORB=N1TOM1:C$(B,A)=C$(PP,QQ):PRINT
@((A+1)*64)+(((B-1)*6)+3),C$(B,A);:NEXT
B,A:MM=0:GOTO170
340
IFA$="*"THENM$="*":GOSUB600:GOSUB1100:G
OTO780
350
IFA$="+"THENM$="+":GOSUB600:GOSUB1110:G
OTO780
360
IFA$="/"THENM$="/":GOSUB600:GOSUB1120:G
OTO780
370
IFA$="-"THENM$="-":GOSUB600:GOSUB1130:G
OTO780
380 IFA$="G"THENGOTO970
390
IFA$="A"THENM$="@":GOSUB600:GOSUB1140:G
OTO780
400
IFA$<>"S"ANDA$<>"L"ANDA$<>"H"ANDA$<>"C"
ANDA$<>"P"THEN170
410 IFA$="L"THEN520
420 IFA$="P"THEN800
430 IFA$="C"THEN1020
440 IFA$="H"THEN1230
450
IFA$="S"THENGOSUB1410:R$="":PRINT@0,"EN
TER NAME OF FILE :";:FORA=1TO15
460 A$=INKEY$:IFA$=""THEN460
470
IFA$=CHR$(13)THEN480ELSER$=R$+A$:PRINTA
$;:NEXTA
480  GOSUB1410:PRINT@0,"READY  CASSETTE
?";
490 IFINKEY$=""THEN490
500 GOSUB1410:PRINT@0,"SAVING...";
510
PRINT£-1,R$:FORA=1TO13:FORB=1TO10STEP2:
PRINT£-1,C$(A,B),C$(A,B+1):PRINT£-1,D$(
A,B),D$(A,B+1):NEXTB,A:GOSUB1410:GOTO17
0
520       R$="":GOSUB1410:PRINT@0,"ENTER
NAME OF FILE :";
530 FORA=1TO15
540 A$=INKEY$:IFA$=""THEN540
550
IFA$=CHR$(13)THEN560ELSER$=R$+A$:PRINTA
$;:NEXTA
560  GOSUB1410:PRINT@0,"READY  CASSETTE
?";
570 IFINKEY$=""THEN570
580
INPUT£-1,R1$:IFR$=R1$THEN590ELSEGOSUB14
10:PRINT@0,"INCORRECT        FILE      ON
TAPE.";:FORA=1TO2000:NEXTA:GOTO170
590
GOSUB1410:PRINT@0,"LOADING...";:FORA=1T
O13:FORB=1TO10STEP2:INPUT£-1,C$(A,B),C$
(A,B+1):INPUT£-1,D$(A,B),D$(A,B+1):NEXT
B,A:GOSUB1410:GOTO170
600
GOSUB1410:IFMM=0THENPRINT@0,CHR$(Y+64);
X-1;"=";ELSEPRINT@0,"";
610 A$=INKEY$:IFA$=""THEN610
620
IFA$<"A"ORA$>"M"THEN610ELSEPRINTA$;:D$(
```

(listing continued on next page)

(continued from previous page)

position of the cursor; then type in the correct entry.

Now move to cell C0 and type in S.C., for sales costs and move to C1. To calculate the sales costs you have to multiply the values of A1 and B1, so press / and then *. The top line clears and

C1 =

appears. Type in A1 and

A1 *

is added. Then type in B1 and

B1 ...

is added. If you want a series of values in the same column multiplied together you could enter, say, D1 if there was anything there. But if you only want A1 * B1 enter B1. Immediately the product of A1 and B1 appears in C1.

Now enter a fixed cost, F.C., in D0 and in D1 a value of 50. The total costs will be C1 + D1 so enter T.C. in E0. Move to E1 and press / and then +. Then, as you did before enter C1, then D1 (to) D1. Now go to F0, enter

"PROF" (PROFI – E1

to find the result of 140, which is your profit.

There is also a function, R, which enables the user to duplicate the value in one cell to a range of cells elsewhere. To do this, after calling up the function as before, type in the source cell, then the range of cells to receive the values. The remaining functions are A, average, which gives the average value for all the data in the cells Xn @ Yn . . . Zn and places the result in the cursor cell.

Three parameters are required for all the maths functions as this allows the user to process information which is in a sequence with an isolated cell. For example

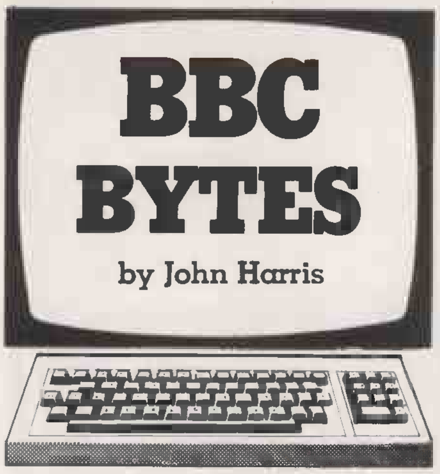
A1 @ B6 . . . B8.

The C, calculation, works out all the maths on the sheet which should only be done when all the figures have been entered. Since the program is entirely in Basic, the process is rather slow. P, plot, constructs a histogram of any row or column of data on the sheet. S, save, and L, Load, are self-explanatory. N, New, clears the sheet for restarting and X, Exit, gets you out of the special function mode in case of error. H, Help, tells you briefly what all the functions do.

Mr Bond is to be congratulated on this program. Through lack of time and space I have been unable to experiment and provide further details, but with experience and exploration it will prove to be a very useful and powerful program.

(listing continued from previous page)

```
X,Y)=A$
630 A$=INKEY$:IFA$=""THEN630
640
IFA$("0"ORA$)"9"THEN630ELSEPRINTA$;:D$(
X,Y)=D$(X,Y)+A$+"    "+M$+"    ":PRINT"
";M$;" ";
650 A$=INKEY$:IFA$=""THEN650
660
IFA$("A"ORA$)"M"THEN650ELSEPRINTA$;:D$(
X,Y)=D$(X,Y)+A$
670 A$=INKEY$:IFA$=""THEN670
680
IFA$("0"ORA$)"9"THEN670ELSEPRINTA$;:D$(
X,Y)=D$(X,Y)+A$+"...":PRINT"...";
690 A$=INKEY$:IFA$=""THEN690
700
IFA$("A"ORA$)"M"THEN690ELSEPRINTA$;:D$(
X,Y)=D$(X,Y)+A$
710 A$=INKEY$:IFA$=""THEN710
720
IFA$("0"ORA$)"9"THEN710ELSEPRINTA$;:D$(
X,Y)=D$(X,Y)+A$
730
FORA=1TOLEN(D$(X,Y)):A$(A)=MID$(D$(X,Y)
,A,1):NEXTA
740
N=ASC(A$(2))-47:M=ASC(A$(1))-64:R=VAL(C
$(N,M)):PP=N:QQ=M
750 N=ASC(A$(6))-64:M=ASC(A$(11))-64
760 N1=ASC(A$(7))-47:M1=ASC(A$(12))-47
770 RETURN
780 GOSUB1150
790 GOTO170
800   GOSUB1410:PRINT@0,"PLOT  ROW   OR
COLUMN (R/C) ?";CHR$(95);
810 A$=INKEY$:IFA$=""THEN810
820 IFA$="R"THEN850
830 IFA$="C"THEN890
840 GOTO810
850     GOSUB1410:PRINT@0,"WHICH    ROW
(A,B,C,D,E,F,G,H,I,J,K,L,M)
?";CHR$(95);
860
A$=INKEY$:IFA$=""ORA$("A"ORA$)"M"THEN86
0
870
A=ASC(A$)-64:FORB=1TO10:A$(B)=C$(B,A):N
EXTB:FORB=1TO3:A$(B+10)="":NEXTB
880 GOTO920
890   GOSUB1410:PRINT@0,"WHICH   COLUMN
(0-9) ?";CHR$(95);
900
A$=INKEY$:IFA$=""ORA$("0"ORA$)"9"THEN90
0
910
A=ASC(A$)-47:FORB=1TO13:A$(B)=C$(A,B):N
EXTB
920
A=0:FORB=1TO13:IFABS(VAL(A$(B))))ATHENA
=VAL(A$(B)):NEXT
930 NEXT
940
B=A/43:CLS:FORYY=0TO45:SET(0,YY):NEXT:F
ORXX=0TO127:SET(XX,45):NEXT:IFVAL(A$(1)
)=0ANDA$(1)()""THENPRINT@1023-LEN(A$(1)
),A$(1);
950
DD=0:FORTT=4TO107STEP8:DD=DD+1:C=VAL(A$
(DD)):FORXX=0TOC/B:SET(TT,45-XX):SET(TT
+1,45-XX):SET(TT+2,45-XX):SET(TT+3,45-X
X):SET(TT+4,45-XX):NEXTXX,TT
960 IFINKEY$=""THEN960ELSE150
970     GOSUB1410:PRINT@0,"WHERE     TO
?";CHR$(95);
980 A$=INKEY$:IFA$=""THEN980
990
IFA$("A"ORA$)"M"THEN980ELSEPRINTCHR$(8)
;A$;:Y=ASC(A$)-64
1000 A$=INKEY$:IFA$=""THEN1000
1010
IFA$("0"ORA$)"9"THEN1000ELSEPRINTA$;:X=
ASC(A$)-47:GOTO170
1020
GOSUB1410:PRINT@0,"CALCULATING...";:FOR
YY=1TO13:FORXX=1TO10:X=XX:Y=YY:IFD$(XX,
YY)()""GOSUB730:GOTO1040
1030 NEXTXX,YY:X=1:Y=1:GOTO170
1040
M$=MID$(D$(XX,YY),4,1):IFM$="*"GOSUB110
0:GOSUB1150:NEXTXX,YY:X=1:Y=1:GOTO170
1050
IFM$="+"GOSUB1110:GOSUB1150:X=1:Y=1:NEX
TXX,YY:GOTO170
1060
IFM$="-"GOSUB1130:GOSUB1150:X=1:Y=1:NEX
TXX,YY:GOTO170
1070
IFM$="/"GOSUB1120:GOSUB1150:X=1:Y=1:NEX
TXX,YY:GOTO170
1080
IFM$="@"GOSUB1140:GOSUB1150:X=1:Y=1:NEX
TXX,YY:GOTO170
1090 GOTO1030
1100
FORA=NTOM:FORB=N1TOM1:R=R*VAL(C$(B,A)):
NEXTB,A:RETURN
1110
FORA=NTOM:FORB=N1TOM1:R=R+VAL(C$(B,A)):
NEXTB,A:RETURN
1120
FORA=NTOM:FORB=N1TOM1:R=R/VAL(C$(B,A)):
NEXTB,A:RETURN
1130
FORA=NTOM:FORB=N1TOM1:R=R-VAL(C$(B,A)):
NEXTB,A:RETURN
1140
FORA=NTOM:FORB=N1TOM1:R=R+VAL(C$(B,A)):
NEXTB,A:R=R/((M-N)+(M1-N1)+2):RETURN
1150
C$(X,Y)=STR$(R):C$(X,Y)=RIGHT$(C$(X,Y),
LEN(C$(X,Y))-1)
1160 C$(X,Y)=LEFT$(C$(X,Y),5)
1170
PRINT@((Y+1)*64)+(((X-1)*6)+3),STRING$(
5-LEN(C$(X,Y)),32):C$(X,Y);
1180 RETURN
1190 A$=INKEY$:IFA$=""THEN1190
1200 IFA$="Y"THENRUN
1210 IFA$="N"THEN170
1220 GOTO1190
1230  GOSUB1410:PRINT@0,"HELP  ON WHICH
FUNCTION  (A,C,D,G,L,N,P,R,S,X,+,/,-,*)
?";CHR$(95);
1240 A$=INKEY$:IFA$=""THEN1240
1250
IFA$="A"THENGOSUB1410:PRINT@0,"AVERAGE
- CALCULATES THE AVERAGE  OF CELLS XN @
YN...ZN.";:FORA=1TO2000:NEXTA:GOTO170
1260
IFA$="C"THENGOSUB1410:PRINT@0,"CALCULAT
E  -   PERFORMS   ALL   THE   SHEET
CALCULATIONS.";:FORA=1TO2000:NEXTA:GOTO
170
1270
IFA$="D"THENGOSUB1410:PRINT@0,"DELETE
-  DELETES THE  CONTENTS OF THE PRESENT
CELL.";:FORA=1TO2000:NEXTA:GOTO170
1280  IFA$="G"THENGOSUB1410:PRINT@0,"GO
-   MOVES   THE   CURSOR   TO   CELL   NO
XN.";:FORA=1TO2000:NEXTA:GOTO170
1290
IFA$="L"THENGOSUB1410:PRINT@0,"LOAD   -
LOADS     A     DATA     FILE     FROM
TAPE.";:FORA=1TO2000:NEXTA:GOTO170
1290
IFA$="L"THENGOSUB1410:PRINT@0,"LOAD   -
LOADS     A     DATA     FILE     FROM
TAPE.";:FORA=1TO2000:NEXTA:GOTO170
1300
IFA$="N"THENGOSUB1410:PRINT@0,"NEW    -
CLEARS                            THE
SHEET.";:FORA=1TO2000:NEXTA:GOTO170
1310
IFA$="P"THENGOSUB1410:PRINT@0,"PLOT   -
PLOTS EITHER A ROW  OR A COLUMN  OF THE
SHEET.";:FORA=1TO2000:NEXT:GOTO170
1320
IFA$="R"THENGOSUB1410:PRINT@0,"REPLICAT
E  -  REPLICATES THE  CONTENTS OF  CELL
XN:
YN...ZN.";:FORA=1TO2000:NEXTA:GOTO170
1330
IFA$="S"THENGOSUB1410:PRINT@0,"SAVE   -
SAVES    THE     PRESENT     SHEET    TO
TAPE.";:FORA=1TO2000:NEXTA:GOTO170
1340
IFA$="X"THENGOSUB1410:PRINT@0,"EXIT   -
LEAVES          SPECIAL         FUNCTION
MODE.";:FORA=1TO2000:NEXTA:GOTO170
1350
IFA$="+"THENGOSUB1410:PRINT@0,"ADD    -
ADDS TOGETHER  ALL  THE  CELLS  IN  THE
RANGE               XN                +
YN...ZN.";:FORA=1TO2000:NEXT:GOTO170
1360
IFA$="/"THENGOSUB1410:PRINT@0,"DIVIDE
- DIVIDES  ALL THE  CELLS IN  THE RANGE
XN                                    /
YN...ZN.";:FORA=1TO2000:NEXT:GOTO170
1370
IFA$="-"THENGOSUB1410:PRINT@0,"SUBTRACT
 -  SUBTRACTS  ALL  THE  CELLS  IN  THE
RANGE               XN                -
YN...ZN.";:FORA=1TO2000:NEXT:GOTO170
1380
IFA$="*"THENGOSUB1410:PRINT@0,"MULTIPLY
 - MULTIPLIES  ALL  THE  CELLS  IN  THE
RANGE               XN                *
YN...ZN.";:FORA=1TO2000:NEXT:GOTO170
1390 GOTO1240
1400     GOSUB1410:PRINT@0,"ERROR     IN
CALCULATION       -       PLEASE      RE
ENTER.";:FORA=1TO2000:NEXTA:RESUME170
1410 PRINT@0,STRING$(64,32);:RETURN
1420 END
```



Spectrum compatible plotting

ROTATION PROGRAMS, or spirals, are thick on the ground. The advertisements for spot-resolution screens and printers abound with examples of them. What Chetan Mehta of Leicester has submitted is rather more than just a good flexible version. It is a graphics program which will work on the BBC and the Sinclair Spectrum with only minor amendments.

Be warned — I have not tried the program on a Spectrum. But on the BBC it generates very pretty pictures. As is usual it took several plays with the co-ordinates before an acceptable result showed up, but that is half the fun.

Something like three corners at 55,55; 111,222; 222,111 centred on 555,555 with a spiral and angle of 11 is as good a place as any to experiment from on the BBC. Use figures between 0 and 80 on the Spectrum, with the following amendments:

```
310 PLOT X(NOC), Y(NOC)
350 DRAW X(N) – X,Y(N) – Y
```

and lines 10 and 20 deleted.

The similarities between the Spectrum and BBC commands could result in more multi-machine listings in this column. The combined sales figures for the two machines indicate that this would cover a high proportion of the medium-resolution micros in home use. Is it worth the extra effort in documentation and design?

Maze

Maze games are popular, several have been printed in micro magazines and others are available commercially. But the one submitted by Andrew Armstrong of Ponteland, Newcastle-upon-Tyne, surpasses any that I have seen before.

A 10 by 10 maze contains gold bars, cages and an exit to the outside world. You also have an option to call up a 2-D map and two minutes real time to appreciate the spectacular perspective views from within the maze corridors.

Mr Armstrong's maze would now reside with Mr Beerling's Gladiator, January issue, on my games-of-the-year disc were it not for a puzzling restriction. When working on a disc-based machine Page is set by OS1.0 to &1900; cassette machines load from &E00. The difference in available memory prevents some of the programs from running on my machine, so I set up f0 and f1 with the three-line relocation routine.

When loading from disc I can press f0

(continued on page 155)

Spectrum-compatible plotting.

```
   10 MODE0
   20 GCOL0,1
   30 INPUT"NUMBER OF CORNERS",NOC
   40 DIM X(NOC+2):DIM Y(NOC+2)
   50 INPUT"ANGLE OF ROTATION",ROT
   60 LET ROT=ROT*3.142/180
   70 INPUT"HOW MUCH SPIRAL EFFECT (16
 FOR NO SPIRAL EFFECT)",SPE
   80 FOR N=1 TO NOC
   90   PRINT"CORNER";N:INPUTX(N),Y(N)
  100   NEXT N
  110 INPUT"CENTRE OF ROTATION",CX,CY
  120 CLS
  130 GOSUB310
  140 FOR N=1 TO NOC
  150   LET Y=Y(N)-CY
  160   LET X=X(N)-CX
  170   DIST =SQR(X^2+Y^2)
  180   IF X=0THEN LET ANGRAD=3.142/2:
GOTO200
  190   LET ANGRAD =ATN(Y/X)
  200   IF X<0THEN LET ANGRAD=3.142+AN
GRAD:GOTO220
  210   IF Y<0THEN LET ANGRAD=2*3.142+
ANGRAD
  220   LET X(N)=COS(ANGRAD +ROT)*DIST
+CX
  230   LET Y(N)=SIN(ANGRAD +ROT)*DIST
+CY
  240   NEXT N
  250 GOSUB 310
  260 FOR N=1 TO NOC
  270   LET X=X(N)-CX:LET X(N)=X*(100-
ROT/3.142/SPE*100)/100+CX
  280   LET Y=Y(N)-CY:LET Y(N)=Y*(100-
ROT/3.142/SPE*100)/100+CY
  290   NEXT N
  300 GOTO140
  310 PLOT69,X(NOC),Y(NOC)
  320 FOR N=1 TO NOC
  330   IF N=1THEN LET X=X(NOC):LET Y=
Y(NOC):GOTO350
  340   LET X=X(N-1):LET Y=Y(N-1)
  350   PLOT2,X(N)-X,Y(N)-Y
  360   NEXT N:RETURN
```

Maze

```
   10 *TV0,1
   20 MODE1
   30 *KEY0*FX12 6|M*FX11 30|M*FX4|M
   40 *FX12 6
   50 PROC_D_D_D:END
   60 ============================
=
   70
   80      Three Dimensional Maze

   90
  100                by
  110
  120         Andrew Armstrong
  130
  140 ============================
=
  150 DEFPROC_D_D_D
  160 ENVELOPE1,1,-1,1,-1,100,100,10
,127,0,0,-1,127,127
  170 ENVELOPE2,1,-1,-1,-1,0,0,0,127
,-3,50,-5,127,60
  180 !&FE00=&10270A:*FX4,1
  190 VDU19,1,9;0;19,2,3;0;19,3,7;0;
  200 VDU23,224,60,126,60,255,24,60,
102,195
  210 DIM M%(9,9),XD%(3),YD%(3),D$(3
)
  220 ST%=120:MB%=0:ST$="BESTTIMER":
MB$="MOSTBARS"
  230 REPEATPROCINSTS:RESTORE
  240    *FX11 1
  250    *FX12 1
  260    VDU29,640;512;:XC%=640:YC%=5
12:G%=0:BL%=3
  270    FOR A%=0TO3:READ XD%(A%),YD%
(A%),D$(A%):NEXT
  280    DATA0,-1,North,1,0,East,0,1,
South,-1,0,West
  290    PROCMAKE
  300    X%=SX%:Y%=SY%:D=1:TIME=0
  310    EFL%=FALSE:REPEATPROCCELL(X%
,Y%,D):PROCMOVE:UNTILEFL%
  320    PRINTTAB(0,30)"Press <SPACE>
.":REPEATUNTILGET=32
  330    UNTIL0
  340 ENDPROC
  350
  360  View generator
  370
  380 DEF PROCCELL(X,Y,DIR)
  390 FORA%=1TO3:VDU19,A%;0;0:NEXT
  400 CLS
  410 VDU19,1,9;0;19,2,3;0;19,3,7;0;
  420 PRINT"X:";X;" Y:";Y;:COLOUR2:P
RINT"  You are going "D$(DIR)".";:CO
LOUR3:PRINTTAB(30)"Time:";120-(TIME
DIV 100)
  430 LDIR=DIR-1:IF LDIR<0 LDIR=3
  440 RDIR=DIR+1:IF RDIR>3 RD!R=0
  450 LD=2^LDIR:RD=2^RDIR:DR=2^DIR
  460 S=900:REPEATS=S/2:LFT%=TRUE:RH
T%=TRUE
  470    IF (FNMAZE(X.Y) AND 16)<>0 P
ROCGOLD_BAR(S)
  480    IF (FNMAZE(X,Y) AND 32)<>0 P
ROCGATE(S)
  490    IF (FNMAZE(X,Y) AND LD)=0 PR
OCLEFT(S):LFT%=FALSE
  500    IF (FNMAZE(X,Y) AND RD)=0 PR
OCRIGHT(S):RHT%=FALSE
  510    PROCCUBE(S,LFT%,RHT%)
  520    IF (FNMAZE(X,Y) AND DR)<>0PR
OCENDWALL(S):S=0
  530    X=X+XD%(DIR):Y=Y+YD%(DIR)
  540    UNTILS<2
  550 ENDPROC
  560
  570 DEF FNMAZE(X,Y)
  580 IF X>=0 AND X<=9 AND Y>=0 AND
Y<=9 =M%(X,Y)
  590 =15
  600
  610 DEFPROCCUBE(SIZE,LEFT,RIGHT)
  620 S1%=SIZE:S2%=SIZE*2
  630 IF (FNMAZE(X,Y) AND 64)<>0 GCO
L0,2:MOVE-S2%,-S2%:DRAWS1%,-S1%:MOVE
S2%,-S2%:DRAW-S1%,-S1%:GCOL 0,3
  640 MOVE-S1%,-S1%
  650 IF LEFT MOVE-S2%,-S2%:DRAW-S1%
,-S1%
  660 DRAW-S1%,S1%
  670 IF LEFT MOVE-S2%,S2%:DRAW-S1%,
S1%
  680 MOVES1%,-S1%
  690 IF RIGHT MOVES2%,-S2%:DRAWS1%,
-S1%
  700 DRAWS1%,S1%
  710 IF RIGHT MOVES2%,S2%:DRAWS1%,S
1%
  720 ENDPROC
  730 DEF PROCLEFT(SIZE)
  740 IF (FNMAZE(X+XD%(LDIR),Y+YD%(L
DIR)) AND 32)<>0 PROCSIDEGATE("L",S)
  750 S1%=SIZE:S2%=SIZE*2:S3%=SIZE/5
  760 IF (FNMAZE(X+XD%(LDIR),Y+YD%(L
DIR)) AND DR)<>0 MOVE-S2%,-S1%:DRAW-
S1%,-S1%:MOVE-S2%,S1%:DRAW-S1%,S1%:E
NDPROC
  770 IF (FNMAZE(X,Y) AND DR)<>0 OR
(FNMAZE(X+XD%(LDIR)+XD%(DIR),Y+YD%(L
DIR)+YD%(DIR)) AND RD)=0 ENDPROC
  780 MOVE-S1%-S3%,S1%:MOVE-S1%,S1%:
PLOT85,-S1%,-S1%:MOVE-S1%-S3%,-S1%:P
LOT85,-S1%-S3%,S1%
  790 ENDPROC
  800 DEF PROCRIGHT(SIZE)
  810 S1%=SIZE:S2%=SIZE*2:S3%=SIZE/5
  820 IF (FNMAZE(X+XD%(RDIR),Y+YD%(R
DIR)) AND 32)<>0 PROCSIDEGATE("R",S)
  830 IF (FNMAZE(X+XD%(RDIR),Y+YD%(R
DIR)) AND DR)<>0 MOVES2%,-S1%:DRAWS1
%,-S1%:MOVES2%,S1%:DRAWS1%,S1%:ENDPR
OC
```

(listing continued on page 155)

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PC

(continued from page 153)

and run as though from cassette with the full memory available — f1 is available in case I modify the program and then want to Save it to disc. On some programs this works fine, but on others, maze included, the resulting program in memory becomes corrupted on Running.

Consequently there is no option but to Chain such programs in from tape every time, setting Page equal to &E00 beforehand, which works albeit tediously. Any ideas on why or the correct approach will be gratefully received.

Orbit

A brave attempt by Michael Griffin to duplicate the programs of Nasa on a micro results in a game which is great fun to play. Orbit is set up to emulate the docking operation with a station in a decaying circular orbit around the sun.

To be in a decaying orbit involves a loss of energy from the craft. The loss can be very slow, as in tidal drag, or more rapid through hitting the increasingly less tenuous atmosphere. Ignoring tidal forces as minimal in this case, the station must be horrifyingly close to the surface of the sun for friction to be slowing it up. At any acceptable distance the station just revolves in identical orbits without decay.

Another unusual feature arises from the orbits being circular. Before Kepler, the whole of astronomy was based on circles, and very complicated it became too. Kepler's great simplification was to say that for a given average orbit radius the circle is but one possibility out of an infinite number of elliptical orbits, and as such a special case.

Using the generalised elliptical orbit it

(continued on next page)

(listing continued from page 153)

```
  840 IF (FNMAZE(X,Y) AND DR)<>0 OR
(FNMAZE(X+XD%(RDIR)+XD%(DIR),Y+YD%(R
DIR)+YD%(DIR)) AND LD)=0 ENDPROC
  850 MOVES1%+S3%,S1%:MOVES1%,S1%:PL
OT85,S1%,-S1%:MOVES1%+S3%,-S1%:PLOT8
5,S1%+S3%,S1%
  860 ENDPROC
  870 DEF PROCENDWALL(SIZE)
  880 S1%=SIZE
  890 IF X=OUT% AND Y=10 GCOL0,1:MOV
E-S1%,-S1%:MOVES1%,-S1%:PLOT85,-S1%,
S1%:MOVES1%,S1%:PLOT85,S1%,-S1%:GCOL
0,3
  900 MOVE-S1%,-S1%:DRAWS1%,-S1%
  910 MOVE-S1%,S1%:DRAWS1%,S1%
  920 ENDPROC
  930
  940  Maze creation subroutine
  950
  960 DEF PROCMAKE:TIME=0
  970 FORX%=0TO9:FORY%=0TO9:M%(X%,Y%
)=15:NEXT:NEXT
  980 X%=RND(8):Y%=RND(3):SX%=X%:SY%
=Y%:D%=0
  990 T%=0:REPEAT:REPEATC%=0:REPEATR
EPEATC%=C%+1:D%=(D%+RND(4))MOD4:NX%=
X%+XD%(D%):NY%=Y%+YD%(D%):UNTIL(NX%<
=9 AND NX%>=0 AND NY%<=9 AND NY%>=0)
:UNTILM%(NX%,NY%)=15 OR C%>5
 1000     IF C%<6 M%(X%,Y%)=M%(X%,Y%
)AND NOT(2^D%):X%=NX%:Y%=NY%:M%(X%,Y
%)=M%(X%,Y%)AND NOT(2^((D%+2)MOD4)):
T%=T%+1
 1010       UNTILC%>5
 1020    REPEATX%=RND(8):Y%=RND(8):UN
TILM%(X%,Y%)<>15:UNTILT%>=95 OR TIME
>4000
 1030 OUT%=RND(8):L%=9:M%(OUT%,L%)=M
%(OUT%,L%) AND NOT4:REPEATM%=M%(OUT%
,L%-1):M%(OUT%,L%)=M%(OUT%,L%)AND NO
T 1:L%=L%-1:M%(OUT%,L%)=M%(OUT%,L%)A
ND NOT 4:UNTILM%<>15
 1040 FORA%=0TOMB%MOD20:X%=RND(8):Y%
=RND(8):M%(X%,Y%)=M%(X%,Y%) OR 16:NE
XT
 1050 PROCCAGES(4,SX%,SY%)
 1060 PRINTTAB(0,30)"Press any key t
o continue":A=GET
 1070 PROCMAP(SX%,SY%)
 1080 ENDPROC
 1090
 1100  User move subroutine
 1110
 1120 DEF PROCMOVE
 1130 *FX15
 1140 REPEATA$=INKEY$(0):PRINTTAB(35
,0);120-(TIME DIV100)" "
 1150    IF FNMAZE(X%,Y%) AND 32 SOUN
DRND(3),2,0,20
 1160    UNTILTIME>12000 OR A$<>"":IF
 TIME>12000 PROCTIMOUT
 1170 IFA$="I" PROCFORWARD
 1180 IFA$="K" D=D+1:IF D>3 D=D-4
 1190 IFA$="B" PROCBLAST:PROCCAGES(1
,X%,Y%)
 1200 IFA$="J" D=D-1:IF D<0 D=D+4
 1210 IFA$="M" D=(D+2) MOD4
 1220 IFA$="H" PROCMAP(X%,Y%)
 1230 IFA$="C" M%(X%,Y%)=M%(X%,Y%) O
R 64
 1240 ENDPROC
 1250 DEF PROCFORWARD
 1260 IF FNMAZE(X%,Y%) AND 2^D PRINT
"You hit the wall!!":SOUND0,-15,6,10
:FORA%=0TO5000:NEXT:ENDPROC
 1270 IF FNMAZE(X%,Y%) AND 32 PRINT"
Ha Ha.. You are trapped.":EFL%=TRUE:
ENDPROC
 1280 X%=X%+XD%(D):Y%=Y%+YD%(D):IF X
%=OUT% AND Y%=10 PROCESCAPE
 1290 IF(FNMAZE(X%,Y%) AND 16)<>0 SO
UND1,1,100,20:SOUND2,1,100,20:SOUND3
,1,100,20:M%(X%,Y%)=M%(X%,Y%) AND NO
T 16:G%=G%+1:IFG%MOD2=1 BL%=BL%+1
 1300 ENDPROC
 1310
 1320  Map drawing routine
 1330
 1340 DEF PROCMAP(X,Y):LOCALX%,Y%,A%
,B%
 1350 CLS:PRINT"Here is a map:":S%=-
32:FORA%=0TO9:FORB%=0TO9
 1360       X%=A%*64-320:Y%=B%*-64+328
 1370       IFM%(A%,B%) AND 1 MOVEX%-S
%,Y%-S%:DRAWX%+S%,Y%-S%
 1380       IFM%(A%,B%) AND 2 MOVEX%-S
%,Y%-S%:DRAWX%-S%,Y%+S%
 1390       IFM%(A%,B%) AND 4 MOVEX%+S
%,Y%+S%:DRAWX%-S%,Y%+S%
 1400       IFM%(A%,B%) AND 8 MOVEX%+S
%,Y%+S%:DRAWX%+S%,Y%-S%
 1410       IFA%=X AND B%=Y VDU5:MOVEX
%-16,Y%+16:PRINT"`":VDU4:'&FE00=&102
70A
 1420       IFM%(A%,B%) AND 64 GCOL0,2
:MOVEX%-S%,Y%-S%:DRAWX%+S%,Y%+S%:MOV
EX%+S%,Y%-S%:DRAWX%-S%,Y%+S%:GCOL0,3
 1430       IFM%(A%,B%) AND 16 S2%=S%
DIV 4:GCOL0,2:MOVEX%-S2%,Y%-S2%:MOVE
X%+S2%,Y%-S2%:PLOT85,X%+S2%,Y%+S2%:M
OVEX%-S2%,Y%+S2%:PLOT85,X%-S2%,Y%-S2
%:GCOL0,3
 1440       IFM%(A%,B%) AND 32 GCOL0,1
:S2%=S%*.8:MOVEX%-S2%,Y%-S2%:DRAWX%+
S2%,Y%-S2%:DRAWX%+S2%,Y%+S2%:DRAWX%-
S2%,Y%+S2%:DRAWX%-S2%,Y%-S2%:GCOL0,3
 1450       *FX15
 1460       NEXT:NEXT:PRINTTAB(0,30)"P
ress any key to continue.":A=GET:END
PROC
 1470
 1480  Game ends
 1490
 1500 DEF PROCESCAPE:T=TIME DIV100
 1510 CLS:SOUND0,-15,7,50:FORB%=0TO3
:FORA%=0TO255STEP5:SOUND1,0,A%,0:NEX
T:NEXT
 1520 PRINT"Well done! You have esca
ped from the"'"maze."
 1530 PRINT"You got out in ";T;" sec
onds,"'" with ";G%;" gold bars."
 1540 *FX15
 1550 *FX12 6
 1560 *FX11 30
 1570 *FX4
 1580 IF T<ST% OR G%>MB% INPUT'"Plea
se enter your name "N$
 1590 IF T<ST% ST$=N$:ST%=T
 1600 IF G%>MB% MB$=N$:MB%=G%
 1610 PRINT''"Most bars by "MB$" (";
MB%;" bars)"''"Shortest time by "ST$
" (";ST%;" seconds)"
 1620 EFL%=TRUE:ENDPROC
 1630 DEFPROCTIMOUT:CLS:FORS%=6TO15S
TEP3:FORA%=255TO0STEP-S%
 1640       SOUND1,-15,A%,1
 1650       SOUND2,-15,A%,1
 1660       SOUND3,-15,A%,1:NEXT:NEXT:
PRINT"You ran out of time."
 1670 EFL%=TRUE:ENDPROC
 1680 DEF PROCINSTS
 1690 CLS:PRINT"*** 3D Maze (C) Andy
 Armstrong 1982 ***"
 1700 PRINTSTRING$(39,"_")''"You are
 stuck in a maze, the exit of"'"whic
h is a red panel in the wall."'" You
 have two minutes to find this and"'
"escape."''" Your controls are:"TAB(
20,10)"I"TAB(19,11)"J K"TAB(20,12)"M
"
 1710 PRINT''"H(elp : Look at map."'
"B(last: Blast a wall (3 shots only)
."'"C(ross: Mark cell with a cross."
 1720 PRINT''"GOOD LUCK"
 1730 ENDPROC
 1740
 1750  Special effects
 1760
 1770 DEF PROCGOLD_BAR(SIZE):GCOL0,2
 1780 IF SIZE<10 ENDPROC
 1790 S1%=SIZE*1.7:H%=SIZE/5:D%=SIZE
/10:W%=SIZE/2:BW%=SIZE/2.2
 1800 MOVE-W%,-S1%:MOVE-W%,-S1%+H%:P
LOT85,W%,-S1%+H%
 1810 MOVEW%,-S1%:PLOT85,-W%,-S1%
 1820 MOVE-W%,-S1%+H%:MOVEW%,-S1%+H%
:PLOT85,BW%,-S1%+H%+D%
 1830 MOVE-BW%,-S1%+H%+D%:PLOT85,-W%
,-S1%+H%
 1840 GCOL0,0:MOVE-W%,-S1%+H%:DRAWW%
,-S1%+H%
 1850 GCOL0,3:ENDPROC
 1860 DEF PROCBLAST
 1870 IF (X%=9 AND D=1)OR(X%=0 AND D
=3)OR(Y%=0 AND D=0)OR(Y%=9 AND D=2)
ENDPROC
 1880 BL%=BL%-1:IFBL%<0ENDPROC
 1890 SOUND0,-15,7,5:FORA%=255TO160S
TEP-1:SOUND1,0,A%,0:NEXT
 1900 M%(X%,Y%)=M%(X%,Y%) AND NOT (2
^D)
 1910 M%(X%+XD%(D),Y%+YD%(D))=M%(X%+
XD%(D),Y%+YD%(D)) AND NOT ((2^((D+2)
MOD4))OR32)
 1920 ENDPROC
 1930 DEF PROCGATE(SIZE):LOCALX%
 1940 S1%=SIZE*2
 1950 GCOL0,1
 1960 FORX%=-S1% TO S1% STEP SIZE/2.
2:MOVEX%,Y%-S1%:DRAWX%,Y%+S1%:MOVEY%
-S1%,X%:DRAWY%+S1%,X%:NEXT
 1970 GCOL0,3:ENDPROC
 1980 DEF PROCCAGES(N,UX,UY)
 1990 LOCALX%,Y%,A%
 2000 FORA%=1TON:REPEATX%=RND(8):Y%=
RND(8):UNTILX%<>UX OR Y%<>UY:M%(X%,Y
%)=M%(X%,Y%) OR 32:NEXT:ENDPROC
 2010 DEF PROCSIDEGATE(SIDE$,SIZE)
 2020 IF S<10 ENDPROC
 2030 LOCALST%,S1%,ST%,GR%
 2040 GCOL0,1
 2050 IFSIDE$="L" ST%=-1 ELSE ST%=1
 2060 S1%=SIZE*2*ST%:S2%=SIZE*ST%
 2070 FORGR%=S1%TOS2%STEPSGN(S2%-S1%
)*(SIZE/8.8):MOVEGR%,-GR%:DRAWGR%,GR
%:NEXT
 2080 FORGR%=S1%TO-S1%STEP SGN(-S1%)
*(SIZE/2.2)
 2090    MOVES1%,GR%:DRAWS2%,GR% DIV
2:NEXT:GCOL0,3:ENDPROC
```

Relocation routine.

```
>WIDTH36
>LISTO1
>REM TO SHIFT DOS-LOADED PROGS
>REM TO CASSETTE-BASED ~E00
>REM WHEN THEY WON'T OTHERWISE
>REM FIT INTO MEMORY
>LOAD"SHIFT"
>
>LIST
   10 *KEY 0 FORA%=&1900TOTOP STEP4:
!(A%-&B00)=!(A%):NEXTA%:PAGE=&E00|MO
LD|M
   15 *KEY 1 FORA%=TOP TO &E00STEP-4
:!(A%+&B00)=!(A%):NEXTA%:PAGE=&1900|
MOLD|M
   20 END
```

(continued from previous page)

became possible to describe the solar system as a simple series of elliptical orbits about the central sun, complicated only by moons and the interaction between planets themselves. The process of reorienting astronomy was completed by Newton when he gave the subject a mathematical basis which enabled predictions to be made.

Now, anyone who has a shot at incorporating that lot has my sympathy, though I should be fascinated to see the result. I doubt, however, whether the lack of agreement between Orbit and Nasa's version of reality makes it any less exciting to play.

Seaspray

A program from C Galbraith of Kilmarnock shows the effect of the white-noise generator. He suggests it might remind you of breakers in a cove. The listing demonstrates the extent to which the Sound and Envelope commands in BBC Basic allow an exact specification to be made of what, in previous levels of Basic, would have taken a lot more program, incorporating areas of machine code. The missing code is embodied in the sound-generating hardware, with its own microprogram. If you cannot accept the limitations which allow this program to be written there is nothing to stop you from going back to square one and programming from scratch.

Line 80 is misleading in that it does not mean what it might appear to;

65 or 70

has a single value to Basic of 71, being an Oring of the bits in the two binary numbers 100001 and 100111. Hence only one time in 98 will be selected, not two.

Saucy

This program from Jennie Page of Lathom near Ormskirk generates a graphics screen on which a sauce bottle is seen to fill with sauce. A message then appears, and on pressing a key or after a set pause the bottle suddenly empties and the cycle recommences. The listing demonstrates the use of Colour, GCol, Move and Draw in several variations and provides a useful introduction from which beginners may benefit.

Orbit.

```
  *REM ORBIT
>LIST
   10 MODE7
   20 VDU&81:PRINT"ORBIT-INSTRUCTION
S"''
   30 VDU&82:PRINT"YOU MUST DOCK WIT
H THE SPACE STATION":VDU&82:PRINT"IN
 THE SHORTEST POSSIBLE TIME"'
   40 VDU&83:PRINT"W MOVES YOUR ORBI
T OUTWARDS"'
   50 VDU&84:PRINT"X MOVES YOUR ORBI
T INWARDS"''''
   60 VDU&86:PRINT"PRESS ANY KEY TO
START"
   70 A$=GET$
   80 MODE1
   90 O=0:P=RND(180)
  100 VDU23,224,32+16+8+4,16+8,255-6
5,255,255,255-65,16+8,32+16+8+4
  110 VDU23,245,8+16,4+8+16+32,255-1
29,255,255,255,255-129,255-68
  120 VDU19,3,1,0,0,0
  130 GCOL1,2
  140 FOR A%=1TO100
  150 PLOT 69,RND(1280),RND(1024)
  160 NEXT
  170 PROCCIRCLE(640,512,50)
  180 TIME=0
  190 X%=640-RND(1280):Y%=512-RND(10
24)
  200 SX%=640-RND(1280):SY%=512-RND(
1024)
  210 Z%=FNDIST(Z%)
  220 SZ%=FNSDIST(SZ%)
  230 IF SZ%<50 THEN MODE4:PRINT"YOU
 LOST, THE SATELLITE FELL INTO THE S
UN":REPEAT:UNTIL INKEY(-99):RUN
  240 IF Z%<70 THEN SOUND0,-15,5,50:
MODE4:PRINT"YOU LOSE,YOUR SHIP FELL
INTO THE SUN":REPEAT:UNTIL INKEY(-99
):RUN
  250 IF (X%-SX%<5 AND Y%-SY%<5)AND(
SX%-X%<5 AND SY%-Y%<5) THEN MODE4:PR
INT"WELL DONE,YOU RESCUED THE SATELL
ITE WITH A TIME OF ";TIME/100:REPEAT
:UNTIL INKEY(-99):RUN
  260 VDU5
  270 GCOL2,2
  280 MOVE X%+640,Y%+512:PRINTCHR$(2
45)
  290 MOVE SX%+640,SY%+512:PRINTCHR$
(224)
  300 GCOL1,1
  310 PROCMOVE
  320 PROCSMOVE
  330 MOVE X%+640,Y%+512:PRINTCHR$(2
45)
  340 MOVE SX%+640,SY%+512:PRINTCHR$
(224)
  350 GOTO210
  360 END
  370 DEFPROCCIRCLE(X,Y,R)
  380 LOCAL XI,YI
  390 FOR XI=X-R TO X+R STEP 4
  400 YI=SQR(R*R-(X-XI)^2)
  410 MOVE XI,Y-YI
  420 DRAW XI,Y+YI
  430 NEXT
  440 ENDPROC
  450 DEFFNDIST(Z%)=SQR(X%^2+Y%^2)
  460 DEFFNSDIST(SZ%)=SQR(SX%^2+SY%^
2)
  530 DEFPROCMOVE
  540 A$=INKEY$(0)
  550 *FX15,0
  560 IF A$="W" THEN Z%=Z%+10:SOUND0
,-10,4,1
  570 IF A$="X" THEN Z%=Z%-10:SOUND0
,-10,4,1
  580 X%=SIN(O)*Z%
  590 Y%=COS(O)*Z%
  600 IF O=180 THEN O=0
  610 O=O+((648000)/(2*PI*Z%)^2)
  620 ENDPROC
  630 DEFPROCSMOVE
  640 SX%=SIN(P)*SZ%
  650 SY%=COS(P)*SZ%
  660 IF P=180 THEN P=0
  670 P=P+((648000)/(2*PI*SZ%)^2)
  680 ENDPROC
```

Seaspray.

```
   10 ENVELOPE1,3,0,-2,-1,2,2,30,50,
-1,-12,-2,126,126
   20 REPEAT
   30 D=RND(3)+3
   40 FORC=1TO28
   50 READB
   60 FORA=1TO4
   70 SOUND0,-B,D,1
   80 IFRND(98)=(65 OR 71)THENSOUND1
,1,200,7
   90 NEXT
  100 NEXT
  110 RESTORE
  120 UNTIL FALSE
  130 DATA1,1,1,2,2,3,5,8,15,15,15,1
4,13,12,11,10,9,8,7,6,5,4,3,2,1,1,1,
1
```

Saucy.

```
   10 REM  *    Saucy       *
   20 REM  *   by  J Page   *
   30 REM  *   (c)  1983    *
   40 MODE 1
   50 COLOUR 131
   60 CLS
   70 COLOUR 0
   80 GCOL 0,0
   90 MOVE 500,100
  100 DRAW 400,100
  110 DRAW 400,400
  120 DRAW 500,700
  130 DRAW 500,800
  140 DRAW 600,800
  150 DRAW 600,700
  160 DRAW 700,400
  170 DRAW 700,100
  180 DRAW 500,100
  190 GCOL 0,1
  200 FOR X=404 TO 698
  210 MOVE X,104
  220 DRAW X,400
  230 NEXT X
  240 Y=700
  250 X=504
  260 REPEAT
  270 MOVE X,Y-400
  280 DRAW X,Y
  290 X=X+1
  300 UNTIL X=600
  305 X=405
  310 GCOL 0,1
  320 Y=395
  330 Z=401
  340 REPEAT
  350 MOVE X,Y
  360 DRAW X,Z
  370 X=X+1
  380 Z=Z+3
  390 UNTIL Z>695
  400 X=X+96
  410 Z=Z-5
  420 REPEAT
  430 MOVE X,Z
  440 DRAW X,Y
  450 X=X+1
  460 Z=Z-3
  470 UNTIL X>695
  480 GCOL 0,3
  490 X=450
  500 REPEAT
  510 MOVE X,150
  520 DRAW X,350
  530 X=X+1
  540 UNTIL X>650
  550 GCOL 0,3
  560 X=500
  570 Y=350
  580 REPEAT
  590 MOVE X,Y
  600 DRAW X,Y+50
  610 X=X+1
  620 UNTIL X=600
  630 X=475
  640 Y=375
  650 Z=400
  660 REPEAT
  670 MOVE X,Y
  680 DRAW X,Z
  690 X=X+1
  700 Y=Y-1
  710 UNTIL Y=350
  720 X=625
  730 Y=375
  740 REPEAT
  750 MOVE X,Y
  760 DRAW X,Z
  770 X=X-1
  780 Y=Y-1
  790 UNTIL Y=350
  800 GCOL 0,0
  810 VDU 5
  820 MOVE 475,335
  830 PRINT"HEINZ"
  840 MOVE 100,900
  850 PRINT"Are you feeling saucy to
day?"
  860 VDU 4
  870 A$=INKEY$(1000)
  880 CLS
  890 REM *** Add line 900 to keep r
epeating the program ***
  900 GOTO 70
```

EPSON HX-20

Morse code

IF YOU THOUGHT that Morse code went out with the *Boy's Own Paper* you may be right. Yet it lives on in several demonstration routines for micros — and now M J Bates of Chelmsford, Essex has written one for the Epson portable.

Now you can send Morse messages while you are in the bath.

Morse code.

```
10 REM TAPCNT=328
20 CLS
30 DIM A(26)
40 FOR I=1 TO 26
50 READ A(I)
60 NEXT I
70 INPUT;C$
80 IF C$="" THEN STOP
90 J=1
100 A$=MID$(C$,J,1)
110 IF A$="" THEN GOTO 7
0
120 IF A$=" " THEN GOTO
280
130 A=ASC(A$)
140 A=A-64
150 A=A(A)
160 A$=STR$(A)
170 B$=LEFT$(A$,2)
180 FOR I=2 TO 5
190 B$=MID$(A$,I,1)
200 IF B$="2" THEN SOUND
 25,1
210 IF B$="1" THEN SOUND
 25,3
220 IF B$="" THEN GOTO 2
50
230 SOUND 0,1
240 NEXT I
250 SOUND 0,2
260 J=J+1
270 GOTO 100
280 SOUND 0,5
290 GOTO 260
300 DATA 21,1222,1212,12
2,2,2212,112,2222,22,211
,121,2122,11,12,111,2112
,1121,212,222,1,221,2221
,211,1221,1211,1122
```

SHARP MZ-80K

Road Runner

WE ARE regular readers of *Practical Computing* but have found few programs for the Sharp MZ-80K. So write John Bethell and Charles Henderson of Edinburgh, who remedied the situation by writing one.

Road Runner is an original game written in disc Basic. it will run on any Sharp MZ-80K and uses about 8K of memory. It could be converted for other computers.

The object is to steer your road runner along an endless track, avoiding deadly snakes basking on the road. If you leave the track you die instantly. Fuller instructions are included in the game.

Lines 1-20. Title, ask if you want instructions.
Lines 20-36. Display instructions
Lines 37. A$ is part of the road; C is the distance of the road from the left-hand side; F is the screen location of the road runner; J is the display code for the road runner
Lines 38-55. Display a comical picture of a road runner
Lines 56-94. Main routine
Line 59. Sets timer at 0
Lines 98-119. Display score
Lines 120-124. Display random snake and house

Road Runner.

```
1 REM***********************
2 REM**** ROAD  RUNNEP ****
3 REM****      By       ****
4 REM****               ****
5 REM**** J.Bethell     ****
6 REM**** C.Henderson   ****
7 REM***********************
8 CLR
9 DC=0
10 PRINT"▣"
11 FORX=0TO79:SETX,0:SETX,49:NEXTX
12 FORY=0TO49:SET0,Y:SET79,Y:NEXTY
13 CURSOR7,12
14 PRINT"DO YOU WISH INSTRUCTIONS"
15 PRINT"▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒▒(Y/N)"
16 TEMPO6
17 MUSIC"¯D5B7R0B5¯C¯D¯B7R0¯B7¯G"
18 GETAS$
19 IFAS$="Y"THEN23
20 IFAS$="N"THEN37
21 GOTO18
22 REM***INSTRUCTIONS***
23 PRINT"▣"
24 PRINT"▒▒▒▒INSTRUCTIONS"
25 PRINT"▒▒▒▒════════════"
26 PRINT"▒▒▒▒TO MOVE YOURSELF (";CHR$(99);") USE :"
27 CURSOR7,9
28 PRINT"A←←  Z← ";CHR$(99);" →C  →→D"
29 PRINT"▒▒ YOU ARE A ROAD-RUNNER BEING CHASED BY
30 PRINT
31 PRINT  "A HUNGERY COYOTE.YOU CAN EASILY OUT-RUN"
32 PRINT:PRINT      "HIM, SO THIS IS THE LEAST OF YOUR "
33 PRINT:PRINT      "PROBLEMS. YOU HAVE TO STAY ON THE TRACK"
34 PRINT:PRINT      "AVOIDING SNAKES(";CHR$(105);"), OR YOU WILL CRASH."
35 PRINT"▒▒▒▒▒▒▒▒▒▒▒▒▒PRESS ANY KEY
36 GETET$:IFET$=""THEN36
37 A$=" ▩      ▩":C=15:F=53267:J=202
38 PRINT"▣▒▒▒▒▒▒▒▒▒▒▒ROAD-RUNNER"
39 PRINT"▒▒▒▒▒▒▒▒▒▒▒▒▒══════════"
40 PRINT"▒▒▒▒PRESS ANY KEY TO START"
41 PRINT"▒▒"
42 PRINT"              ──
43 PRINT"             >●  ──
44 PRINT"               \    ──
45 PRINT"                \   ◸
46 PRINT"                 ▩▩▩ ───
47 PRINT"                 ▼▼
48 PRINT"                /|  ─────
49 PRINT"               / |
50 PRINT"               \  \ ───
51 PRINT"                \  \ ──
52 PRINT"                 ─  ─
53 TEMPO5
54 FORWE=1TO100:NEXTWE:MUSIC"B1R0B1"
55 GETHA$:IFHA$=""THEN55
56 PRINT"▣"
57 REM***MAIN ROUTINE***
58 FORQ=1TO30:PRINTTAB(C);A$:NEXTQ
59 TI$="000000"
60 B=INT(3*RND(1)+1)
61 L=INT(20*RND(1)+1)
62 IFB=1THENC=C-1
63 IFC=1THENGOTO87
64 IFC=2THENGOTO88
65 IFB=1THENA$=" ◢      ◢"
66 IFB=2THENC=C+1
67 IFC=32THENGOTO89
68 IFC=31THENGOTO90
69 IFB=2THENA$="◣      ◣"
70 IFB=3THENC=C
71 IFB=3THENA$=" ▩      ▩"
72 POKEF,J
73 GETR$
74 IFR$="Z"THENGOSUB91
75 IFR$="C"THENGOSUB92
76 IFR$="A"THENGOSUB93
77 IFR$="D"THENGOSUB94
78 IFL=10THENGOTO 120
79 IFL=14THENGOSUB121
80 IFL=7THENGOSUB123
81 PRINTTAB(C);A$
82 K=PEEK(F)
```

(continued on page 160)

LYNX

Recovering programs

CONTRARY to what the manual states, it is possible to recover Basic programs on the Lynx after typing New, writes Chris Cytera of Reading, Berkshire. All that is required is a machine-code program which removes a marker from the Basic text space and sets up a relevant pointer in the system RAM.

When you type New the computer inserts an End of Text marker right at the beginning of the Basic text space. The marker is the byte 80 hex, and replaces the exponent of the very first line number of the program present. A pointer at locations 61FC and 61FD, which points to the end of the program, is then reset to point to the beginning of the Basic text area. Fortunately, the contents of memory are not destroyed.

In order to recover the program that has been Newed, the first step is to replace the exponent of the first line number, removing the End of Text marker. As it is not possible to know the exponent value prior to when New was typed, a value of C0 is assumed, which multiplies the mantissa by 10^0 or 1. This means that the first line number may be altered.

As Basic normally starts at 694D, the statement

POKE &694D, &C0

will appear to recover Basic programs. Unfortunately this does not set up the pointer to the end of the program, which must be done if it is to be edited or if it uses arrays.

At this point the machine-code routine searches through the program for the old End of Text marker, which is still present. When it is found, its location is put into locations 61F and 61FD.

Recovering programs.

```
6343H DD 2A FA 61   LD    IX,(61FAH)
6347H DD 36 00 C0   LD    (IX+00H),C0H
634BH 06 00         LD    B,00H
634DH DD 7E 00      LD    A,(IX+00H)
6350H FE 80         CP    80H
6352H 28 07         JR    Z,635BH
6354H DD 4E 05      LD    C,(IX+05H)
6357H DD 09         ADD   IX,BC
6359H 18 F2         JR    634DH
635BH DD 22 FC 61   LD    (61FCH),IX
635FH C9            RET
```

To type in the program, enter the monitor and use M6343. This address is actually within the cassette file name buffer. The machine code will be safe in this area, provided that file names are restricted to 51 characters in length.

When the hexadecimal code has been entered, go back to Basic and type in a program. Enter New to delete it. Now for the crunch: execute the machine code with Call &6343. The Basic program should be recovered, possibly with the first line number altered.

When you are satisfied that the machine code is working correctly, save it through the monitor with

D 6343 635F 6343 'OLD'

Old is the file name I have used for reasons of familiarity with two other well-known computers.

Whenever you lose a Basic program by typing New, or by resetting the Lynx it can be recovered by MLoad 'Old'. The Z-80 Reset pin is available on the socket labelled Interface. The machine code will execute automatically when it is loaded. If it is already in memory, then just Call &6343.

(continued from page 158)

```
83 IFK=32THEN60
84 IFK=JTHEN60
85 IFK<>0THENGOTO96
86 GOTO60
87 C=C+2:GOTO60
88 C=C+1:GOTO60
89 C=C-2:GOTO60
90 C=C-1:GOTO60
91 F=F-1:RETURN
92 F=F+1:RETURN
93 F=F-2:RETURN
94 F=F+2:RETURN
95 REM***CRASH ROUTINE***
96 POKEF,107:FORDF=1TO500:NEXTDF
97 MUSIC"A0DADADADAEBEBEBEADADABC":FORTY=1TO500:NEXTTY
98 PRINT"■"
99 FORRT=1TO4
100 USR(68)
101 REM***DISPLAY SCORE***
102 PRINT"■■■■■■■■■■■■■■■■■■■YOU HAVE CRASHED !!"
103 FORVU=1TO100:NEXTVU:USR(71)
104 PRINT"■■■■■■■■■■■■■■■■■■■                    "
105 FORVU=1TO100:NEXTVU:NEXTRT
106 PRINT"■■■■■■■■■■■YOU LASTED FOR ";VAL(TI$);" SECONDS"
107 PRINT"■■■■HIGH SCORE";
108 IF VAL(TI$)>DCTHENDC=VAL(TI$):TEMPO7:GOTO110
109 GOTO111
110 MUSIC"D5_B_G7R0_G7R0_G5_A5_BCD7R0D7R0D7_B7":GOTO113
111 PRINTDC
112 GOTO115
113 PRINTDC
114 PRINT"■■■■YOU HAVE BEATEN THE HIGH SCORE"
115 PRINT"■■■■DO YOU WISH ANOTHER GAME ?"
116 GETAS$
117 IFAS$="Y"THEN37
118 IFAS$="N"THENPRINT"■":END
119 GOTO116
120 PRINTTAB(C);MID$(A$,1,4);CHR$(105);MID$(A$,6,8):GOTO82
121 POKE54208+C+10+B,50:POKE54209+C+10+B,51
122 POKE54168+C+10+B,167:POKE54169+C+10+B,160:RETURN
123 POKE54208+C-2-B,50:POKE54209+C-2 -B,51
124 POKE54168+C-2 -B,167:POKE54169+C-2 -B,160:RETURN
```

BASIC ROUTINE

Mouse maze

THIS MBASIC PROGRAM was inspired by the article on the direction-finding mouse by Roy Sayers in the October 1982 issue. It will run on any system that supports a 24 by 80 screen and an addressable cursor.

The program has three phases. First it builds a random maze of 20 columns by 10 rows. This is a "perfect" maze, in that there is only one shortest route, and both a left-hand wall follower and a right-hand wall follower will eventually reach the exit, having covered the whole maze between them. The program then solves the maze, using Roy Sayers' algorithm. Finally, the operator is invited to have a go at solving the maze. The operator has the same information as the mouse: the current square, the route followed so far and the position of the exit.

Two "bugs" remain in the algorithm. The mouse has no way of detecting that it has isolated a portion of the maze and need not investigate it. Assuming that the entry is at the top and the exit at the bottom, if the mouse enters the maze and eventually runs into the left wall then all turns to the left can now be eliminated. The exit must be to the right of and below the path. Adding this intelligence would make a significant contribution to the speed of the solution.

Secondly, the mouse will oscillate back and forth along a track that represents an equidistant path from the exit whenever there is unexplored territory at both ends of the path. As soon as all territory at one end of the path has been explored then the whole path will be closed off. Until this happens a considerable amount of time is wasted in back-tracking. Humans have an advantage in this situation, as they tend to explore a path to its end before backtracking, even if it appears to be leading away from the exit. Comments on both these failings are included in the description, so the hardy might like to attempt to improve the algorithm.

Line numbering is in steps of 10 so the Auto command can be used. Names have generally been kept to one letter to facilitate conversions to other Basics, but some special functions may have to be recoded. The code is fully compatible with the Microsoft Basic compiler.

Lines 1-90. Initialise. CHR$(26) is the Clear Screen command. Line 50 is one way of generating the Randomise function

Lines 100-110. Select a starting square and draw it

Lines 120-220. Select a search direction for expanding the maze, and search for a frontier cell, − 1

Lines 230-270. Search for any remaining frontier cells and 120 to 220 until none left

Lines 280-330. Select entry and exit points and redraw appropriate cells

Lines 340-380. Copy the maze into the mouse's private array, then place him at the entry

Lines 390-420. Calculate the distances to the exit of each cell adjacent to the current one

Lines 430-510. Any adjacent square that is not accessible from the current square gets a distance value of 99. The last square visited gets a distance value of 50, to discourage back-tracking

Lines 520-540. If there is only one exit from this cell set the V flag so it can be sealed off as a dead end

Lines 550-590. Select shortest path and pass the direction code to the update routine. This is the part to change if the simple shortest-straight-line algorithm is to be improved on

Lines 600-630. Check if you have escaped the maze

Lines 640-650. Delay a little then if you do not want to update the mouse's private array go back to select the next move. If you want to search the array for "encircled" cells which need not be examined by the mouse you would do so here

Lines 660-680. Close off the entry into the path from which you just moved. The V flag indicates that it is a dead end. If you are working back along a corridor that has been fully explored then the whole corridor will be closed behind you until you reach a cell which has more than one choice

Lines 690-890. A subroutine used in maze building. Examine a random cell adjacent to the selected frontier cell; if it is a maze cell blow the wall away. Keep picking directions until you find one. The rule for setting up the maze and generating frontier cells means that it must be adjacent to a maze cell

Lines 900-980. Clear the screen, display instructions, display the mouse at the entry point and wait for input

Lines 990-1030. Accept commands. Move the mouse and display its cell until it exits

Lines 1040-1100. Display message and repeat or exit

Lines 1110-1200. Subroutine to create frontier cells around a maze cell.

Lines 1210-1330. Print the cell at maze position I, J. The routine uses the vertical bar, but a capital I works nearly as well

Lines 1340-1350. Print I$ at screen row R and screen column S. This subroutine and CLS$ should be the only machine-dependent parts of the code

Lines 1360-1550. Subroutine to display the move option, reposition the mouse and count the number of moves

Mouse maze.

```
10  REM MAZE
20  DEFINT A-Z:WIDTH 255
30  CLS$=CHR$(26)
40  PRINT CLS$;"HIT ANY KEY TO START";
50  WHILE INKEY$="":I=RND:WEND
60  DIM A(10,20),B(10,20),S(4)
70  X=0:P=2:PRINT CLS$;"Building the maze -";
80  FOR I=1 TO 10:FOR J=1 TO 20
90  A(I,J)=0:NEXT J:NEXT I
100 I=INT(RND*10)+1
110 A(I,I)=16:J=I:GOSUB 1110
120 A=SGN(RND*2-1)
130 B=1:IF A>0 THEN B=10
140 C=INT(RND*10)+1
150 D=SGN(RND*2-1)
160 E=1:IF D>0 THEN E=20
170 F=INT(RND*20)+1
180 FOR I=C TO B STEP A
190 FOR J=F TO E STEP D
200 IF A(I,J)=-1 THEN 690
210 NEXT J
220 NEXT I
230 FOR I=1 TO 10
240 FOR J=1 TO 20
250 IF A(I,J)=-1 THEN 120
260 NEXT J
270 NEXT I
280 Y=INT(RND*20)+1
290 A(10,Y)=A(10,Y)-2
300 Z=INT(RND*20)+1
310 A(1,Z)=A(1,Z)-8
320 I=1:J=Z:GOSUB 1210
330 I=10:J=Y:GOSUB 1210
340 FOR I=1 TO 10:FOR J=1 TO 20
350 B(I,J)=A(I,J):NEXT J:NEXT I
360 I=1:J=Z
370 GOSUB 1210
380 R=I*2:S=J*3+1:I$="##":GOSUB 1340
390 S(1)=10-I+ABS(Y-(J+1))
400 S(2)=10-(I+1)+ABS(Y-J)
410 S(3)=10-I+ABS(Y-(J-1))
420 S(4)=10-(I-1)+ABS(Y-J)
430 IF I=1 THEN S(4)=99
440 N=B(I,J)
450 IF N/2=INT(N/2) THEN S(1)=99
460 IF N>8 THEN S(4)=99
470 IF (N>4 AND N<9) OR N>12 THEN S(3)=99
480 IF N/2<>INT(N/2) THEN N=N+1
490 IF N/4=INT(N/4) THEN S(2)=99
500 A=P-2:IF A<1 THEN A=A+4
510 IF S(A)<>99 THEN S(A)=50
520 A=0:FOR K=1 TO 4:IF S(K)<99 THEN A=A+1
530 NEXT K
540 V=0:IF A=1 THEN V=50
550 C=99:FOR K=1 TO 4
560 IF S(K)<C THEN C=S(K):P=K
570 NEXT K
580 K$=MID$("RDLU",P,1)
590 GOSUB 1360
600 IF I<11 GOTO 640
610 R=22:S=1:I$="It took me"+STR$(X)+" goes. "
620 GOSUB 1340
630 GOTO 900
640 FOR K=1 TO 100:A=FRE(A):NEXT K
650 IF V<>50 GOTO 370
660 A=P-2:IF A<1 THEN A=A+4
670 B(I,J)=B(I,J)+2^(A-1)
680 GOTO 370
690 A=INT(RND*4)+1
700 ON A GOTO 710,720,730,740
710 K=I:L=J-1:GOTO 750
720 K=I-1:L=J:GOTO 750
730 K=I:L=J+1:GOTO 750
740 K=I+1:L=J
750 IF K>0 AND K<11 AND L>0 AND L<21 GOTO 770
760 GOTO 780
770 IF A(K,L)>0 GOTO 810
780 A=A+1
790 IF A>4 THEN A=A-4
800 GOTO 700
810 B=A-2:IF B<1 THEN B=B+4
820 A(I,J)=16-2^(B-1)
830 GOSUB 1210
840 I1=I:J1=J
850 A(K,L)=A(K,L)-2^(A-1)
860 I=K:J=L:GOSUB 1210
870 I=I1:J=J1
880 GOSUB 1110
890 GOTO 120
900 R=23:S=30:I$="Hit any Key when Ready "
910 GOSUB 1340
920 I$=INPUT$(1)
930 PRINT CLS$;"U=up,  D=down,  L=left,  R=right
940 R=20:S=Y*3+1:I$="::":GOSUB 1340
950 X=0:I=1:J=Z
960 GOSUB 1210
970 R=I*2:S=J*3+1
980 I$="##":GOSUB 1340
990 K$=INPUT$(1)
1000 IF INSTR("LRUDlrud",K$)=0 GOTO 990
1010 IF ASC(K$)>90 THEN K$=CHR$(ASC(K$)-32)
1020 GOSUB 1360
1030 IF I<11 GOTO 960
1040 R=22:S=1:I$="WELL DONE !. It took you"+STR$(X)+" goes."
1050 GOSUB 1340
1060 R=R+1:I$="Do you want to go again ? ":GOSUB 1340
1070 I$=INPUT$(1):IF I$="" THEN I$="Y"
1080 IF I$="Y" OR I$="y" GOTO 70
1090 IF I$<>"N" AND I$<>"n" GOTO 1040
1100 SYSTEM
1110 K=I:L=J-1:GOSUB 1150
1120 L=J+1:GOSUB 1150
1130 L=J:K=I-1:GOSUB 1150
1140 K=I+1
1150 IF K<1 THEN RETURN
1160 IF K>10 THEN RETURN
1170 IF L<1 THEN RETURN
1180 IF L>20 THEN RETURN
1190 IF A(K,L)=0 THEN A(K,L)=-1
1200 RETURN
1210 N=A(I,J):R=I*2-1:S=J*3
1220 I$="|  |":IF N>8 THEN I$="|--|
1230 GOSUB 1340
1240 R=R+1:I$="    "
1250 IF N>12 THEN MID$(I$,1,1)="|"
1260 IF N<9 THEN IF N>4 THEN MID$(I$,1,1)="|"
1270 IF N/2=INT(N/2) THEN MID$(I$,4)="|"
1280 GOSUB 1340
1290 R=R+1:I$="|  |"
1300 IF N/2<>INT(N/2) THEN N=N+1
1310 IF N/4=INT(N/4) THEN I$="|--|"
1320 GOSUB 1340
1330 RETURN
1340 PRINT CHR$(27);"=";CHR$(R+32);CHR$(S+32);I$;
1350 RETURN
1360 I$=K$:R=22:S=1:GOSUB 1340
1370 I$="..":R=I*2:S=J*3+1:GOSUB 1340
1380 N=A(I,J)
1390 K=INSTR("RDLU",K$)
1400 ON K GOTO 1410,1430,1460,1490
1410 IF N/2<>INT(N/2) THEN J=J+1
1420 GOTO 1500
1430 IF N/2<>INT(N/2) THEN N=N+1
1440 IF N/4<>INT(N/4) THEN I=I+1
1450 GOTO 1500
1460 IF N<9 THEN N=N+8
1470 IF N<13 THEN J=J-1
1480 GOTO 1500
1490 IF N<9 THEN I=I-1
1500 IF I<1 THEN I=1
1510 IF I>10 GOTO 1540
1520 IF J<1 THEN J=1
1530 IF J>20 THEN J=20
1540 X=X+1
1550 RETURN
```

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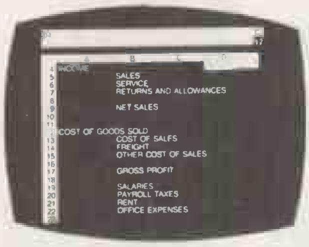

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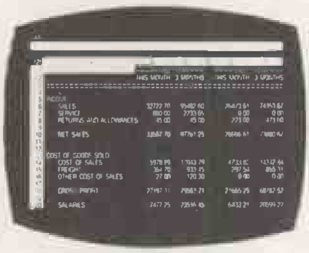

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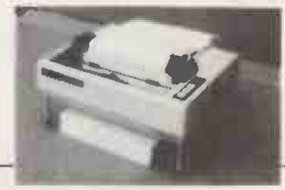

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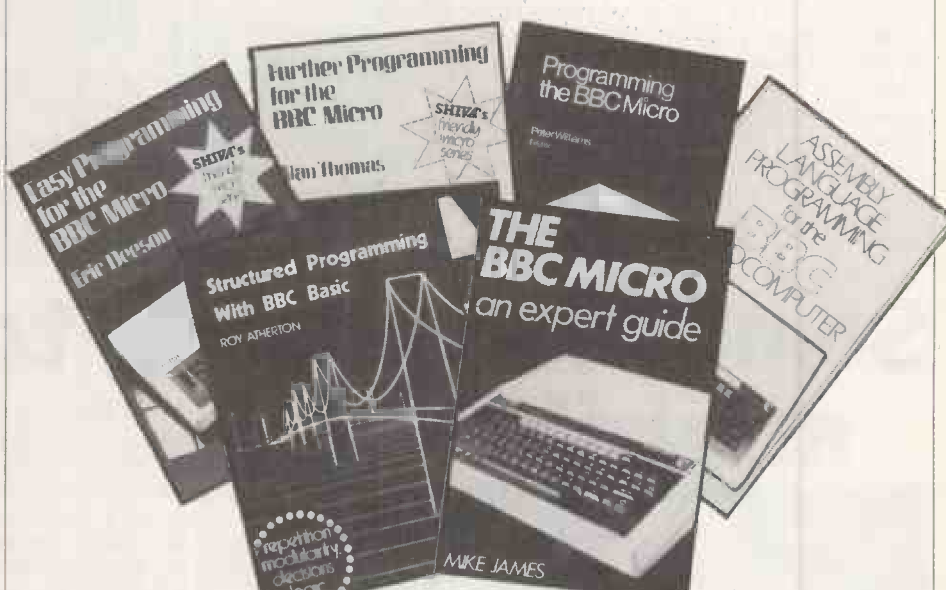
Bringing the BBC to book

Simon Beesley finds much that's familiar among a crop of guides to the BBC Micro.



MOST OF THE new books published for home computers are pitched at a low level and seem content just to rehash the manual — an unfortunate consequence of the present computing book boom. Naturally publishers want to release their books as soon as possible after the launch of a new machine, and computing primers are the books that are written most quickly.

Probably the best of the introductory works for the BBC Microcomputer is Ian Sinclair's *Introducing the BBC Micro*. Ian Sinclair must surely challenge Tim Hartnell for the title of home computing's most prolific author. Over the past year he has written books on no less than six new computers — the Dragon, Spectrum, Lynx, Oric, Color Genie, and Commodore 64.

In justification of this his latest book, Ian Sinclair cites a survey which shows that 30 percent of purchasers of the BBC Micro are newcomers to computing. Most newcomers, however, will have already been introduced to the machine by the *User Guide*, which as manuals go is an exceptionally good one, being both clear and comprehensive.

Nonetheless Sinclair's introduction is an attractive supplement to the manual. It takes the reader over the same ground but in greater detail.

Easy programming for the BBC Micro by Eric Deeson is also for the beginner, written in what the author describes as a light style. The style turns out to be excessively chatty, full of exclamation marks and unnecessary comment. Eric Deeson likes to encourage the reader with remarks such as "easy, n'est-ce pas?" or "Hey presto, it works!". This finally becomes wearisome and tends to intrude on what are otherwise clear explanations. Again, it repeats and enlarges on material found in the *User Guide*.

One of the virtues of the *User Guide* is the number of program examples it provides. *Further Programming for the BBC Micro* by Alan Thomas, goes further along this line by supplying some 90 programs to illustrate the special features of the BBC. There is a brief introduction to each section and each program is accompanied by notes. Most of the programs are short and do little more than demonstrate the use of particular commands. As such they would be useful to anyone still in the dark after working through the manual.

Yet another book for the beginner is *Programming the BBC Micro* edited by Peter Williams. The idea behind the book, that six authors should contribute articles on their areas of expertise, seems a promising one but the result is rather uneven.

The early chapters contain a few nuggets of new information alongside a lot of familiar material — string handling, bits and bytes, programming dos and don'ts, and so on. The later sections pass on to more advanced topics such as assembly language and the BBC hardware; but these are not covered in sufficient detail to be of much help to the beginner.

Rather than read a cursory survey of the BBC assembler, the beginner would be better advised to plunge into Ian Birnbaum's *Assembly Language Programming for the BBC Microcomputer*. Ian Birnbaum has a good sense of the sort of problems someone coming to machine code from Basic will encounter. As far as possible he relates machine-code instructions to their Basic equivalents. Groups of instructions are introduced in terms of their use in specific program tasks, rather than through formal explanations.

This approach, geared to the demands of the BBC assembler and operating system, makes this course in 6502 programming unusually accessible. As a bonus the book includes a listing for a machine-code monitor as well as exercises with answers supplied.

Most of the books under review pay lip service to the idea of structured programming, periodically recommending the use of procedures over Goto statements. Roy Atherton's book *Structured Programming with BBC Basic* is wholely devoted to the cause. Taking graphics as its central theme it proceeds in thorough fashion to demonstrate the techniques of good programming. There is a clear discussion of the principles involved, alongside numerous examples, exercises and solutions.

In his quest for program purity Roy Atherton displays an almost obsessive concern with the dangers of the Goto statement. It should only be used, he warns, by mature and experienced programmers — and then with caution.

Given that BBC Basic is not a fully

(continued on next page)

(continued from previous page)
structured language, one might wonder whether it is always so easy to avoid using Gotos, or even always desirable. For example, Roy Atherton recommends against the On Goto or Gosub construction for handling multiple decisions, and suggests instead a series of If-Then statements.

This alternative strikes me as inefficient and consequently inelegant. But overall the book makes a powerful argument for structured programming. As an unreconstructed Goto user I felt duly chastened.

It is remarkable how the same limited stock of game concepts is endlessly recycled for new machines. *Games BBC Computers Play,* a collection of program listings by Tim Hartnell, S M Gee and Mike James is no exception, and serves up many of the old favourites. It includes BBC versions of Breakout, Squash, Moonlander, Pontoon, Mastermind and other regulars.

Many of them appear to have been directly converted from other Basics and make little use of BBC Basic's strong features. Liberally spattered with Gotos, they would have Roy Atherton shaking his head in dismay. Few of them, however, take long to key in and as a bumper package they could well give games addicts a limited satisfaction.

Mike James's *The BBC Micro, an Expert Guide* can rightly claim to be just that. It covers such topics as the operating system, the sound generator and the hardware without repeating the substance of the manual. Mike James has the gift of presenting new information clearly and concisely. Within a few pages he gives useful explanations of features, such as the way Basic stores its variables or the way the screen memory is organised.

But the book does not purport to be more than a general survey. By and large, the more experienced owner who has already spent several months becoming familiar with the BBC Micro is still poorly catered for.

None of the books reviewed fully explores the BBC's potential. None of them mentions one of the machine's unique features: the ease with which the start of Basic can be moved to permit multiple programs to be stored at the same time.

I would like to see a more exhaustive and detailed treatment of the system; perhaps at the level John Leach dealt with interrupt routines in the June issue of *Practical Computing*. But books of this sort may be a while coming: they take rather longer to write and research than introductory potboilers.

Assembly Language Programming for the BBC Microcomputer by Ian Birnbaum. Published by Macmillan Computing Books, £8.95. ISBN 0 333 34585.

Introducing the BBC Micro by Ian Sinclair. Published by Granada, £5.95. ISBN 0 246 12146 7.

Structured Programming With BBC Basic by Roy Atherton. Published by Ellis Horwood, £6.50. ISBN 0 85312 548 1.

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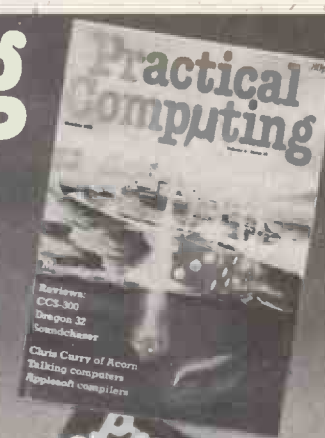

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The Zenith Z-110 is a dual eight/16-bit micro which, thanks to superb manuals, offers a high-class route to computer literacy. Read Chris Bidmead's benchtest of the Zenith. We also examine the network-orientated Corvus Concept: how does it stand up as a stand-alone micro? Plus BBC games, Dragon books and the IBM PC XT continued.

>PORTABLES UPDATE

New portable micros have been flooding the market since our in-depth survey in the January issue, so we have had to update our listing. Ian Stobie provides an over-view.

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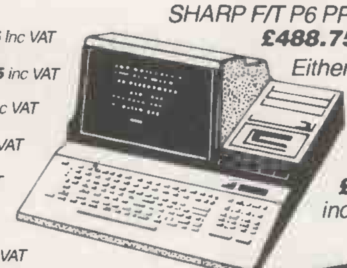

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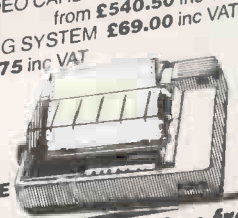

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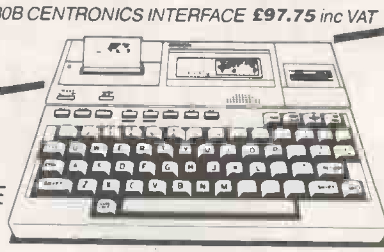

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Go softly on

Chris Bidead speculates on the tussle for supremacy among 16-bit operating systems.

IN FEBRUARY 1982 when I last reported on Digital Research Incorporated, DRI, the company had an annual turnover of $14 million. Now it is $40 million, and growing at a rate that doubles that figure every eight months. But do not be misled by big numbers with dollar signs in front of them. Bernie Cornfelt's famous company International Overseas Services, IOS, was on the point of becoming the largest controller of capital in the history of the world when it vanished almost overnight.

This not entirely flattering comparison was brought to mind by DRI's choice of the Café Royal's Dubarry Room for a recent rally of its supporters. Reflected in the huge *fin de siècle* gilt mirrors arching across the wall, the 450 CP/M-minded independent software vendors seemed like three times that number — some huge national sales convention being briefed before going into battle. There was an atmosphere of — well, the word bounced around by DRI was "synergy", which roughly translates as "let's work together and we'll all get rich". Cornfelt would have approved.

Though the name was not spoken, the enemy against whom this army was being recruited was Microsoft, who with MS-DOS and the IBM equivalent, PC-DOS, is already beginning to claim victory in the domination of the 16-bit microcomputing field. "There is no battle between MS-DOS and CP/M-86 — MS-DOS emerged as the leader in the U.S. by late 1982." The speaker is Bill Bates, the young genius who gave the world Microsoft Basic. Now 27 years old, Bill Gates is Microsoft.

About two miles outside Heathrow Airport is a parked space freighter called the Sheraton Skyline Hotel. In the tropical jungle it carried as cargo — remember *Silent Running*? — Bill Gates holds his own rally for rather fewer friends and members of the press. The message, not surprisingly, is that the future lies with Microsoft's upgrade path through MS-DOS versions 1, II and III to the great Xenix in the sky. Xenix is Microsoft's own brand of the full Unix.

Like DRI, and indeed Cornfelt, Microsoft is in the business of selling you the future. Not so much an operating system, more an operating-system upgrade path — thus disarming those with experience of other operating systems who have been underwhelmed by the charms of MS-DOS 1. A recent agitated correspondent to a computer weekly, who found Microsoft's assembler "completely unusable" because of bugs and lack of support.

Digital Research's present offering in the 16-bit market is no great shakes either. CP/M-86 is a clone of the unglamorous CP/M 80, with one or two additional features grafted on from the luke-warmly acclaimed shared-processor system, MP/M. In its defence you could call it mature, but you would also have to admit the correctness of Bill Gates' claim that it is not getting much of a look in with 16-bit manufacturers. It is because Digital Research is holding down costs by leading into a new market with old technology dual-floppy drives. MS-DOS offers faster file access on such systems because of the way it keeps its directories. Round 1 to Microsoft.

Bill Gates declares his real achievement has been to organise a programming team and a set of tools based around Xenix, which enables him to knock out high quality software in short order. Digital Research might tell you otherwise. Is Gates' whizz-kid personality causing internal friction which is holding up new output and precluding proper support of products already in the field? Certainly a few eyebrows were raised at the Sheraton when we heard that Microsoft's plans depend on recruiting 100 extra programmers this summer. Software teams have to be grown, not bought in job lots.

But on the evidence of MS-DOS 2, the upgrade now filtering through to end-users, the Microsoft high-productivity programming pool appears to be paying off. The new version is a big improvement, with many added Unix-like features including a treed directory ideal for the management of high-capacity Winchester drives.

Meanwhile the stately progress of DRI has been somewhat accelerated by all this the competition. CP/M-86, failing to repeat the success of CP/M 80, is now being shrugged off within the company as a place-marker product; something to remind the 16-bit industry of the presence of DRI while the real McCoy is honed and polished in the workshops. The real McCoy is Concurrent CP/M, a single-user multi-tasking operating system at present only visible on the IBM PC. "Concurrent" and "multi-tasking" describe systems capable of undertaking a number of different jobs at the same time, rather than having to execute them one after another as in ordinary single-tasking systems like the existing CP/Ms and MS-DOSs.

The simplest way to implement this idea is to allow a job to be suspended at any point, all information about the current state of the processor being saved automatically, so that the user can switch to any other job. On returning to the interrupted job the state saved is restored, and the threads picked up at the exact point where processing was suspended.

Swapping like this gives the feeling of handling all the tasks simultaneously, but in fact all except the current one are frozen. True simultaneity implies that the processor will continue to serve the background tasks; they will stay live even when the operator is not observing them, which is what actually happens to separate tasks under Concurrent CP/M.

Bill Gates argues that the average micro user will not be interested in running more than one job at a time. If switching is needed it will be between user-driven applications like spreadsheet programming and word processing, which as background tasks can comfortably be freeze-dried because they have nothing to accomplish without user input. This is the simpler multi-tasking he will be using in version 3 of MS-DOS. If you need more, he argues, you should be using Xenix.

True concurrency undoubtedly has an advantage in a program development environment where the user can get on with writing the next bit of source code while the last lot is being compiled. Networked micros will also find it valuable. But if ordinary single-user business software is to derive any benefit it will have to be rethought to take advantage of background processing. The snag is that software like this will be dependent at design level on Concurrent CP/M and will only run under that operating system.

The crunch will come early next year when MS-DOS 3 meets Concurrent CP/M on a wide range of cheap hardware. Bill Gates will have the advantage of a considerable head of steam, but may well be over-extended. DRI on the other hand has the maturity and resources to back its product to the hilt. The question is whether independent software vendors will want to venture out on a limb with DRI to develop software that cannot run under MS-DOS.

Probably there will be no clear victor. Looking back on the doldrums created around CP/M 80 by lack of any real competition, the industry will keep both parties on their toes by making sure they both survive.

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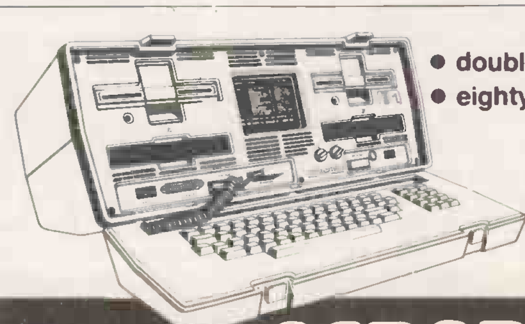

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