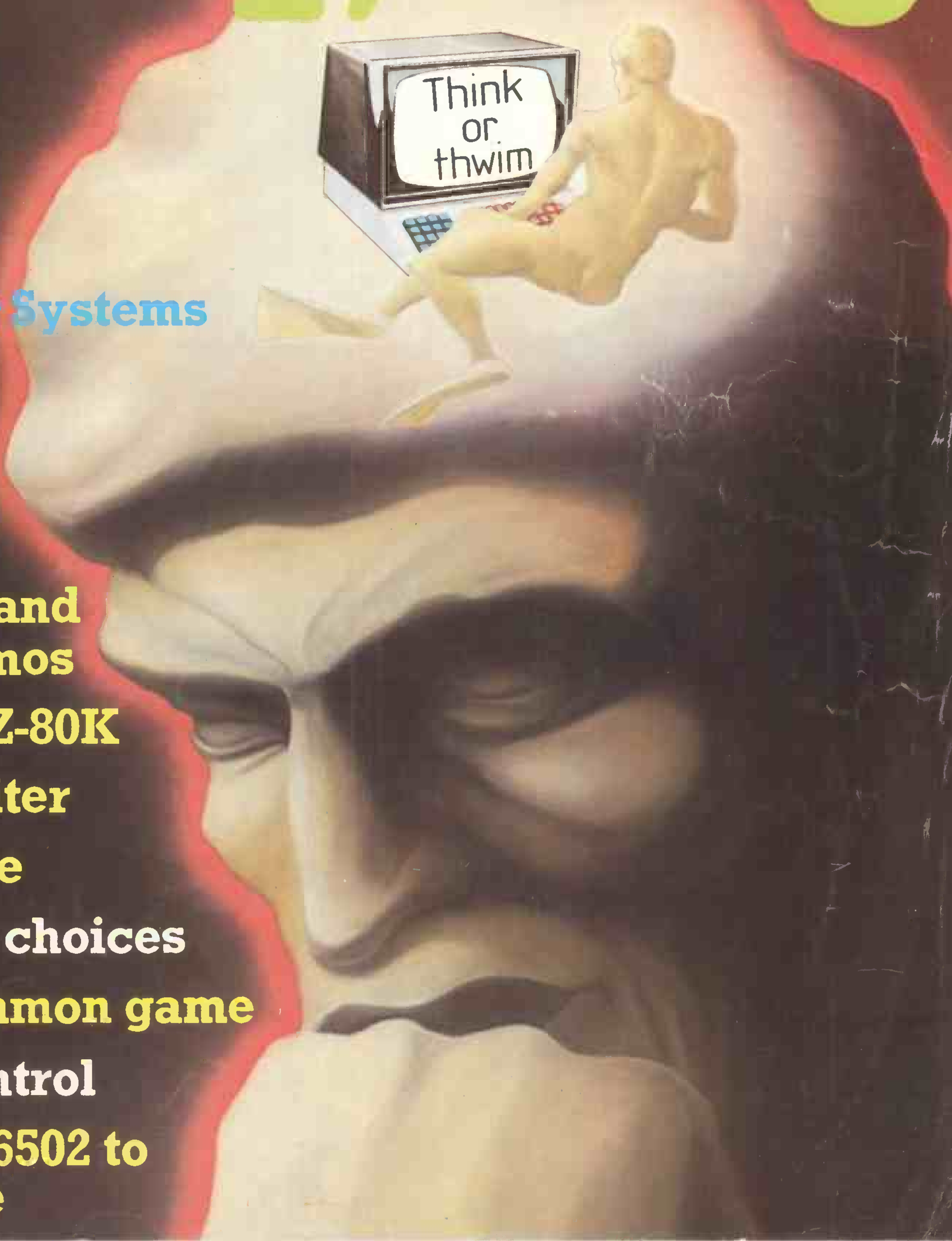
60p

Practical Computing

May 1981

Volume 4 Issue 5



Thinking Systems

Reviews:

Equinox and MVT Famos

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MicroCentre introduce . . . . . . System Zero

New System Zero Computer with quad-capacity DDF disk drive. The system includes built-in diagnostics for a quick system test of memory, controller and disk drives

Basic System Zero £587
System Zero/D with DDF £2355

The System Zero is a small computer especially designed for dedicated applications. It is particularly useful in process control situations.
In the basic model you get Cromemco's famous Z-80A single card computer, 1k of RAM, 4k of ROM, Control Basic, and an attractive cabinet. The motherboard provides 3 extra card slots on the S-100 bus, for tailoring the system to particular applications.
The basic model is designed for ROM-based programs, but it can be expanded by the addition of memory and I/O cards. It is fully compatible with all Cromemco peripherals, including floppy disks and hard disk systems.
Suitably configured the System Zero can run any Cromemco operating system or software package.

System Zero/D

This special version of the System Zero has 64k of fast RAM, and a model DDF dual disk drive. It includes two double-sided double-density 5 inch disk drives giving a total of 780k bytes storage; and RDOS-2, a new resident disk operating system with terminal and printer drivers, and self-test diagnostics.
The System Zero/D is an exceedingly inexpensive development computer ideal for setting up dedicated applications to run in the basic model. It will support Cobol, Fortran IV, Ratfor, Structured Basic, Lisp, RPG II, Word Processing, DBMS, and the full range of Cromemco's business applications software.

At the recent UK launch of the System Zero Computer, Cromemco's Technical Director Roger Melen presented a System Zero/D with 128k memory running Cromix. Here he is seen discussing the system with MicroCentre Director Andrew Smith (right).

Operating system

The System Zero/D will run any Cromemco operating system provided sufficient memory is available. The mimimun configuration of 4k ROM runs control Basic; with 64k RAM the system will run RDOS-2 or CDOS (compatible with CP/M); and with 128k the Zero/D will run the Cromix system (based on Unix).

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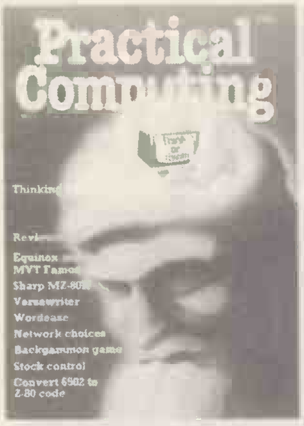

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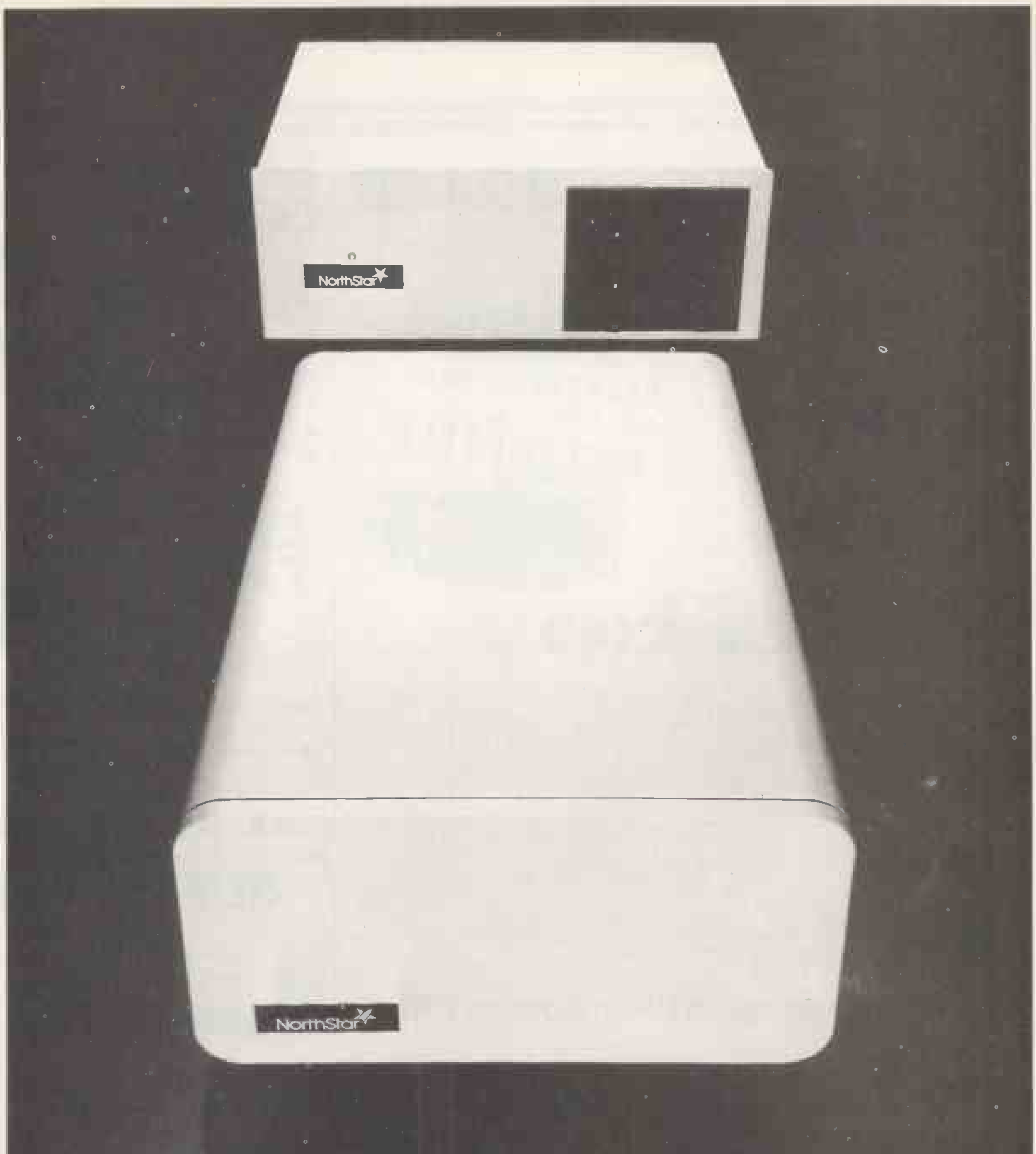

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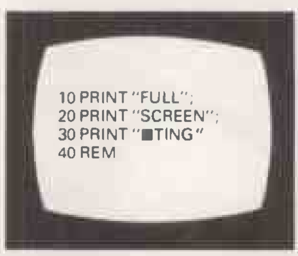

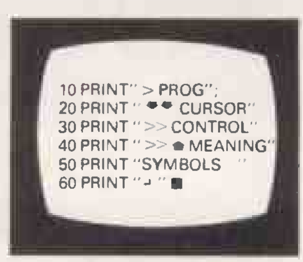

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EIDOS SYSTEMS

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☐ COMPANY PURCHASES — Performs purchase accounting Ⓛ function. Controls invoices, credit & debit notes. Prints purchase ledger, aged creditors report and payment advices. Comprehensive VAT control and analysis of all purchases, Interfaces with the ADD system. Requires CBASIC-2 .... £425/£35

☐ GENERAL ACCOUNTING — Produces Nominal Ledger, Trial Ⓛ Balance, P/L and Balance Sheet. Define your own coding system. Interactive data entry plus optional data capture from Company Sales and Company Purchases. Requires CBASIC-2 .... £375/£35

☐ STOCK CONTROL
Maintains stock records, monitors stock levels to ensure Ⓛ optimum stock holding. Details include stock desc., product code, unit, unit price, quantity on hand on order/minimum, Stock analysis reports can be weekly, monthly, quarterly etc. Interfaces with Order Entry Invoicing system. Requires CBASIC-2 .... £325/£35

☐ ORDER ENTRY & INVOICING
Performs order entry and invoicing function. Handles invoices Ⓛ for services and consumable items, part orders and part quantities. Sales Analysis report shows sales movemets and trends for user-defined period Interfaces with Stock Control, ADD and Company Sales systems. Requires CBASIC-2 .... £325/£35

☐ ADD — Complete control of all your names & addresses Ⓛ including suppliers, clients, enquiries etc. Assign your own coding system and select all output via the report generator. Will print anything from mailing labels to directories. Requires CBASIC-2 .... £225/£35

☐ TIME RECORDING SYSTEM — Provides comprehensive Ⓛ control over manhour expenditures by job or account. Expense details can also be controlled. Up to 75 activities can be assigned and reports produced weekly/monthly showing movements and job account totals to date. Requires CBASIC-2. .... £375/£35

☐ LEASE RENTAL & HP SYSTEM — Designed to control Ⓛ agreements and contracts that are payable at regular intervals by fixed amounts. Handles lease, rental, HP or maintenance agreements with payments by invoice, SO, or cash. Can be used with ADD and CSS for complete credit control system. Requires CBASIC-2 .... £375/£35

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Software with Manual / Manual Alone

STRUCTURED SYSTEMS GROUP

☐ **ANALYST** — Customised data entry and reporting system. User specifies up to 75 data items per record. Interactive data entry, retrieval and update facility makes information management easy. Sophisticated report generator provides customised reports using selected records with multiple level breakpoints for summarisation. Requires CBASIC-2, 24 x 80 CRT, printer and 48K system .... £125/£10

☐ **LETTERIGHT** — Program to create edit and type letters or other documents. Has facilities to enter, display, delete and move text, with good video screen presentation. Designed to integrate with NAD for form letter mailings. Requires CBASIC-2 .... £105/£15

☐ **NAD** Name and Address selection system — interactive mail list creation and maintenance program with output as full reports with reference data or restricted information for mail labels. Transfer system for extraction and transfer of selected records to create new files. Requires CBASIC-2 .... £45/£12

☐ **QSORT** — Fast sort/merge program for files with fixed record length, variable field length information. Up to five ascending or descending keys. Full back-up of input files created. Parameter file created optionally with interactive program which requires CBASIC-2. Parameter file may be generated with CP/M assembler utility .... £50/£12

SOFTWARE SYSTEMS

☐ Ⓜ **CBASIC-2** Disk Extended BASIC — Non-interactive BASIC with pseudo-code compiler and runtime interpreter. Supports full file control, chaining, integer and extended precision variables etc. .... £75/£10

MICRO FOCUS

☐ Ⓛ **STANDARD CIS COBOL** — ANSI '74 COBOL standard compiler fully validated by U.S. Navy tests to ANSI level 1. Supports many features to level 2 including dynamic loading of COBOL modules and a full ISAM file facility. Also, program segmentation, interactive debug and powerful interactive extensions to support protected and unprotected CRT screen formatting from COBOL programs used with any dumb terminal .... £400/£25

☐ Ⓛ **FORMS 2** — CRT screen editor. Automatically creates a query and update program of indexed files using CRT protected and unprotected screen formats. Output is COBOL data descriptions for copying into CIS COBOL programs. No programming experience needed. Output program directly compiled by CIS COBOL (standard) .... £100/£12

☐ Ⓩ **APL/V80** — Concise and powerful language for application software development. Complex programming problems are reduced to simple expresions in APL. Features include up to 27K active workspace, shared variables, arrays of up to 8 dimensions, disk workspace, copy object library. The system also supports auxiliary processors for interfacing I/O ports. Requires 48K CP/M and serial APL printing terminal or CRT .... £270/£20 **NEW**

☐ **PASCAL/M** — Compiler generates P code from extended language implementation of standard PASCAL. Supports overlay structure through additional procedure calls and the SEGMENT procedure type. Provides convenient string handling capability with the added variable type STRING. Untyped files allow memory image I/O. Requires 56K CP/M .... £195/£20

☐ **PASCAL/Z** — Z80 native code PASCAL compiler. Produces optimised portable reentrant code. All interfacing to CP/M is through the support library. The package includes compiler companion macro assembler and source for the library. Requires 56K and Z80 CPU. Version 3 includes all of Jensen/Wirth .... £205/£15

☐ Ⓜ **PASCAL/MT** — Subset of standard PASCAL. Generates ROMable 8080 machine code. Symbolic debugger included. Supports interrupt procedures, CP/M file I/O and assembly language interface. Real variables can be BCD, software floating point, or AMD 9511 hardware floating point. Version 3 includes Sets, Enumeration and Record data types. Manual explains BASIC to PASCAL conversion. Source for the run time package requires MAC (See under Digital Research). Requires 32K. .... £135/£20

☐ **TINY C** — interactive interpretive system for teaching structured programming techniques. Manual includes full source listings .... £45/£30

☐ Ⓜ **BDS C COMPILER** — Supports most major features of language, including Structures, Arrays, Pointers, recursive function evaluation, linkable with library to 8080 binary output. Lacks data initialization, long & float type and static & register class specifiers. Documentation includes "C" Programming Language book by Kernighan & Ritchie .... £60/£10

☐ Ⓜ **WHITESMITHS' C COMPILER** — The ultimate in systems software tools. Produces faster code than Pascal with more extensive facilities. Conforms to the full UNIX Version 7 C language, described by Kernighan and Ritchie, and makes available over 75 functions for performing I/O, string manipulation and storage allocation. Compiler output in A-Natural source. Supplied with A-Natural. Requires 60K CP/M .... £325/£20

☐ Ⓛ **ALGOL 60 Compiler** — Powerful block-structured language featuring economical run time dynamic allocation of memory. Very compact (24K total RAM) system implementing almost all Algol 60 report features plus many powerful extensions including string handling, direct disk address I/O etc. Requires Z80 CPU .... £110/£12

☐ Ⓜ **Z80 Development Package** — Consists of (1) disk file line editor, with global inter and intra-line facilities; (2) Z80 relocating assembler, Zilog Mostek mnemonics, conditional assembly and cross reference table capabilities; (3) linking loader producing absolute Intel hex disk file for CP/M LOAD, DDT or SID facilities .... £50/£12

☐ Ⓜ **ZDT** — Z80 Debugger to trace, break and examine registers with standard Zilog/Mostek mnemonic disassembly displays. Facilities similar to DDT £20 when ordered with Z80. Development Package .... £30/£7

☐ **DISTEL** — Disk based disassembler to Intel 8080 or TDL/Xitan Z80 source code, listing and cross reference files. Intel or TDL Xitan pseudo ops optional. Runs on 8080. .... £35/£7

☐ Ⓜ **DISILOG** — As Distel to Zilog Mostek mnemonic files. Runs on Z80 only .... £35/£7

☐ Ⓜ **TEXTWRITER III** — Text formatter to justify and paginate letters and other documents. Special features include insertion of text during execution from other disk files or console, permitting recipe documents to be created from linked fragments on other files. Has facilities for sorted index, table of contents and footnote insertion. Ideal for contracts manuals. etc. .... £75/£3

☐ **DATEBOOK** — Program to manage time just like an office appointment book but using the speed and memory of a computer. Keeps track of three appointment schedules (three dental chairs, three attorneys, etc.) at once. Appointments consist of name, reason for the appointment, the date and time, and the length of the appointment. System can be quickly customized for the individual user. Many helpful features for making, changing, finding, and reporting appointments. Requires 48K CP/M and 180K bytes diskette storage. Not available for Apple CP/M .... £185/£15 **NEW**

☐ Ⓜ **POSTMASTER** — A comprehensive package for mail list maintenance that is completely menu driven. Features included keyed record extraction and label production. A form letter program is included which provides neat letters on single sheet or continuous forms. Compatible with NAD files. Requires CBASIC-2 .... £85/£10

☐ **XASM-68** — Non-macro cross-assembler with nested conditionals and full range of pseudo operations. Assembles from standard Motorola MC6800 mnemonics to intel hex .... £115/£15

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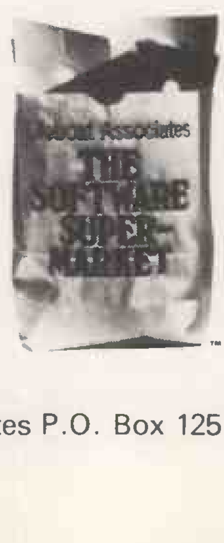

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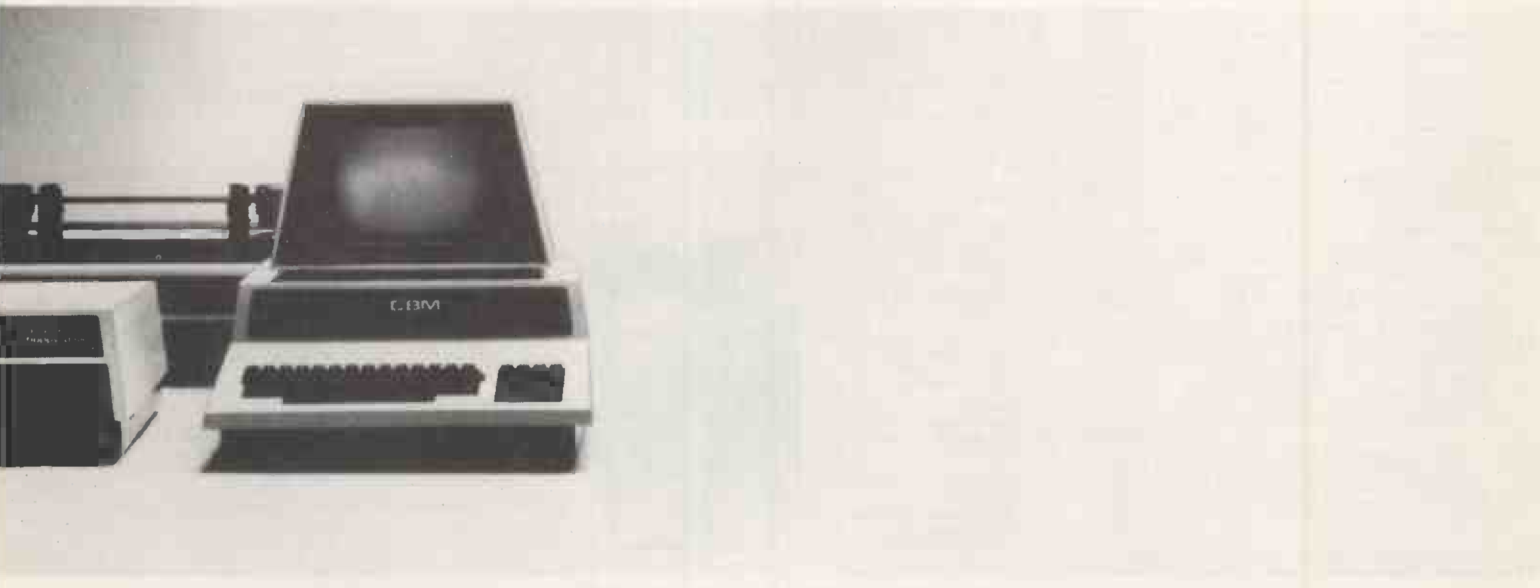

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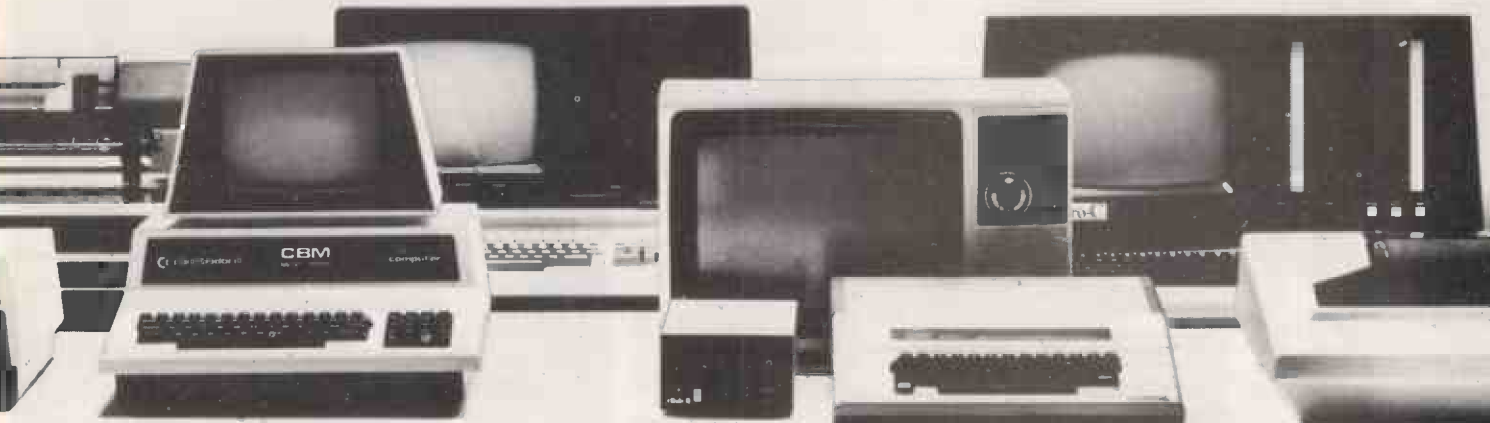

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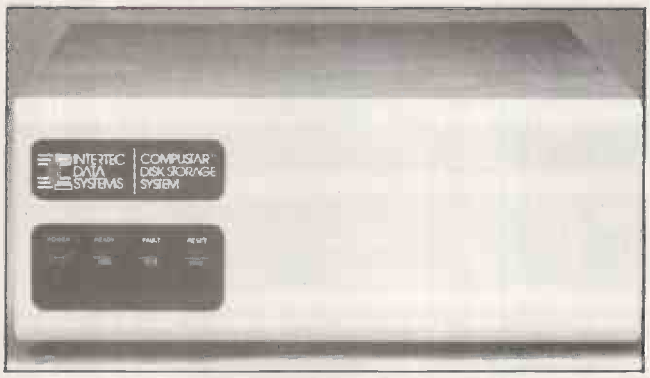

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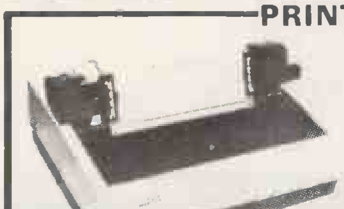

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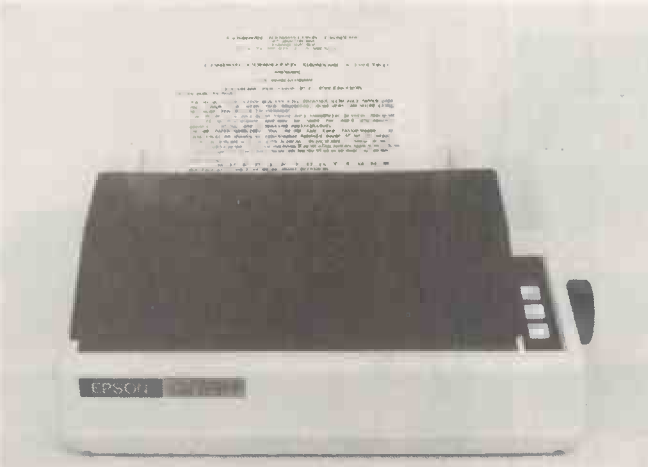

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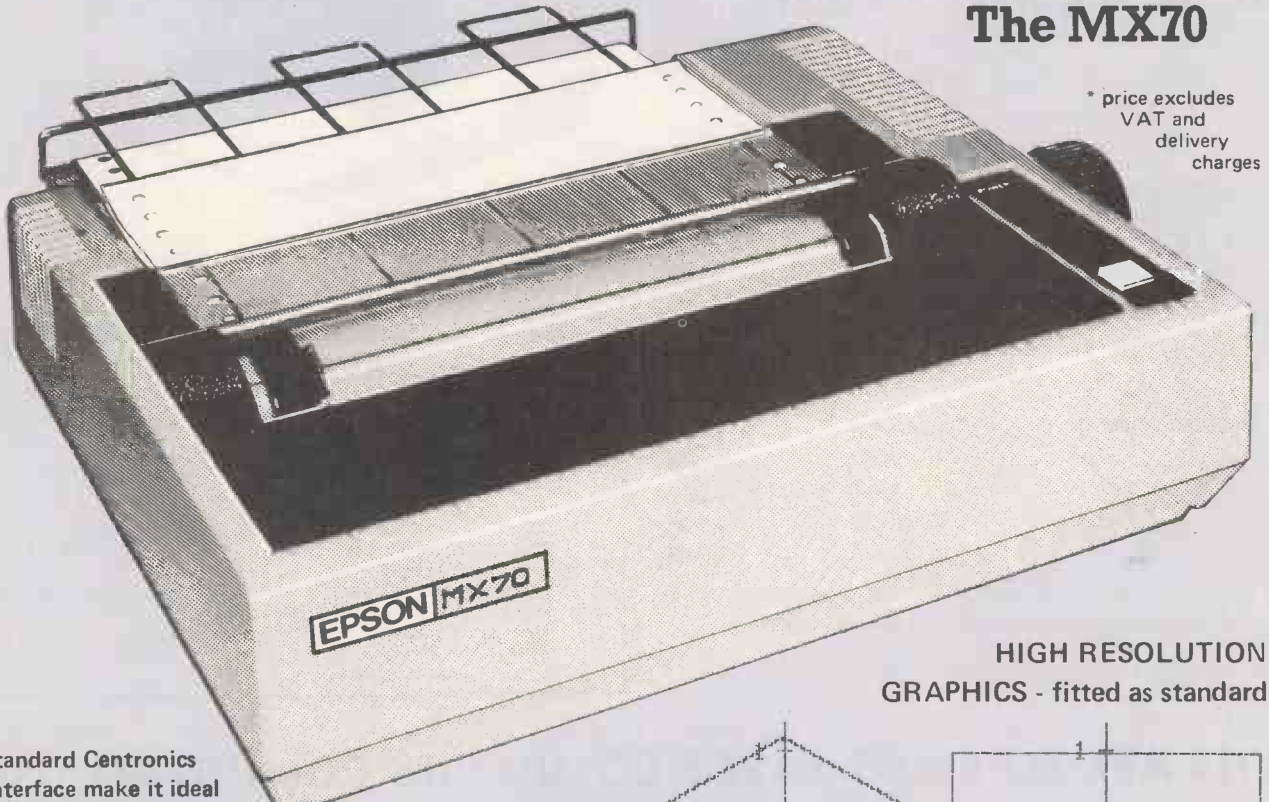

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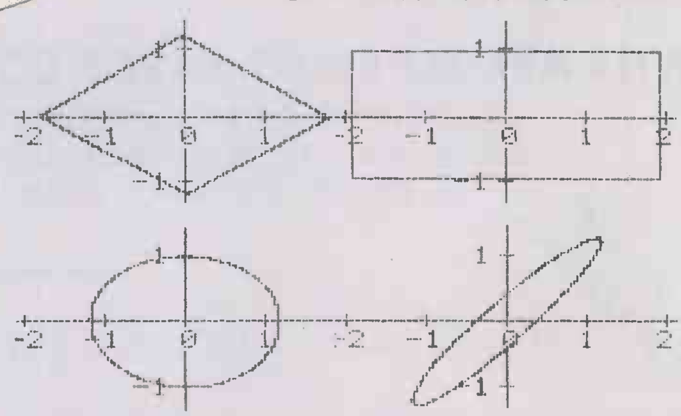

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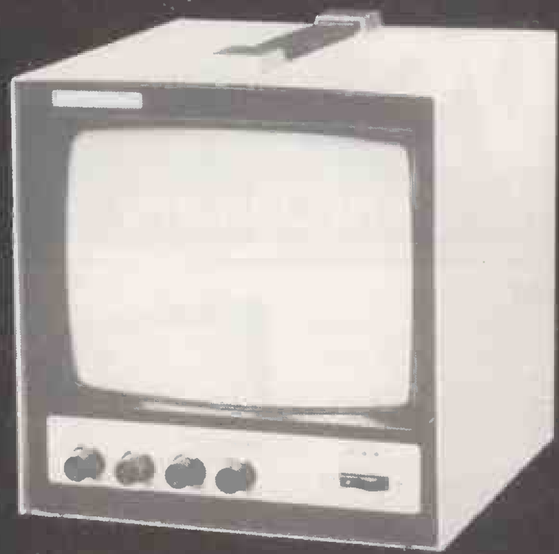

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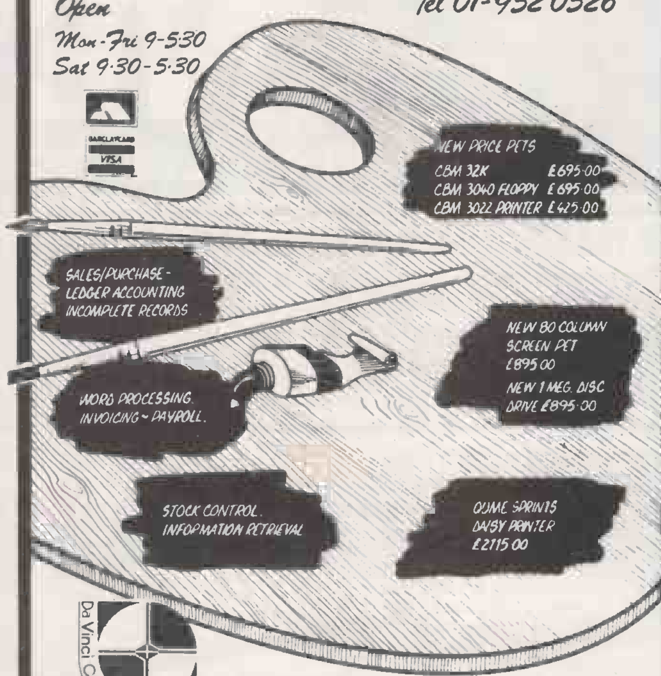

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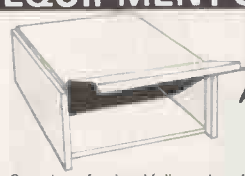

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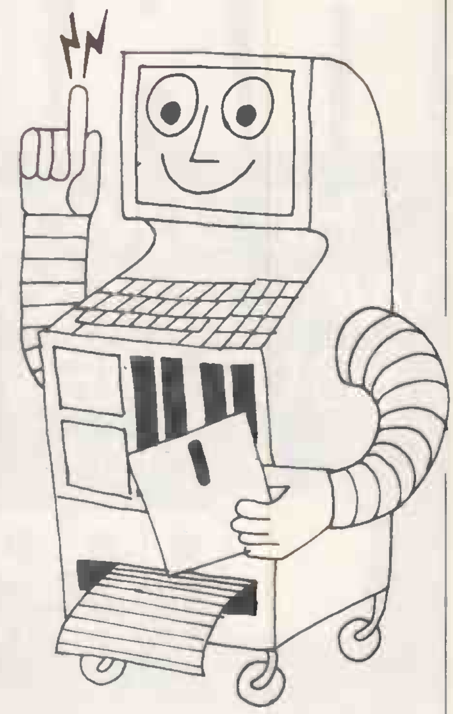

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Financing the future

THERE ARE two sides to the micro business: the fun and thrills of making machines do things no-one in their right minds would even consider and there is the small matter of staying alive while you do it. It is accepted on all hands that Britain's salvation is to be found through microelectronics, and that it is the prime duty of government and industry to foster this delicate plant.

There is an impressive list of organisations willing — nay, anxious — to fund the micro entrepreneur. There is the National Research and Development Corporation, NRDC, the National Enterprise Board, NEB, the Industrial Commercial Finance Corporation, ICFC, Department of Industry's software support scheme, and the Department of Industry itself. The clearing banks have "start-up" schemes for small businesses. Elaborate and expensive committees look into the situation and regularly report that there is no shortage of money for investment — rather, there is a shortage of projects.

The micro business is very like the Wild West, and, as in any frontier town, the sheriff — your genial editor — is apt also to be the local seed merchant. Thus it is with us. As well as running this delightful magazine, I have a software publishing business. What concerns us here is the light my experience sheds on the way the micro industry is actually funded.

We start at Christmas 1979 with a list of projects and a way of doing business. We go to NRDC who say yes; the whole project looks interesting, the products seem sound,both technically and from the marketing point of view. They want to become involved in the micro business and they will think about it — urgently. We are still waiting for an answer to the letter asking for support, dated November 1979.

ICFC: they think it's a topping idea — well, kind words cost nothing — but they are not really interested in research and development. Perhaps a little later on? A little down the road? Yes, fine, fine. Nice to see you. Do come back — when you do not need us.

NEB: prostrate from the INMOS deal, there seemed little point bothering them with a request for a few piffling thousands. Your friendly local bank is advertising easy finance for small businesses; bank manager says he does not know much about software, but will think about it. Thinks and advances nothing but the neat idea that if we put up £15,000 cash, the bank will match it with a two-year loan at 21 percent — repayments to start immediately.

At last, a gleam of light in the gloom. At the Department of Industry — whose Information Technology Division contains some patient people who clearly want to be helpful — mention is made of the Software Products Scheme, SPS, which is managed for them by the National Computing Centre. Haven't you heard of it? It's just what you need.

The SPS gives approved products marketed by approved companies a choice of support: you can have 25 percent of your projected costs as a gift, or 50 percent as a loan, repayable as a percentage of gross income. Better still, the SPS is intended to help with marketing as well as development.

It sounded too good to be true. I spend a great deal of time thinking how much it might take to sell the two products we have finished, and then to finish and sell two more products which were in embryo. It is rather like guessing the length of four expensive pieces of string. Finally, the proposal is sent to Manchester. After the usual silence, back comes the answer, no.

Why not? Long telephone conversation with a frank and helpful man. Firstly, SPS is designed to help small software houses.

PL: You can't get smaller than us. We haven't even got a dog.

SPS: Ah, you misunderstand me. When I say small, I mean turning over, say, £60,000 or less. With accounts for only five years.

PL: But the whole micro industry is less than three years old.

SPS: Ah, well, there you are. There is another difficulty. Two of your products are finished, you say?

PL: Yes, you can see them running.

SPS: Well, the SPS is not really designed to support marketing alone.

PL: But surely it's better to put public money into something which works rather than something which might work? Less, how shall we say, risky?

SPS: That may well be so, but it's not how the Treasury sees it.

PL: So, if we had been going five years and hadn't done any work, you might help?

SPS: Not so fast. How many full-time employees have you?

PL: Thank God, none. Everyone works on a royalty. Like a book author.

SPS: Well, that puts the lid on it. You must have three full-time technical employees.

PL: That's £40,000 a year.

SPS: And anyway, I don't see in your accounts that you have the money to match what you're asking us to give you.

PL: Of course we haven't. If we had any money we wouldn't be going through these loops.

SPS: You have to convince us that you can put up your 75 percent or 50 percent of the money your firm needs.

PL: We can't, but what about this? You agree in principle that certain expenses qualify for support under the SPS. When we've paid a bill in one of those areas, we'll send it to you and you give us 50 percent. In that way, it doesn't matter that we don't have the money now. We must have found it because the bill will be paid before you see it.

SPS: That would be retroactive financing. The Treasury would never hear of it.

PL: Thank you so much for your time.

Some of the wisest words ever printed in this magazine were these: "When we first started, we believed that if we had substantial backing, we could have made a fortune very quickly. In retrospect, we simply would have lost all the money. We might still have come in the right direction but our mistakes would have cost money rather than just time. I don't think that in the long term, if you are determined to make a business work, backing on a large scale is worth it, especially if you do not have a good deal of business experience". Mike Fischer on the start of Research Machines, *Practical Computing* April 1980 page 84.

True enough for the individual small company. Yet notice the trade-off between time and money. Time is what Britain does not have very much of. Our rivals are putting a great deal of money into the microelectronics industry. They are forging ahead, in their fields, at an impressive rate.

It happens that our microsoftware industry is — potentially, at least — spread among many people who work in back rooms. What we need is some way of giving them small amounts of money while accepting the risk that only one in 10 will pay off. What is £5,000 or £10,000 put into 100 small firms compared to the umpteen billion hurled daily and irretrievably into heavy industry?

If microelectronics is going to produce a new cottage industry, we have to be willing to support people in cottages with talent but no capital — not in the crumbling palaces of dying industries. If this frightens the Treasury, we will be able to congratulate ourselves on having expired in complete financial rectitude.

Had we but world enough and time.
This coyness, Minister, were no crime.

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.

Friend or foe?

WITH Boris Allan as a friend, who needs enemies? Though I tend to agree with his argument, I found his article confusing — December 1980 issue. For a more direct example, this program contains both a recursive, FNF, and iterative, FNG, method of determining the factorial of a given number. As can be seen, they give identical results on the HP-3000.

```
FACT
   10 LONG A
   20 INPUT "FACTORIAL ",A
   30 PRINT FNF(A)
   40 PRINT FNG(A)
   50 GOTO 20
   60 DEF LONG FNF(LONG N)
   70   IF N=0 THEN RETURN 1
   80   ELSE DO
   90     IF N<0 THEN RETURN 0
  100     ELSE RETURN N*FNF(N-1)
  110   DOEND
  120 FNEND
  130 DEF LONG FNG(LONG N)
  140   LONG R
  150   R=1
  160   IF N=0 THEN RETURN 1
  170   ELSE DO
  180     IF N<0 THEN RETURN 0
  190     ELSE DO
  200       FOR I=1 TO N
  210         R=I*R
  220       NEXT I
  230       RETURN R
  240     DOEND
  250   DOEND
  260 FNEND
>RUN
FACT
FACTORIAL 3
 6.000000000000000L+00
 6.000000000000000L+00
FACTORIAL 30
 2.652528598121911L+32
 2.652528598121911L+32
FACTORIAL 50
 3.041409320171338L+64
 3.041409320171338L+64
FACTORIAL
*CONTROL-Y BREAK IN LINE 20 IN FACT
>
```

Now, I doubt that anyone could suggest that either solution is the better one, in terms of aesthetic appearance. Both are simple, and both reflect the algorithm adopted. However, FNF uses a method which is a step removed from the normally-used definition of a factorial — as used in FNG — and it is this extra step which makes the program more difficult to follow.

Personally, if I had to use the factorial in a program — and, in 17 years of computer work, I have used recursion no more than three or four times, and the factorial never — I would use the recursive method because of its conciseness. However, it is extremely wasteful with stack space, and on smaller machines, I might be forced to use the iterative approach.

Paul Farrell's letter, Feedback, February 1981, on the other hand, gives a perfect example of recursion being used in its proper place. Unfortunately, the outside world of commercial computing is not so well-defined, and I fear that most computer people's experience is similar to mine — recursion is one of the hundreds of techniques we have in our armoury but which is rarely used.

Doug Scott,
Maidstone,
Kent.

Liverpool MuPet

IN CASE Pet users are rushing out to buy the MuPet multi-user system, following your highly favourable review, February 1981, may I add two points of caution.

First, our MuPet has the most disconcerting habit of hanging-up in operation. The cause is unknown but the effect is disaster, for the whole system, including the Pets, is frozen and the only remedy is to power-down and start again. If two or three users are in the middle of program development work, the result is anger and chaos. As an add-on re-set switch is available for the MuPet in the U.S., it suggests that this particular problem is not uncommon.

Second, and of great importance to systems set up solely for package job running, is our MuPet's total inability to do batch printing. Thus, if two or more Pets are running print-output jobs, the printing is inter-leaved. This is inevitable, as the Print statement in Pet Basic closes-down the printer channel after execution and leaves it available for further calls. If the next call is from another Pet — perhaps while the original Pet is doing some processing — interleaving of print runs is the result.

Despite the claims that no program changes are necessary to run on the MuPet, the only way to overcome the problem is a complete re-write of all our programs to ensure that all print statements are placed together thus forcing domination of the channel.

GSP Thomas,
University of Liverpool.

Sorcerers' coven

WHEN THE Sorcerer was first introduced in early 1979, two separate user groups were started. One, based in Woking, Surrey, never got off the ground. The other group, started in June 1979, has been in continuous production ever since.

This second group was started at a time when there was a great shortage of software for the Sorcerer and so one of its main aims in those early days was to spread programs within the group. For this reason, the group name Sorcerer Program Exchange Club, SPEC, was chosen.

It soon became apparent that there were problems involved in distributing cassette tapes. These problems were technical, logistic and not least legal. Therefore, it was decided to play down the program exchange part of the group and to concentrate on the newsletter side.

In view of the misleading nature of the title SPEC, it was decided late last year to change it to something more suitable. The group's membership is very widespread with members in Australia, New Zealand, Hong Kong, U.S.A., Canada and every country in Europe with a particular concentration in the Netherlands.

Because of this mainly European rather than British membership, we decided to rename the group the European Sorcerer Club — or ESCape as it has become known within the group. Incidentally, the reason for the predominance of Dutch members is due to the Dutch TV service running a computer course which used the Sorcerer as the preferred machine. They beat the BBC by about 18 months.

For further details write to me, Colin Morle, 32 Watchyard Lane, Formby, Near Liverpool L37 3JU. Telephone 070-48-72137. Subscription costs £5 per annum if you live in the British Isles and £7 for elsewhere in Europe; outside Europe, the cost is £12.

Colin Morle,
Formby,
Merseyside.

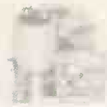
Teaching quality

THE ARTICLE by M P Thorne in *Practical Computing*, January 1981, on poor-quality mathematics software evokes a great deal of sympathy. It was satisfactory to note that the programs which were praised were from good educational backgrounds.

When other aids to learning, such as books, are produced, authors' names are given. Teachers rightly view with suspicion any materials for which no educational sources are given; this certainly applies to computer programs. I suggest that the following points be looked for when buying educational software:

- The material should have sound educational origins based on teaching experience and on sound educational theory and practice. Full explanations should be given in teachers' notes and student leaflets.
- The computer program and documentation should be written by someone with experience in writing educational software — or under such a person's guidance.

(continued on page 44)



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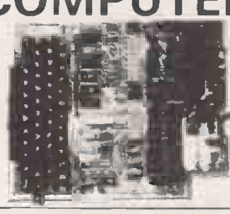

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(continued from page 42)

- Both teacher originators and programmers should have the backing of some group or organisation for discussion in the early stages.
- The whole unit should be edited, preferably by someone — or some persons — with considerable experience of teaching the subject matter and of computer education.
- The unit should have been on school trials and revised in the light of comments received.
- The names of the teacher originator(s), programmer(s), editor(s) and of the group organising discussion trials and production should be given.

Programs from the Schools Council project, Computers in the Curriculum, director R Lewis, the leading producer of educational software for secondary schools in this country, and from other projects such as ITMA will be found to satisfy these criteria.

It is not meant, in any way, to discourage teachers and their computing friends from producing their own programs to meet specific needs, nor from exchanging such programs with their friends. Such authors would do well to note some of the snags which Thorne mentions, and also to consult the project papers produced by the Computers in the Curriculum project. Especially relevant are paper 17 on guidelines for authors and paper 14 on the project's aims and methods in producing materials in mathematics.

Donovan Tagg,
Lancaster.

Statistical errors

THE PROGRAM described in the article, Statistics on a micro, *Practical Computing* February 1981, is very interesting and ingenious but unfortunately contains a number of errors. To save anyone who wishes to run the program the trouble of debugging it, here are the errors which I have found.

Lines 15, 35 and 915 can be deleted as they only duplicate other lines. Lines 640 and 660 apear to have some characters missing. These lines should read:

```
640 IF NA = 0 THEN Z = 1 : GOTO 740
660 IF TA > TB THEN U = UA:M = NA:
GOTO 680
```

In line 550 the subscript for SB should be NB and not MB as shown. Perhaps the worst error occurs in line 2000. Not only is the program incorrect but the error has been repeated in the text describing it. The maximum value of the last element in Q should be N — 1 and not M — 1 as stated.

For those whose Basic does not have the If Then Else form of decision statement, I would suggest that subroutine 2000 be rewritten as follows:

```
2000 IF Q(M—1) = N—1 THEN RETURN
2010 Q(M—1) = Q(M—1) + 1
2020 GOSUB 4000
2030 GOTO 2000
```

With these corrections, I have run the program successfully on a Pet. The only further changes required were the deletion of line 10 and references to the strings A and B made in the conventional form of A$ and B$.

J Halliday,
Port Talbot,
West Glamorgan.

Solid advice

I HAVE been repairing radar and electronic instrumentation for some 20 years now, so am reasonably sure of my soldering. I bought myself a computer kit, regularly advertised in your pages.

Had I had problems with bad joints or duff components there would have been no problem. However, the plated through holes in the board were intermittent. All components in the kit were guaranteed, of course, but in the case of the board, once my iron had made the first joint the supplier could and would say that I had damaged it.

A repair service was offered, but having spent the best part of a month's wages, another £25 was throwing good money after bad — especially as the nature of the trouble was such that I could see the computer commuting between Derby and London for months on end.

So, my recommendation to anyone buying a kit, is this: pay the extra for a ready-built machine, preferably from a supplier who has enough confidence in his product to give a year's guarantee. Make sure you have some protection.

I would go further and say: treat it as roughly as possible, short of visible damage, to try and show up any incipient open circuits.

J Bland,
Derby.

Old-ROM update

IN FEEDBACK, February 1981, I wrote about the updating of old-ROM Pets to the newer Basic 2 versions. Since my letter was published I have had a letter from the sales manager of Commodore U.K. which says that I have my facts wrong. I had obtained my facts from Commodore U.K. at Euston Road, London.

The facts given in the letter from the Commodore U.K. sales manager are as follows:

- Machines with 901447 series ROM chips require a set of four ROMs to update, these are and always have been £38 the set.
- Machines using 6540 ROM sets require seven chips to update. They are £104 the set.
- However, as a gesture to good customer relations, Commodore is now making these ROM sets available for £38 — all prices exclusive of VAT. Official Commodore User Club members can obtain these ROM sets free if they buy a disc drive.

It would seem sensible for anyone contemplating updating an early 8K machine to purchase ROM sets now — the current prices may not last for ever and at £38, they are being sold at below cost price.

J A Banks,
Loughton,
Essex

Micro leasing

IN THE March issue of *Practical Computing*, in your article, Is it worth leasing a Micro?, you quoted my company's bureau charges as £100 establishment fee, with weekly charges of £110. I must point out that this figure would reflect the average monthly cost to maintain a sales ledger of roughly 100 accounts.

Our weekly charges are based on a run charge and then prorata, based on input and output volumes. When one considers that the fees also embrace on-the-job training for our users, our charges become the most cost-effective way of implementing a computer system.

Malcolm Harvey,
West One Computer Services
London W1.

- **In case it was not clear from the March 1981 article on leasing micros, Malcolm Harvey and Roger Martin both worked for CSC when they were in Nigeria.**

Electronic accounting

I WAS interested to read the comments of G D Herbage of Gnomist International Ltd, March 1981 Feedback, on the need for a business accounting packaged based on the well-known Kalamazoo system.

In collaboration with B & D Steels Ltd, Altrincham, Cheshire, we have developed just such a system, based on the TRS-80 with 48K of RAM and four mini-floppies. It has now been in operation for more than a year. The system was run in parallel with the Kalamazoo cards for one month only — the changeover was so smooth that it was felt that the cards could be safely dispensed with after that time.

According to Robin Lucas, chief accountant of B & D, the ease of the transition was largely due to the fact that the entry procedures closely followed those of the Kalamazoo system, with which they were already familiar.

George Sassoon,
JZK Electronics,
Warminster,
Wiltshire.

Kalamazoo's answer

IN MARCH 1981 Feedback, G D Herbage referred to the need for a ready-to-go microcomputer package capable of replacing the Kalamazoo or similar accounting method and costing less than £5,000.

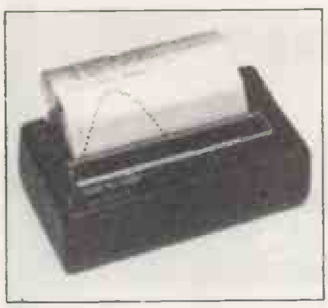
Readers with similar interests to those expressed by Herbage may like to know that Kalamazoo will shortly be launching just such a package for use with a new range of microcomputers.

P J Rex,
Kalamazoo Ltd,
Birmingham.

ZX-81 — lower price for higher performance

A PERSONAL computer from Sinclair Research launched to replace the popular ZX-80 is priced at only £69.95 and is now in production at the Timex factory in Dundee. Based on an innovatory four-chip design, the Sinclair ZX-81 also sells in kit form at £49.95 — the mains adaptor is an extra £8.95.

At the launch of the new computer, its designer, Clive Sinclair, claimed that in the U.K., his ZX-80 is now outselling all other personal computers put together and he confidently predicted that by the end of 1981, Sinclair Research will exceed the production volume of any other personal computer manufacturer in the world.



The ZX printer.

The key design achievement in the ZX-81, which is constructed in thick black plastic, is a new master-chip custom-built in the U.K. by Ferranti. It replaces 18 chips in the ZX-80 and adds some new features. The ZX-81 has a Z-80A microprocessor and an 8K Basic ROM which allows floating-point arithmetic and gives full scientific functions.

The new computer embodies all the main features of its predecessor including single-stroke key word-entry, automatic checking of every statement line and a display of 24 lines by 32 characters.

New features, in addition to a print-drive facility, include the ability to operate in two software-selectable modes, fast and normal — fast is four times the speed of normal. In normal mode the Sinclair ZX-81 will compute and display simultaneously and allows continuous moving, flicker-free graphics.

A 40-key, touch-sensitive membrane keyboard gives the equivalent of 81 keys using function mode and single-press key-word systems. The graphics mode enables an additional 20 graphical and 54 inverse video characters to be entered directly from the keyboard.

Programs can be loaded and saved on a conventional home cassette player and re-selected from the computer keyboard. The cassette-interface facility has been improved to overcome some of the ZX-80's loading problems and programs are given names so the ZX-81 can search through a tape for the required program. There is also a new 200-page instruction manual.

The new 8K Basic ROM used in the ZX-81 will shortly be available to ZX-80 owners as a drop-in replacement chip, supplied with new keyboard templates and operating manual. It will enable the ZX-80 to offer all ZX-81 features except flicker-free graphics.

Sinclair has also announced that a printer for the ZX-80/81 computers will be available in June for around £50. It will offer full alpha-numerics across 32 columns and includes a command, COPY, which prints out exactly what is on the TV screen.

Sinclair's ZX-81.

In the first nine months since the ZX-80 was launched in February 1980, 50,000 of the computers were sold — about half of them in the U.K. Since then, the units have been sold at the rate of about 10,000 per month with 30 percent going into the U.K. market. Production of the ZX-81 began in March at the rate of 10,000 per month.

Health hazard of VDUs

IN RESPONSE to a call from a conference on the health and other hazards associated with the use of VDUs, a research project has been initiated by the Institute for Consumer Ergonomics.

The conference was entitled Health hazards of VDUs, and was held by the Husat Research Group, of Loughborough, Leicestershire. It was the widespread concern voiced by delegates at the conference which prompted the research.

The project is to be funded by the EEC coal and steel community, and will be carried out in those industries. Certain others will participate by contributing financially or by allowing access to sites.

It is intended to research into the incidence and severity of the various types of discomfort and fatigue caused by these units, and in certain cases, to specify the ergonomic requirements necessary for the optimisation of VDU use with regard to the existing constraints.

The Institute for Consumer Ergonomics would be pleased to hear from companies thinking about VDUs and their use, and anyone else involved in similar research.

Pet displays its multi-lingual prowess with Cytek device

CYTEK (U.K.) Ltd of Manchester has launched a device which enables the Pet to display multi-lingual text on its screen. The device, Multifont, works in conjunction with the Wordcraft word-processing system. There are five main versions of Multifont; scientific, legal, commercial, European multi-lingual, non-European multi-lingual. Each version can format the special characters relevant to its application.

Multifont is used in conjunction with any 32K Pet, and any version of the Wordcraft program and the Qume Sprint 5 series of daisywheel printers. The operator can see the effect of using different print-wheels without printing anything.

This is achieved by matching the characters within the computer to those on a specified print-wheel.

Up to four separate fonts can be stored in the computer at any one time — the first is the standard Commodore business set. Multifont does not occupy any of the Pet memory, so the operation of the computer is not affected.

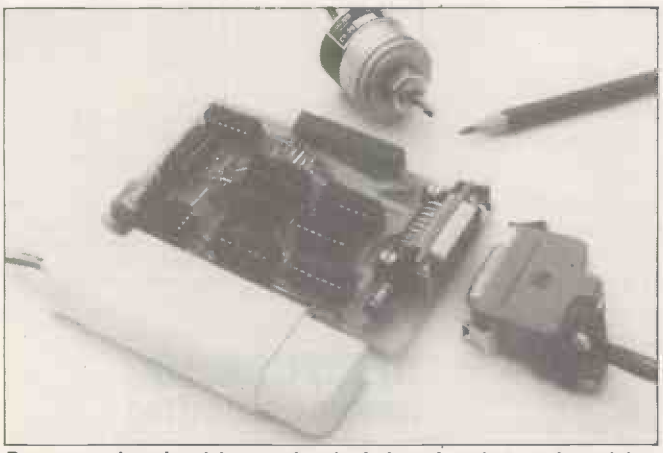
A total of 73 fonts are available for the Qume printer and 29 keyboard sequences. The Multifont fonts correspond to these sequences, and since one sequence may be used by several different typefaces, the four available fonts could cover many print-wheels. Keyboard overlays are available to enable the operator to identify quickly and easily all the characters in the sequence and locate the appropriate keys.

Cytek can create Multifont sets to user's own specifications if required and groupings other than the main five can be provided. Multifont is available as an add-on to Wordcraft at £172 + VAT and a complete system is £4,200. For information telephone Cytek on 061-872 4682.

Educational grant

A GRANT of £60,000 has been made by the Council for Educational Technology as part of a micro electronics education programme. Initially, the project will take the form of a course to be run at and by the Thames Polytechnic for teachers in such subjects as biology, geography and economics.

The course lasts 10 weeks, is attended by teachers on secondment from local authorities and it is specifically aimed at those teaching in secondary schools.



Pet users involved in mechanical data logging and position control may find this shaft position encoder from Cetronic Ltd of use. Recently added to the Commodore-approved product list, the C030C absolute optical shaft encoder will enable a Pet computer to communicate with mechanical systems in the real world using a specially designed interface. The encoder will be capable of resolving mechanical rotation into 256 eight-bit words, utilising grey code to increase the reliability of the readings. An interface/decoder board is supplied to convert the grey code to binary and feed it to the Pet via the input port. Cetronic may be contacted at Hoddesdon Road, Stanstead Abbotts, Ware, Hertfordshire SG12 8EJ, telephone 0920 871077.

Acorn picked to make new machine for BBC series

ACORN COMPUTERS has landed the job of building the new BBC microcomputer — and the projected BBC-TV series *First Byte* will use an extended form of Atom Basic in its instructional material.

Acorn describes the new machine, which will retail for less than £200 and should be ready by the end of 1981, as "a condensed version of the forthcoming Proton". Its specification was devised by a BBC team which included Charles Sandbank, head of BBC Research, Richard Russell of BBC Designs, who styled the exterior and John Coll, president of MUSE. Other consultants included Ray Kernow, John Sweeton and Peter de Bono.

The specification of the new micro is for 16K of RAM as standard, with the potential for expansion to 96K; add-on teletext receiver at a cost of around £100; add-on Prestel interface; high-quality moving keyboard "with a positive action like a top-class electric typewriter"; ultra high-resolution graphics in black and white — 640 horizontal points — a feature which it is claimed can be found only on micros costing more than £1,000; colour graphics at a lower level of resolution; and potential for networking with other computers or peripherals.

Initially, the requirement was for a Z-80 processor, teletext capability and CP/M support, but intensive discussions throughout the industry showed that it was not possible to have a machine built in Britain within the time limit. The Z-80 requirement was scrapped but Acorn has been able to meet the others within the time limit. A new BBC Basic to be called ABC was to have been developed but this too was dropped for lack of time.

Not all within the industry are, however, agreed that the BBC tried hard enough for what it wanted. Clive Sinclair, at the launch of the ZX-81, indicated that he could have built such a machine for a price of £110 at the point of sale — sales will be by the manufacturer under licence to the BBC and marketed on behalf of the BBC by mail order from a box number.

Sinclair tells *Practical Computing:* "We did quote for it. We had a specification from the BBC but it wasn't very full and there were some ambiguities in it. We said we could build it for £110 but it was clear our bid wouldn't come to anything. We had to put in a bid to protect ourselves.

"We feel that the BBC should have talked more to the industry and made the specification better known. We think it's crazy. Here we are trying to compete with the world's industry and our own national broadcasting system is operating against us".

Charles Sandbank of BBC Research disagrees: "The BBC has taken advice from a great many people with experience of the micro industry", he says. "As an employer of engineers, I think it's a worthwhile machine but it's a very difficult decision. The BBC has gone into it very carefully and has done all the right things and has gone for the solution which seems to have the highest probability of doing what it wanted".

Acorn Computers will also supply some of the software, which will be written in Atom Basic, adapted for compatibility with Microsoft Basic. Proposed programs include how to plan your electricity use more economically, work out your tax liability, learn maths, spelling or typing, manage business accounts or run an office. There will be hobby programs to interest the amateur astronomer, musician or photographer.

A 30-hour course will be run by the National Extension College at Cambridge to tie in with the TV series, and several course books are planned.

Texas 16-bit TMS-9995 wins added operation speed

TEXAS Instruments has developed a 16-bit microcomputer in a 40-pin package which includes the 6MHz clock generation, 256 bytes of fast RAM, an interval timer and the necessary circuitry for handling prioritised interrupts.

The device, called the TMS-9995 to indicate its generic link with the 9900 family, was designed and developed by Texas Instruments at its Bedford location. The generic link with the TMS-9900, TMS-9980, and SBP-9900 family of processors gives it complete software compatibility, so that a range of component software is already available.

However, the TMS-9995 has a significantly superior performance. The instruction set is that of the TMS-9900 with the addition of four new commands which enhance its ability to perform numerical tasks. There are also two new system interrupts, one of which, the arithmetic overflow, helps speed maths operations by handling overflow conditions without resorting to extra software.

An evaluation board will soon be available for the TMS-9995 which contains a monitor for program assembly, editing and execution. The hardware contains two data links.

The TMS-9995 is fabricated using NMOS and operates from a single +5 volt supply and will cost £23 for quantities of 100 plus.

How you and your machine can make beautiful music

THE LATEST product range from Alf Ltd will turn an ordinary Apple II computer into a sophisticated musical instrument. Two music boards which plug into the Apple expansion socket, and some associated software including an ear-training package and a collection of Albums are available on cassette or disc.

The MC-1 music card has nine independent channels or voices. Each voice is monophonic — it can play like a one-fingered keyboard player. The use of more voices means that chords can be formed or the computer could use a voice to provide its own accompaniment.

Three voices provide the left stereo output, three the right and the remaining three play through both speakers to provide the middle. The voices have individual control over pitch, envelope, and volume and one voice from each of the three stereo positions can be used to create white noise effects. This would be of great use to users synthesising percussive effects such as cymbals, etc.

The MC-16 music board is similar but provides only three voices on one output channel. This reduction in voices is compensated for by the inclusion of some extra features; a range of 63 half-tones as opposed to MC-15, more volume control levels and an ability to have two channels with variable pulse-width mode; the frequency is controlled by the third channel.

The software provided with the boards is comprehensive, will provide the user with a colour graphic display of the music being played. Songs can easily be entered from sheet music and the display shows the music on the screen.

When you enter music, a menu of available notes is displayed and an arrow indicating the selected note is manoeuvred by the paddle. The other paddle is used to position the note on the stave which is also displayed on the screen. A subroutine facility enables the user to call-up passages which need to be repeated and there is also an editing facility. The MC-1 card costs £91 and the MC-16 £114 and both are available from Apple dealers.

Keeping school-leavers in the pink and micro firms in the black

ON THE one hand, we have the typical micro firm and on the other, an impending tide of school-leavers who have all played with computers and look forward to exciting jobs in the microrevolution.

The problem — to bring the two together without breaking the banks of one or the hearts of the other. One solution might be the Youth Opportunities Scheme, YOP. The central idea of YOP is to introduce out-of-work school-leavers, 16-18, to the world of work. The Government's part is to pay them a tax-free allowance of £23.50 a week for six months — the sponsor's part is to have them around the place and show them, in a reasonably humane and constructive way, how the real world earns its bread — and perhaps butter. One hopes that by the end of the six months, or sooner, they will be so useful they are offered a full-time job.

It seems possible that there might be places in micro businesses for such young people, especially if they already have some idea of programming.

To get this scheme off the ground, the Manpower Services Commission has to be presented with a draft scheme of activities which will be approved centrally and then passed to local Job Centres for action. Our suggestion for such a program might be:

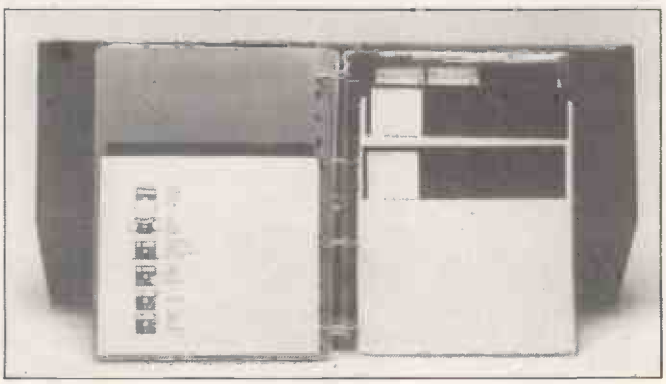
- Introduction to company and what it does.
- Basic office procedures: keeping records, filing correspondence, liaising with customers/clients.
- Computing: keeping records, making back-ups of programs and data, simple applications programming.

The scheme's main stipulations are:

- The company must have three full-time employees but it may employ more.
- The young people on the scheme must not replace any full-time employees.
- Their work must conform to health and safety regulations.
- They must not work nights or Sundays.

Anyone interested should write to us with suggestions. Literature about YOP is available from Miss J Trenor, Manpower Services Commission, Selkirk House, 166 High Holborn, London WC1V 6PF.

Software is neither cheap nor indestructible. Discs left lying about in offices seem to attract tea and other spills or are knocked to the floor — before you know wher you are, next week's payroll data is corrupted. The new data storage aid from Rexel has been designed to make the storage and retrieval of floppy discs a simple matter. The storage aids are in the form of binders, with pockets made of tough Nyrex material to hold the discs. The system will also consist of labels to help identification. Further details from 0296-81421.



Apple sees to the lighting

AN AUDIO-visual system which uses an Apple II computer as its base is now being introduced to the U.K. The Superstar multivision computer system can be used to program the batteries of slide projectors and ancillary equipment used for multi-projector slide presentations.

The "professional" multi-vision production market has so far been dominated by dedicated microprocessor systems. The Apple-controlled system could also be used to run standard Apple software.

The system in action.

The Superstar system consists of an Apple computer, twin disc drives, a 9in. VDU and a Universal Interface which allows disolve units, slide projectors and auxiliaries such as lights, motorised curtains and film projectors to be driven from the computer.

The system was developed by Clear Light in Florida and uses its own high-level language for programming the light sequences. Details in the U.K. from Myriad, 01-240 1941.

Gateway is Prestel's route into new teletext territory

PRESTEL is to offer a new service later this year. Mysteriously known as Gateway, it will permit Prestel users to access third-party databases. Based on a system already operating in West Germany, with software developed by Systems Designers under contract to Aregon International, Gateway is expected to enlarge greatly the scope of Prestel when it is fully implemented in 1982.

Key to the system is the so-called Gateway frame which leads the user from the Prestel network into a privately-owned computer, all of whose facilities may then be enjoyed by the user, assuming, of course, that he is in possession of the relevant password.

A demonstration at the London Prestel headquarters hosted by Prestel boss Richard Hooper, showed Gateway in action live from West Germany, whose *Bildschirmtext* is closely modelled on Prestel although there are as yet only two computers.

There were two short demonstrations, one of a customer-account enquiry and one of a conversion from sterling into U.S. dollars. This kind of networked information retrieval and processing is nothing new, of course; but it will be the first time this type of access has been feasible through Prestel.

Gateway's advantages, according to Iain Chisholm, who is in charge of marketing, are fourfold:

- It puts far greater processing power in the hands of a user who already has access to Prestel.
- There is great flexibility in security arrangements for different categories of information — even a single page can have its own security password.
- It makes keyword searches available.
- Interactive transactions via Prestel are now a possibility. At present you may send a message via Prestel but there is no acknowledgment that the message has been received and acted on.

Triumph-Adler micros enter the field

THE Triumph-Adler group, owned by the West German industrial giant Volkswagen, has finally made its move into the small-business microcomputer market with the launch of its Alphatronic range of systems.

The Alphatronic is based on the 8085A microprocessor chip running at 3MHz. There are two basic configurations of the system: the standard P1 at £1,550 which includes the processor, VDU, an integral double-density floppy disc unit and full documentation written in clear English; the P2 has a further floppy disc drive and a dot-matrix printer and costs £2,345.

The outstanding feature of the Alphatronic is the large amount of applications software already available for the system, including programs written by larger software houses. Among the software is a payroll program called Flexipay, written by Compuserve. There is also a business software package which consists of several modules; payroll, sales, purchase ledger, nominal ledger, and stock control with a sales invoicing option. The program is written by Tridata of Birmingham.

Microtrend has produced a complete range of software for the system, including a word-processing system, a data-management package which apparently has helped to sell many Alphatronics already, two user-friendly commercial accounting packages and Basic teach-in, a computer-aided learning program designed to teach beginners Microsoft Basic. Adler Business Systems Ltd, 27 Goswell Road, London EC1M 7AJ. Telephone 01-250 1717.

Paper Tiger trio

THERE ARE three new Tiger printers on the market, replacing the old Tiger 440. They are distributed through Microsense and the nationwide network of more than 400 Apple dealers. At the bottom of the range is the Tiger 445, an impact printer with a full 96-character upper- and lower-case set, a choice of eight user-selectable character sizes, graphics option, tractor-feed and multiple-copy capability. The 440 can print at speeds of up to 95 characters per second.

Next in the range is the 460 which because of an unusual matrix head will print denser, higher-quality characters. It is bi-directional and can print at speeds in excess of 150 cps. At the top of the range is the Tiger 560, a 132-column matrix printer with graphics and an expanded buffer. It is intended for data- and text-processing.

The Paper Tiger family.

The prices for the range are; 445, £545, 460; £795, and 560; £995.

Microsense is bought

MICROSENSE Computers of Hemel Hempstead, Hertfordshire, the sole distributor of Apple Computers in the U.K. has been purchased by Apple for an undisclosed sum. The transition is expected to be completed by the autumn.

Microsense will become a subsidiary of Apple.

Sophisticated Micromodeller to be distributed by ACT

ACT Microsoft — one of two British computer companies quoted on the Stock Exchange — has become the sole U.K. distributor of an important new software package designed to run on micros.

The product is called Micromodeller and is a low-cost financial-modelling package for the Apple II, developed in Britain and U.S. by Intelligence (U.K.) Ltd. David Low, managing director of ACT comments: "Each year, two or three software packages of real significance emerge — Micromodeller is one of these".

ACT is already the sole distributor of VisiCalc, the best-selling program in the world last year, and envisages Micromodeller emulating its success. Its main appeal will be to the small-to-medium-sized businesses and the middle layer of management in larger concerns.

Micromodeller represents a fraction of the yearly bureaux fees a comparable facility would cost, plus it has the added advantage of being a personal system — at less than £4,000 a system, everyone in a company needing the facility could have a personal system.

Like VisiCalc, the program is user-friendly — the commands are in plain English. It has a menu and is supported locally by the dealer and nationally by a hotline. Financial functions are built-in, and reports are generated automatically to the user's own specifications. Summary reports can be displayed on the screen before any printing is performed.

An attractive feature of Micromodeller is the slide-show presentation, which uses colour graphics to present information in a graphical form.

This useful facility will, no doubt, help to sell the package to those people whose job entails disseminating financial information.

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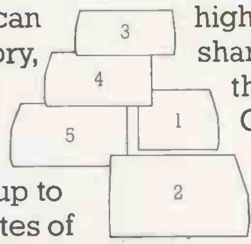

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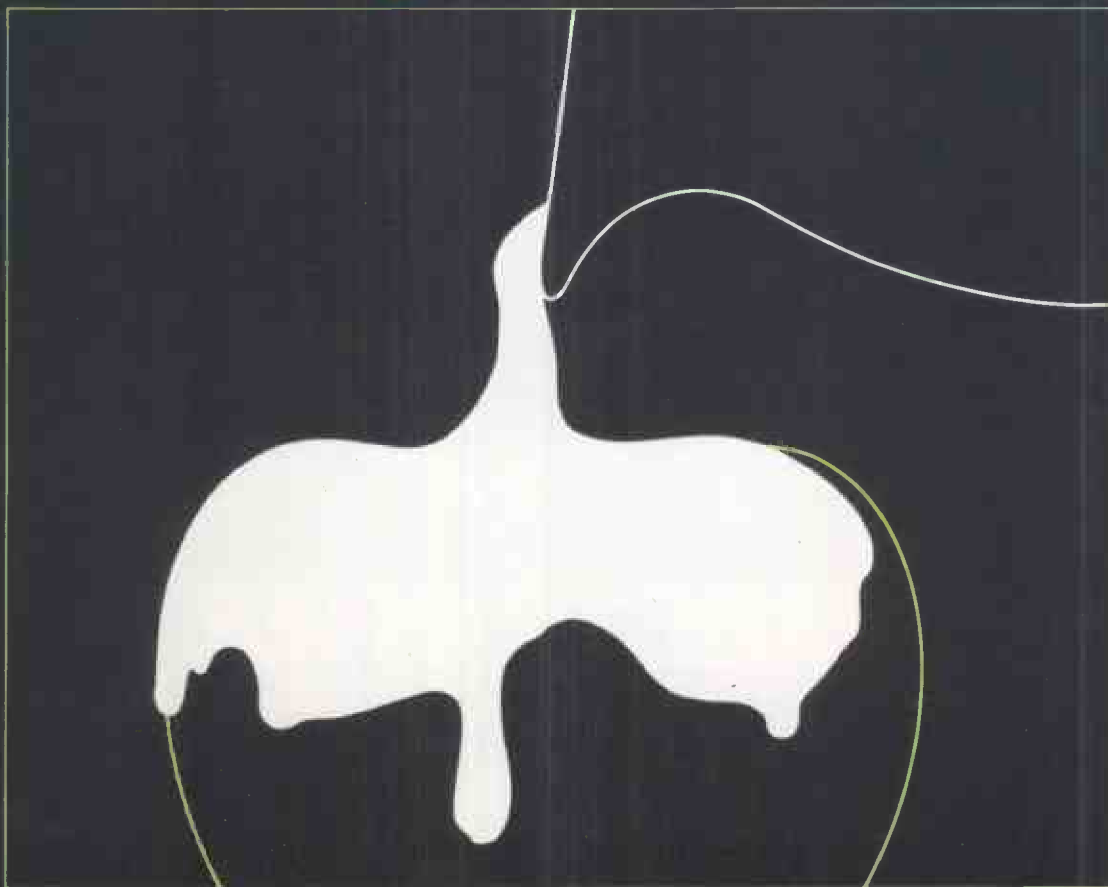

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Low-cost Wordease fits the bill for office applications

Nick Laurie analyses the strengths and weaknesses of Wordease, the word-processing package for Nascom.

THE GREATEST weakness of Wordease lies in its documentation. Written with the computer buff in mind, the documentation for this otherwise extremely useful program is guaranteed to frighten away anyone unfamiliar with computer terminology. It is written using a wealth of technical jargon, it does not contain worked examples which might at least have made Wordease a little easier to use and it contains a few minor inaccuracies.

I do not consider myself a computer whizz-kid, but at the same time, I think I know enough about the subject to be able to have a commercial program up and running as quickly as the next person. Yet by the time I had unraveled the vectoring to my existing print routines and had persuaded the program to read my standard keyboard, it had taken me four hours to load and run Wordease.

Another four hours passed before I was able to use it to any real purpose after which I was on the learning curve which should have been reached after a single reading — or, at most, two readings — of the manual. The typical user of the program, say, typist or secretary with no special computer knowledge, might abandon the program because the initial learning hump is just too steep. That would be a shame because when used at its best, Wordease is a print formatter *par excellence,* comparing well to many modern typesetting machines.

So what is Wordease? It is described as a text editor and text processor and its use is clearly divided into these two separate functions. As a text editor I found it inferior to Naspen — the only Nascom-based competitor in the same price and size range, reviewed September 1980 — but that as a pre-print processor, it is extremely versatile and capable of producing complex multi-page documents easily and to a very high standard.

Available controls

Assuming a memory already full of text, the more obvious controls are easily available. Scrolling-up and down through the buffer, inserting and deleting, finding and replacing pre-defined strings — all with full on-screen cursor mobility — is straightforward and a bytes-remaining display is available although it is updated only occasionally when text is processed but not during normal entry.

The speed, incidentally, of such actions as insertion or replacement is particularly impressive and is achieved through the use of a "playground" area — an interesting and useful way to increase text processing speed. For further details read Wilkes: *Scroll editing,* IEEE transactions on computers volume 19, number 11, November 1970.

The find command is also capable of handling wild characters embedded as asterisks in the find string. There is, however, a serious disadvantage — it is a line-based editor with all the action except entry taking place on a single edit line — line 8 on the screen — and the text is reflected on to the screen exactly as it appears in the buffer.

Blank lines

There is no tidy-up routine so that words wrap around from one line to the next. It is essential, therefore, to hit newline at the end of each screen line for tidiness — fine for touch typists but hell for two-finger Peek and Poke types. Insertions and deletions have an unnerving habit of leaving blank lines and odd word-breaks permanently inserted into the text.

The general untidiness is cleared-up in the processed output but not in the buffer and it makes editing of text on the screen into a very disjointed affair and really prevents Wordease from being used extensively for original writing. On the other hand, when large blocks of the text are standard as is often the case in business letter writing, the program really saves time.

By using the so-called macro commands, it is possible to store up to 10 text sections which can be called up by referring to them by number in the body of the text. They will be inserted and formatted automatically leaving, for example, only the names and addresses of a standard letter to be defined by the operator.

Two such macros are dedicated to providing the page headings and footings and can include automatic page numbering as well. Very useful when a multi-page report is being prepared. A macro can contain an embedded instruction to call up another macro — and so on to the full depth of 10 — so allowing considerable versatility.

As well as these normal editing features, there are a number of commands available for use in a direct mode. 'U' and 'D' followed by a number will cause the screen display to scroll-up or down by as many lines as required while 'T' and 'B' put the top or bottom lines respectively on to the edit line. A software shift lock is available.

Text on the edit line can be marked and new markers — maximum of two, to define a single block of text — adjust themselves automatically to point towards each other so that, as new markers are added, the nearest old one is deleted and the new one points towards the remaining one. Marked areas can then be copied to any required line or killed.

Again, the fact that the editor is line-orientated may mean that some fine shuffling is needed to place text at exactly the right spot. A save command feeds the marked area direct to cassette or disc in some systems and the saved text can be replayed direct to the edit line as though it were from a keyboard. Misread characters are displayed as '?' to allow easy recognition. The KILL command is the only command that has to be spelt in full — just as well since it is not possible to recover killed text. 'Q' or quit returns control to the system monitor.

The final command as far as the editor is concerned is 'P' for process and it leads us to the second and, to my mind, far more impressive face of Wordease.

Format and output

The purpose of the processor is to format and output the contents of the text buffer to one or more of the three ports. Each of the ports is a vector to a user-defined — and user-supplied — output routine. Typically, port 1 would be sent to the screen to provide a view of the general appearance of the formatted text while the second might be directed to a printer operating routine with the third going to a tape or disc system. All three ports have to be vectored by the user so that any output routine can be used.

Unfortunately, the manual again assumes that the user is used to fiddling about in individual memory locations in machine code and keeps explanations of procedure to a minimum while the occasional inaccuracy in the memory map provided does little to help find the proper location. Each vector is followed by a control word which can be set to any of the following options:

1. Character delay feature on or off
2. Use Nascom 1 carriage return code
3. Inhibit line feeds
4. Force upper-case — capitals

(continued on next page)

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The control word, inserted by the user in Hex, can be the sum of any of these options to give different controls on different ports. The required port or combination of ports is selected by entering the command 'Pn' where 'n' is the port number followed, if required, by a 'Dn' command which sets the pre-coded port delay factor to control the character output speed while 'Pn' defines the page number of the first page output in multi-page documents.

Text is processed from the buffer as a single continuous string and is justified automatically whether you want it so or not. I consider this to be a fault since, if a line is to be printed unjustified, it is necessary to insert a specific command into the text each time this format is required.

With the current ubiquity of word processors, there is a tendency for everyone to produce tidy, justified output on any three-by-two dot-matrix printer and this tends to give an appearance on a par with the resprayed banger or the gilded stinging nettle.

On poorer-quality word processors, the justification routines can lead to a gappy appearance and the overall result is that the style of computer-generated word output is becoming very recognisable — and not for its better qualities either. There are times when one would like to pretend that a letter has been hand-typed and at such times, the forced justification is a positive disadvantage.

Error message

During the processing it is possible, or even probable, that errors caused by the use of inappropriate or conflicting commands will occur. An error message is displayed and a jump made to a vector defining your machine's "bell" routine — very useful if you want to leave your machine during processing. If no bell is available, the Hex command C9 is inserted in the bell vector and the error message is displayed silently.

While most of the error messages are self-explanatory, the fact that they are not explained in the manual is a fault which does nothing to help the slope of the learning curve. Processing is halted when an error occurs and the offending line of buffer is placed on the edit line.

Unfortunately, the precise spot at which the error was found is not marked and, bearing in mind that there may be 12 or more commands embedded in a line of text, it can call for a good deal of studying to find the mistake. That again is not a fault exclusive to the system but one which I have encountered on other machines costing upwards of £15,000.

The formatting commands consist of 14 very comprehensive codes which can be inserted into the body of the text to tell the printer exactly what to do when they are encountered. Imagine you have written and edited your text, you have pre-defined a number of macros for your standard paragraphs and it is now time to think about printing.

Going through the text line by line, you insert commands into the text at each point where the printer has to do something other than print justified words — it can do that with no commands beyond a defined line length. Insertion of control 'C' — an up-arrow, 5E Hex — indicates to the processor that the following character is a command — which will not, of course, be printed — at which point the processor interprets the next character and controls the printer accordingly.

These characters are 'Ln' which is used to set the line length. Here and in all commands using a numeric suffix, 'n' is a decimal number which defaults to 1 and is to the command character. Beware, though, of numbers which are part of the text to be printed; if they follow a command, a separating space must be used to avoid confusing the system.

'D' and 'S' set the line spacing to single- or double-spaced, 'I' sets an indent causing printing to start at column n on all lines until the command is cancelled using IO, while 'T' for tab causes a once-only tabulator to column 'n'. 'N' prints a new line while 'E' for eject prints new lines until the end of the page, whose length is initially defined using 'Pn', is reached.

A very clever conditional eject 'Cn', operates the multiple line feed only if there are fewer than 'n' lines left on the current page and would, for example, be used before a chapter heading to avoid printing it at the foot of the page.

The last few commands complete the system: 'F' for finish which outputs new lines to the end of the page and then halts the printer; an 'H' simply halts the printer until any key is pressed allowing the user to change the sheets in a sheet-fed printer and it would normally be included in the foot-of-page macro which is referenced whenever a page has been completed.

This same macro would usually contain the 'X' instruction to print the current page number — three digits, leading zero suppression. 'Un' is a user command allowing decimal 'n' to be output to the printer for special-purpose control codes such as a printer on/off switch. One handy feature of the commands is that they can be entered in upper- or lower-case which helps to avoid errors.

In spite of the apparent complexity of reading the text buffer once it has been padded out with commands, one can grow used to it very quickly with regular use. With practice, it is possible to read a piece of text, visualise the finished appearance required and then insert the control codes to produce it. Many a sub-editor would be able to master the machine — given a decent manual — in minutes.

A trial run formatting to the screen is essential to check that everything you wanted happened and it is a shame that this output is, in effect, lost once it has scrolled off the screen. Ideally, it should replace the existing buffer string with the processed string to allow further editing to take place.

Once satisfied with the format the print process command is given and manuals, books, circular letters can be churned out *ad nauseam*. The Wordease manual is produced on Wordease and is a model of tidiness — visually, if not in terms of content.

In large volumes, it is still far less expensive to typeset and print using slightly less modern techniques than to use impact printers and photocopying. That is because the area of paper required for typeset material is far less than it is for type-written material and on a 30- or 40-page manual, the reproduction costs of a mass of paper far outweigh the savings made by avoiding professional typesetting.

I have used Wordease to format and print a number of experimental pieces and found that with practice — and, preferably, some familiarity with modern photosetting techniques — it is invaluable in the preparation of complex reports and standard letters although practically hopeless for original or creative writing.

The ideal user for Wordease would be the small business involved in the continuous generation of similar but non-identical material such as an estate agent or mail-order company. Such a firm might well consider dedicating a Nascom and printer solely to this purpose at a very low cost indeed. A copywriter or an author not requiring the powerful processing on offer but needing detailed and tidy editing facilities would go out of his creative mind in a very short time.

The fact that this editor seems to be geared for report writing and standard letter writing rather than to creation of original material gives Wordease the appearance of either having been built specifically for a particular job and then marketed as an afterthought or of simply being another half-completed program rushed on to the market ahead of time.

Wondering which answer was correct I had a word with Program Power who distribute it and I was put in touch with the author, TR Harris of Vader Systems in Portsmouth who confirmed that he wrote it with a view to satisfying his own needs — mostly for standard letters — and that the marketing followed when various people expressed interest. Hence the documentation and low cost — £25.

Conclusions

- **Wordease is very much a purpose-designed program and while it may be unsuitable for many people, those whose interests lie in the production of standard letters, complex multi-page documents and short runs of things like instruction manuals will find it superb.**
- **It is at its worst for creative writing.**
- **It does everything it is supposed to do and does them well, but it may not do everything you would like it to do.**

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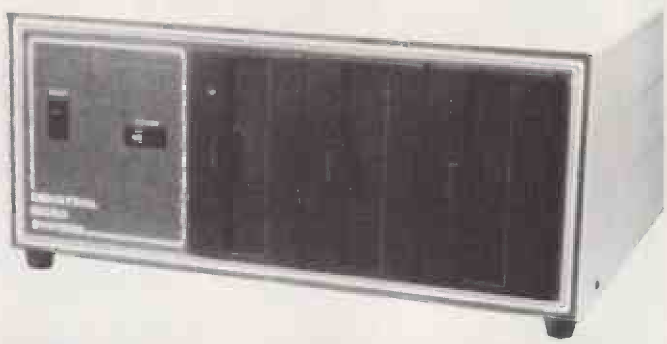

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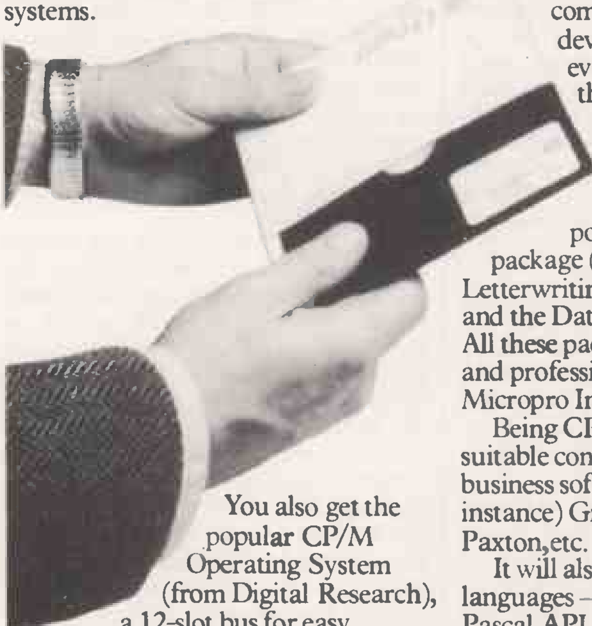

You also get the popular CP/M Operating System (from Digital Research), a 12-slot bus for easy expansion, a Z-80A CPU for powerful performance, 2 serial and one parallel interfaces, 64KB of dynamic RAM with in-built error detection capability, and dual 5″ double-density drives with the option of a third drive (or quad capacity drives in place of double-density) in the same cabinet. Additionally, there is the Turbocharger option providing both enhanced disc capacity, disc performance and diagnostics. And if even greater storage is required we can supply 8″ floppy drives and cartridge disc drives.

A powerful system for the computer-user and system developer – and one with eventual access to OS/2000, the Industrial Microsystems networking system.

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Being CP/M based, the system with suitable configuration will also run the business software developed by (for instance) Graffcom, Peachtree, Paxton, etc.

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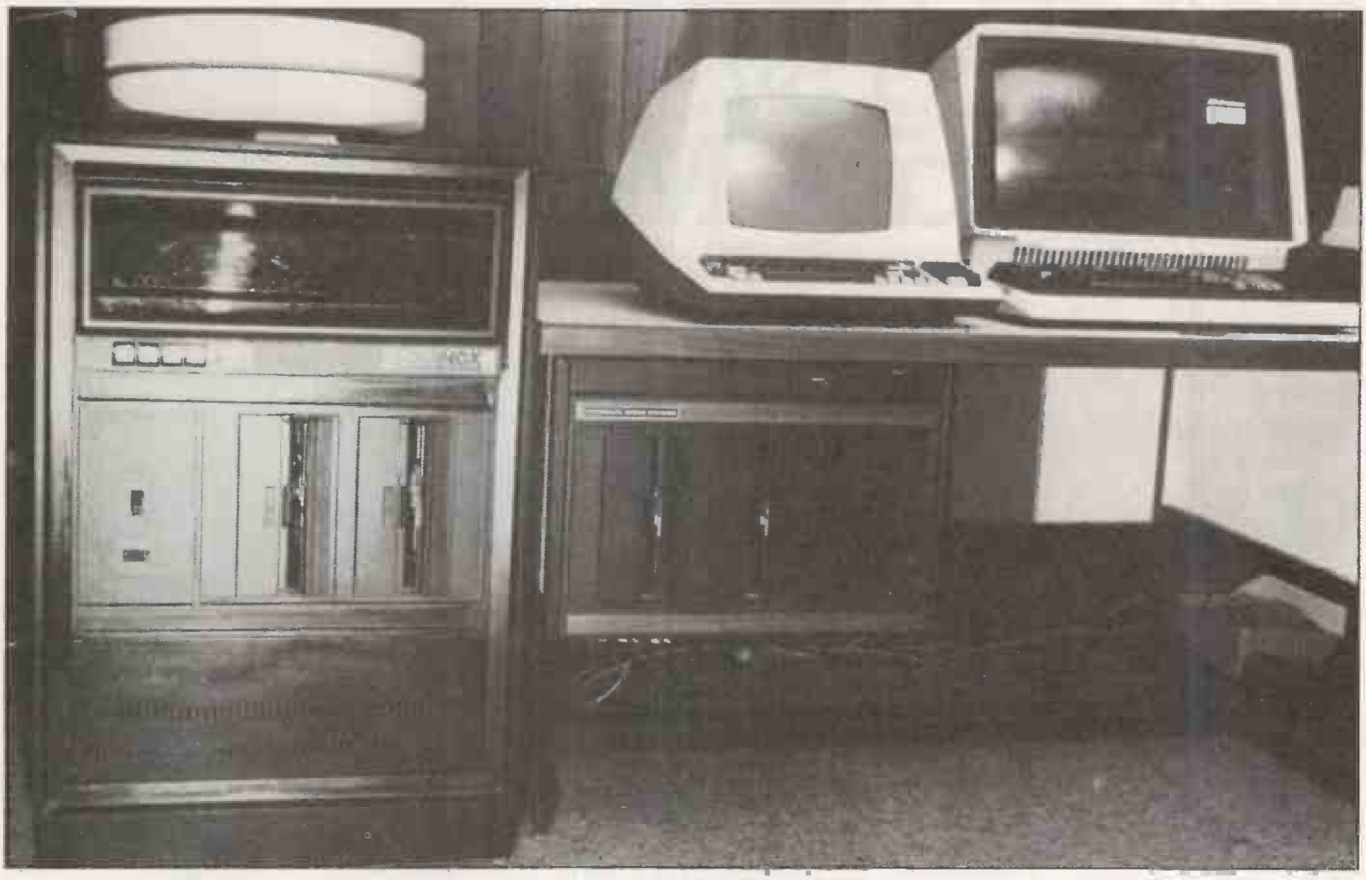
Business computing combination of Equinox and MVT-Famos



EQUINOX Computer Systems Ltd is a British company based in London and was established three years ago, in July 1978. That was at the height of the initial wave of enthusiasm about microcomputers. At that time, most suppliers were selling computers for the hobbyist and educational markets.

Many companies were supplying micros without the peripherals necessary to make a complete system. The customer was expected to buy the components separately and build-up a system, rather like a stereo enthusiast and, like the stereo enthusiast, he would run into the attendant problems — how to select compatible equipment, and how to store the equipment so that it is not just a mess of boxes and wires.

Equinox was set-up with the aim of supplying complete systems — the computer, VDU, printer and disc drives. It has a staff of 12, including eight technical staff involved in setting-up and testing the equipment before it is sent to customers. It supplies many of its systems through the OEMs, own equipment manufacturers.

This is a term in the computer trade referring to companies which buy equipment from other manufacturers and add other hardware or software to it before selling the complete system to the customer.

Recently, it has often been used to refer to systems houses which buy the hardware at a discount and provide applications programs either in the packages or customer-written software. Equinox has a network of about 30 such dealers around the U.K., particularly in the south, south-west, East Anglia and the north-west.

Its first two products were a system based on the North Star Horizon and the Equinox 300. The North Star Horizon is a

by David Watt

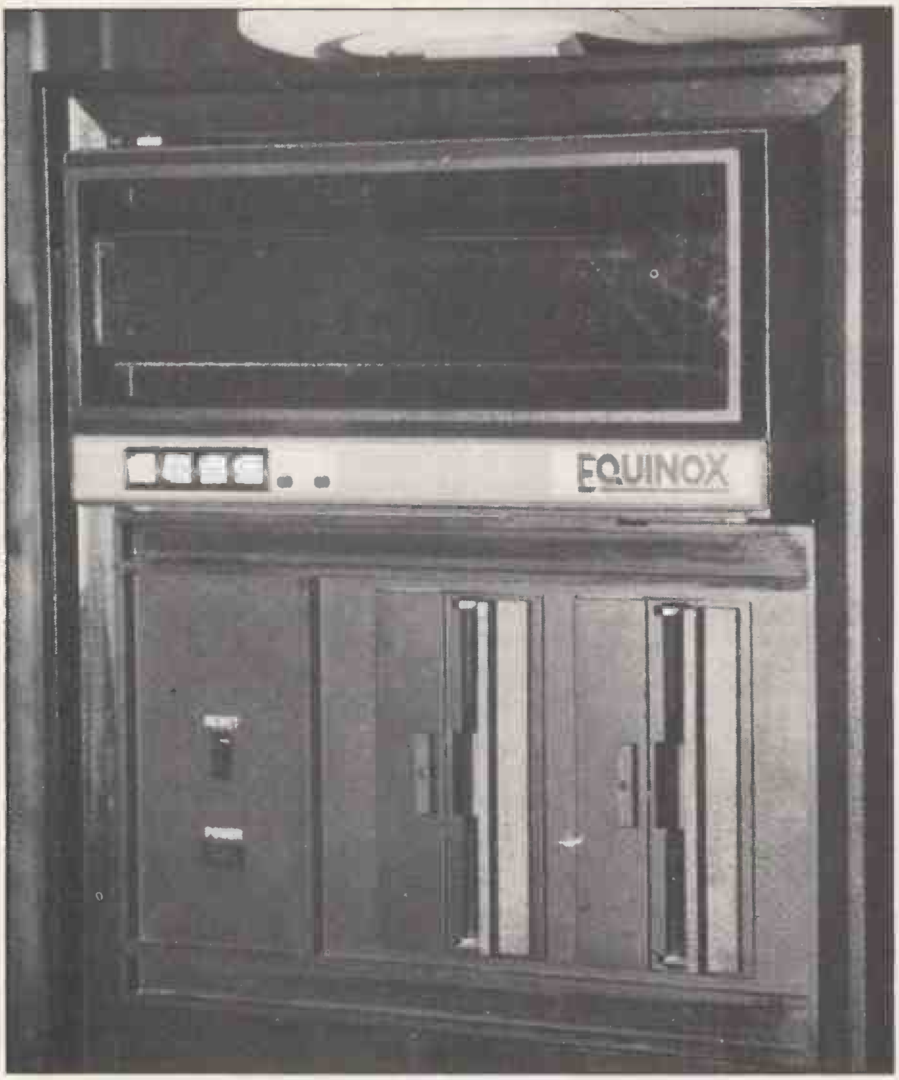
well-known Z-80 system sold by several other suppliers with a maximum 56K of memory and two 5¼in. floppy discs in an integral cabinet. The Equinox 300 is a 16-bit multi-tasking multi-user system using a chip set manufactured by the Western Digital Corporation.

The system features a minimum 48Kbytes of memory with dual floppy discs, up to a maximum 512Kbytes of memory and a variety of hard discs, from a 10Mbyte system with 5Mbytes fixed storage and a 5Mbyte removable cartridge, up to the CDC Phoenix disc which has a 16Mbyte removable cartridge and may have from 16 to 80Mbytes of fixed storage.

In autumn 1979, Equinox announced the IMS 5000 and 8000 systems, and in the summer of 1980, the Equinox 200. As with the 300, the systems may have from 48Kbytes to 512Kbytes of memory, using bank switching, and a range of disc drives for mass storage. The 5000 and 8000 are supplied directly by IMS, Industrial Micro Systems of Orange, California, with 5¼in. mini floppy and 8in. floppy diskettes respectively.

The 5000 may have from one to three disc drives, and the 8000 up to four disc drives. Both types of disc may be supplied in single-density, double-density or double-sided, double-density formats, giving a maximum of 1Mbyte on-line storage with the 5000 and 4Mbytes with the 8000. The Equinox 200 is more suitable for multi-user applications — it is supplied with the same discs as the Equinox 300, the Ampex 448 10Mbyte disc manufactured by the Ampex Corporation, or the CDC Phoenix disc providing from 32 to 96 Mbytes of on-line mass storage. The same processor is used in the 5000 and 8000 and is supplied by IMS.

Equinox supplies a variety of operating systems, program languages and two word-processing packages for use with its systems. For single-user systems, it has the



ubiquitous CP/M from Digital Research Inc, complete with Microsoft MBasic or Basic-80, Fortran-80 and Cobol-80. CIS-Cobol is also available from the British firm, MicroFocus — it is one of the most acclaimed Cobol compilers available for eight-bit microcomputer systems. Wordstar may be used for word-processing applications.

Multi-user systems

Also from Digital Research is MP/M for multi-user systems. It is compatible with CP/M so any of the languages mentioned may be used on a MP/M system, as can Wordstar. Omnix is also a CP/M-compatible multi-user operating system from a U.K. firm, 1500 Systems Ltd. MP/M and Omnix are useful for upgrading to a multi-terminal system where different applications will be run on each terminal, especially when those applications have been developed under CP/M. Unfortunately, MP/M has no means of preventing unauthorised use of files. Many multi-user operating systems allow files for a single user to be grouped together which may then be protected by a password.

From CAP, one of the largest computer system houses in the country, the CAP-MicroCobol business operating system is available. Various applications packages have been developed to run with MicroCobol, including sales ledger, purchase and nominal ledger, Autoclerk, a file maintenance utility for creating, amending and inspecting business data files, and Autoindex, a database indexing system for fast storage and retrieval of data.

Finally, from MVT Microcomputer Systems Inc is another multi-user, multi-task operating system called MVT-Famos. Famos is an extremely powerful disc operating system for eight-bit microcomputers featuring multi-user security and uses passwords to allow access to selected programs and files.

Memory may be bank-switched up to 512Kbytes with tasks dynamically allocated to individual memory banks. If there is sufficient space, two or more tasks may use the same bank. Applications programs may be written in assembler using ASMZ, a Z-80/8080 macroassembler, or in MVT-Basic. MVT-Basic consists of a re-entrant compiler and run-time module. The compiler produces re-entrant object code, so if several operators are running the same program, only one version of the program need be loaded in memory.

For the purposes of the review, I examined the Famos operating system on an IMS 8000, with twin double-sided, double-density 8in. diskettes and a Hazeltine 1500 VDU. The benefits of Famos would be more noticeable on the hard-disc Equinox 200 systems, but as the IMS 5000, 8000 and Equinox 200 are compatible with identical processor and memory, it was easier to examine the 8000. I received a good deal of advice in the use of Famos from Microtek Computer Services, an Equinox OEM, based in Orpington, Kent.

Central processor

The central processor unit, CPU, used in the IMS 5000, 8000 and Equinox uses a Z-80A processor chip and is mounted on a 12-slot S-100 motherboard. The systems may be configured with a minimum of 56K and a maximum of 512Kbytes of random access memory, and they will support up to 20 terminals using RS232 serial interfaces. Two parallel ports are provided for devices such as printers.

The IMS systems, the 5000 and 8000 may be provided as desk-top models or suspended beneath a desk-top, to give a work-station configuration. The Equinox 200 series are rack-mounted, again in a cabinet 22in. wide by 32in. deep and 34in. high for the 10Mbyte system and 42in. high for the 32Mbyte system. The standard motherboard for the Equinox 200 has 19 slots giving more space for extra memory and interface boards.

The 200 series may be configured with the Ampex 448 10Mbyte disc with 5Mbytes on a removable cartridge, or the CDC Phoenix drive which has a 16Mbyte removable cartridge and from 16 to 80Mbytes of unformatted fixed disc storage — when formatted the storage is slightly reduced. In addition, floppy discs may be provided with the system as in the smaller models. This is particularly useful for the easy transfer of programs and files — particularly when applications programs are being developed.

Various peripherals

Equinox supplies a variety of other peripherals to complete the system, including Televideo 912C, Hazeltine 1500 or Elbit 1920X VDUs and OKI Microline 80 printer, Texas Instruments 810 150 cps printer, or NEC Spinwriter — a word-processing-quality printer.

Starting the system is a simple matter of switching on the computer and all peripherals and inserting the boot disc in drive 0. The operating system is loaded into memory automatically. There is a spring loaded re-set switch on the front of the cabinet above the red power switch to reload the operating system in the event of a system crash. The power switch also serves as a "power on" indicator and

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lights-up whenever it is switched-on.

The hard disc drives have additional controls, a stop/start switch, ready light, fault light and write-protect switches for the cartridge and fixed discs. The 10Mbyte drive also has an active light which flashes on and off indicating disc activity.

Once the Famos operating system is loaded the operator may sign on to the system by typing "Q" at the terminal which will cause a message to be displayed indicating the version of Famos being used. No other character will have any effect so it is important to make sure your keyboard is set for upper-case input, or like me, you could find yourself wondering why nothing happens when the "Q" key is pressed. All system commands must be typed in upper-case or they will be rejected by Famos.

Famos may be supplied without user-accounting for single-user systems, in which case the system will display SSREADY, which is the standard prompt indicating the system is ready to execute a task. However, with the user-accounting version, a user name, up to eight characters, must now be entered followed by the password associated with the user name. The password is not echoed on the screen when it is typed-in, making it harder for unauthorised people to learn passwords and gain access to the system.

Restricting access

Besides restricting access to the system, user-accounting also permits file access for a user to be restricted to the files in his own account. File names may be up to 15 characters long. When user-accounting is in operation, all file references made by the user have a three-character prefix tagged on to them automatically — the prefix is the first three characters of the user's name.

It is invisible to the user except when using certain system commands, such as MAP which displays the list of files on a disc and it means if two users specify the same file name, they will access two different files unless they have the same first three characters in their user names.

File-name prefixing is optional. If it is disabled, any user can access any file. Also, file-name prefixing does not occur if the user name begins with "X", or the file name begins with "C". User names beginning with "X" are designated as system accounts and can access any file on the system and similarly file names beginning with the letter "C" are designated as common files which may be accessed by any user.

In addition to user account passwords, another level of security is provided by allowing individual files to be protected by passwords. Passwords are specified by putting a comma and the password after the name of the file — the whole string is up to 15 characters long. The passwords are not normally displayed with the file names, but whenever a file name is specified for processing, the password must be specified as well.

There are four types of files handled by Famos, types A, B, C and E. Type A is for print spool files, data files or program source files, type B indicates compiled Basic programs, type C indicates assembler programs and type E, temporary edit files created by Wordflow, the MVT word-processing system.

The device on which a file resides may be specified by prefixing the file name with a colon, followed by a unit number. Up to 16 units may be referenced in this way. Unit numbers may be in the range 0 to 9 or A to O with the numbers 1 to 9 being equivalent to A to I. Devices may be random, i.e., discs, or serial such as printers. Serial devices are indicated by using the special character "<" in place of the file name in the file specification.

When the operator has signed on to the system, his terminal is under control of Superselector, the re-entrant command processor. This issues the prompt SSREADY and waits for the operator to input a command. Superselector allows the user to queue an assembler program as a task for execution, suspend a task, resume a task, resume a task attached to the terminal so that the task may display messages or receive input from the terminal, end a task deleting it from the system, or end all tasks currently initiated by the terminal and sign the user off the system.

In addition to these commands, various system functions which are part of the operating system may be executed just by typing the name of the required function.

Sample hardware prices

1. Horizon System. 56K RAM, two 5¼in. double-sided, double-density disc drives Hazeltine 1500 VDU OKI Microline 80 Printer	£ 4,200
2. As for 1 but with Elbit 1920X VDU NEC Spinwriter	£ 5,450
3. IMS 5000 64K RAM three 5¼in. double-sided, double-density disc drives Elbit VDU NEC Spinwriter	£ 5,650
4. IMS 8000 64K RAM two 8in. double-sided, double-density disc drives Elbit VDU NEC Spinwriter	£ 5,900
5. Equinox 200-10 64K RAM 10Mbyte disc drive Elbit VDU Texas 810 150 cps printer	£ 9,750
6. As five but with 192K RAM four Elbit VDUs one Texas printer one NEC Spinwriter	£15,500
7. Equinox 200-32 256K RAM six Elbit VDUs two printers	£20,500

These functions allow the user to create, delete, copy and merge files, display files and file names, edit, compile and run Basic source files, display various system statistics and control the operation of the system.

Famos does not allow the operator to type-ahead — that is to continue entering commands or data while the system is processing previous commands. I found this rather inconvenient. If one attempts to type-in data before the system is ready, the input is rejected and the terminal makes a beep.

The Superselector will accept a string of commands and parameters input in a single line of up to 66 characters. Each command must be separated by a "/", parameters by "[", and the first parameter for a command must be preceded by a dot.

Command sequence

This is useful for inputting sequences of commands which might take a comparatively long time to execute and for which all the required parameters are known, for instance, when compiling and running a Basic program. Alternatively, new system functions may be set-up which consist of a set of the existing commands, or systems programmers can create entirely new system functions using existing commands.

A special editor, MCOMM, is used to create the function in a type C file. The commands to execute the function are input as described for command lines but only one command and its parameters may be input on each line.

Although these facilities, particularly the ability to set-up special functions, are useful, I found it was very easy to forget to type a dot before the first parameter of a command with the result that the system misinterpreted the command. With type-ahead, the operator does not have to learn any special characters for inputting the commands.

Some special control codes can be used to correct commands before they are input to the system. Control "X" cancels all input on the line as a new command can be typed. Control "G" and Control "H" move the cursor right and left respectively so that characters can be changed by positioning the cursor correctly and typing the new character over the existing character. Characters can be inserted by using control "I".

Control "X" does not cause the cancelled input to be cleared from the screen, or give any other visual indication that it has been entered. Control "I" causes the character under the cursor to be duplicated and the display is not changed until the cursor is moved along, so it can be confusing to use both these characters.

There are two other special characters used by Famos. Control "T" is used to generate an interrupt when a program is executing a Wait statement, and ESCAPE which may be used to suspend a task and return to the Superselector. The task may then be resumed or terminated by the Superselector.

If the task requires no operator intervention and does not require any operator input, it may be suspended after being initiated by pressing ESCAPE, and then resumed. This frees the terminal for use by another task.

Another facility available only with user-accounting versions of Famos is batch processing. Programs may be run under control of the batch processor which accepts commands and data from a special file called job file, as though they were being typed in by an operator.

Job files may contain job control lines or terminal input lines. Job control lines allow terminal output to be routed to a special file or device, user-account names and passwords to be specified, terminal input to be echoed on the terminal output file, and for the current task to wait until its sub-tasks are complete.

Terminal-input lines are lines of data to be input to the programs being executed by the batch processor and appear exactly as they would if typed by an operator. Batch-processing tasks are controlled by the batch monitor which is a special program which is treated by Famos as a dummy user. That is why it is available only with user-accounting versions. The batch monitor maintains a queue of tasks awaiting execution which can be examined and manipulated by a batch control program.

Job displayed

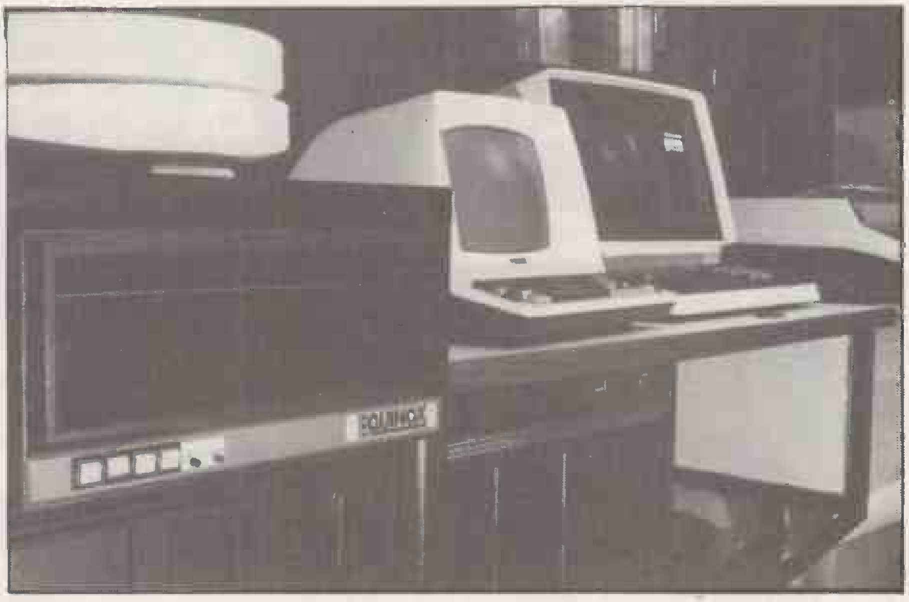
BCONTROL allows the operator to display the jobs awaiting execution and the current job being executed, to abort the current job, or all jobs, to delete the current job-file name and to bump jobs up the queue so they will be executed sooner.

Batch processing is a very powerful facility because it allows non-urgent tasks to be queued for processing as required, freeing the terminals to be available for input and enquiry and other tasks requiring a good deal of operator intervention.

Efamos, the E stands for extended memory, allows systems to be configured with up to 512Kbytes of random access memory. The memory is allocated in 32Kbyte banks — the first bank is used by the operating system and remaining banks are available to user tasks.

Terminals are assigned to banks either explicitly via a bank-assignment table, or banks may be allocated dynamically, in which case a user is assigned to the bank with the least number of other users. The bank assignments can be changed by using the ASSIGNB system command. They are not fixed when the system is initially generated as they are in many other operating systems.

At present only Basic and assembler are available for writing application pro-



grams, although Cobol is reputedly under development. MVT-Basic consists of a re-entrant run-time package and compiler. The compiler produces semi-compiled object code, which also re-entrant. Using a compiled language, it is less easy to develop and test programs than using an interpreter, but a compiler usually produces more efficient code, so that programs execute more quickly. MVT-Basic certainly seems to be acceptably fast. Except in the case of transcendental functions like SIN, COS and LOG.

The review system performed approximately 83 operations per minute of a simple loop containing a SIN and a LOG function. I asked Paul Ringer at Microtek about it and he said MVT did not write them very efficiently because an assumption was made that they are not used very frequently in business data processing. That is true, but when they are used, the same calculation may need to be done on hundreds of records in a file. Microtek solved this by designing its own routines for the function it needed.

The Basic contains all the usual verbs and expressions. Variable names may be up to eight characters long and string variables up to 55 bytes long. The size may be defined by the Size statement at the beginning of the program. It is good practice to define the size of all string variables used in a program. Otherwise, strings will default to a size of 80 bytes which is wasteful of program space.

The precision of floating-point variables is determined when the system is generated. The default size is six bytes which allows numbers to be held to 10 decimal digits of accuracy. Multi-dimensional string and numeric variable arrays are supported by Famos. There does not appear to be a limit on the number of dimensions which may be specified but the total number of elements may not exceed 255.

There are two methods for input from a terminal, the Input statement and the GBYTE function. The Input statement allows one or more variables to be input separated by single spaces. Commas are not treated as delimiters and may be included in string variables. GBYTE allows a program to receive the next character input from the keyboard. There is no Input Line statement in MVT-Basic to input a complete line of data terminated by line feed or carriage return.

Fixed-length strings may be input using the FLD function which allows spaces to be input as part of the string. If a string longer than the length specified is typed, the string will be truncated. If the string is too short, the input will be rejected and the program will re-execute the whole Input statement — as it does in the event of any error.

Input statement

In general, I found the Input statement rather inflexible, particularly for input of string data. I believe it is better to use the GBYTE function and the FLD function would have been much more useful if it accepted short strings.

The Print and Print Using statements work in a similar fashion to M-Basic and other versions. The Print Using statement allows data to be output in specific formats and is also similar to M-Basic. The Tab function may be used for positioning the cursor anywhere on the screen and may have one argument specifying the next print position on the current line, or two arguments specifying a line and column position, which is very useful for inputting or displaying screen formatted data.

Basic has facilities for handling files in two ways. Type I access is primarily for sequential ASCII files, while type II, internal format, is used for mainly random access data files, although files can, in fact, be accessed by either method. ASCII files are used for print spool files or job files to be used in batch processing and are treated in a similar fashion to

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the terminal input/output methods.

MVT-Basic treats type I files as containing variable length fields delimited by spaces or "Escape" characters. Alternatively, fixed length fields can be referenced using the FLD function.

For type II files, data is input using the Get statement and output using the Put statement. Both statements have the same format consisting of file number, record size and record number parameters followed by a variable list.

If the record size parameter is zero, the record number parameter may be used to move the file pointer, which indicates the current position in the file, backwards or forwards a specified number of bytes. Data is held on the file in a fixed format according to type.

Numeric variables occupy six bytes and string variables the length of the string as defined by the Size statement plus two bytes. There appear to be no restrictions on having variable length records in a file but obviously one would have to be very careful how one accesses such a file so as to keep track of the file pointer.

Disc-file integrity is maintained by the operating system. Allocation of file storage space is managed by using a bit-map. That is common to many operating systems, but Famos keeps the bit-map constantly up-to-date. When Famos needs to refer to the bit-map, it is read into a special buffer. It is amended as necessary and then written out immediately. That ensures the bit-map always reflects the state of the disc, although it obviously will slow file accessing.

Bit-map update

The time taken to write 100 256byte records on the IMS 8000 system was 50 seconds, compared with five seconds to read the same records. Many other systems, particularly those designed to use hard discs, hold the bit-map in memory continually and only update the map on the disc just prior to the disc being removed from the system or the system being shut-down.

If the bit-map is not written back before a disc is removed, in the event of a system crash the bit-map is not updated and will not indicate the true state of the disc. If the bit-map is not recovered at the earliest opportunity, data can be lost or corrupted. The file system also prevents two tasks accessing the same record simultaneously by automatically providing record lock-outs.

The physical block size used for disc file accessing is 256bytes for both floppy and hard discs. However, logical records may be any size from one to 65,536bytes. Lock-outs operate on physical blocks, so if there are multiple records to each block in a particular file and one record is being accessed in a particular block, other tasks will be prevented from accessing any records in the block until the first record is released. For cases where records span blocks, Famos provides a method for setting long locks.

GETR and PUTR should be used instead of Get and Put for records which span blocks. These statements control the setting of long locks. There is also a statement ULOCK which forces the removal of long locks from a file although it does not affect the normal block locks.

There are two functions for use with either type of file: POSI allows the program to position the file pointer to the start of a specified block, and CHGF allows a file to be expanded or contracted.

Software Prices

MVT-Famos run-time system	£	475
MVT-Famos Development system including Wordflow	£	1,350
MVT-Wordflow	£	250
CAP-MicroCobol	£	2,650
CP/M	£	95
MP/M	£	395
Omnix	£	495

Both assembler and Basic subroutines may be called by a Basic program. The format for Call is similar in both cases. A control code may be specified in the call. For assembler routines the control code just allows the program to load, retain, release or call routines, as required.

For Basic subroutine calls, the control code allows the routine to be executed and then return to the calling program, or to act like the Chain statement in most other versions of Basic, which transfers control to the new module releasing the calling program. The Call statement for Basic subroutines also has a parameter specifying which variables are to be used for passing values to the subroutine and which are receiving return values.

The Basic subroutine may then have two special statements, a PARM statement listing the variables to receive data from the calling program, and a Return statement listing variables to be returned to the calling program. This last is different from the normal internal subroutine Return statement.

This facility is very powerful — particularly in being able to call Basic subroutines. Despite the format being similar for Basic or assembler calls, there is no danger of confusing the two because the control code for assembler calls is in the range 0 to 4, while for Basic calls, it must be 10 or 11.

For indexed-sequential file access, an assembler program called ISM2 is provided with Famos. It uses a hash index table to locate keys which gives very fast access times when keys are random. The hash index table is held in a key file together with the keys. ISM2 uses a special algorithm to calculate hash values. Each key in the file is pointed to by an entry in the hash index table.

That means the keys can normally be found by using only two reads of the key file. This may be compared to tree-structured index files where keys are stored in successive levels, each level indicating the position in the level below where the key might be found, until one arrives at the lowest level where the keys point to the actual data file.

In this type of structure, it normally requires as many reads as there are index levels to locate the data record. Hash index tables are fine unless there are several keys with the same hash value, when they can become inefficient.

Since new keys are added to the end of the key file rather than being inserted in order, it can be inefficient to produce reports in key order. To sort key files into order, a utility called SUPSORT has been provided. It is claimed to be very fast. The Basic manual quotes 20,000 to 50,000 keys per hour on a hard disc, depending on the ordering of the file and key length.

There is a comprehensive set of development tools for producing assembler programs, including a macro assembler ASMZ, debugging program DBUG, and linkage editor LKED. ASMZ is compatible with 8080 or Z-80 code. DBUG allows the programmer to test assembler programs by setting breakpoints, display and set memory contents, and read and writes data to disc or the terminal.

Word processor

There is also a word-processing package available for use with Famos. Called MVT-Wordflow, it consists of a screen editor and a print program. The editor allows up to three document files to be processed in the same session. Wordflow is very versatile — it features commands for setting rulers, cut and paste of text from one file to another, or within the same file, insertion of control codes to set underlining, boldface, printing of superscripts or subscripts.

Composite characters can also be created and there is a facility for listing processing. Rulers allow the setting of top, bottom, left and right margins, paragraph and word-wrap indenting. Also tabulators can be set which allow left- or right-alignment, or text strings can be aligned on a particular character. So columns of numbers can be printed with the numbers all aligned on the decimal point.

I found the editing commands themselves relatively easy to use, although most of the commands required two control codes to be entered, rather than one. For instance Control D Control C is used to delete a character, and Control V Control B to go to the start of the file.

Some commands are even more complex, but this is not a criticism as they are for special operations like search and replace, or for specifying fields to be inserted when performing list processing. As text is entered or edited, words are often split on the right margin and the display becomes confusing to read. If you want to see the text correctly formatted, Control

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X is the key which must be pressed.

The output program is used to bring the document inserting fields like the date and data from list processing files which must be in a special format.

The documentation provided with Famos was all produced by MVT-Microcomputer Systems. It consisted of a Famos Users' Manual, Wordflow Users' Manual, Program Development Manual, a Basic Programmers' Guide and a MVT-ASMZ Programmers' Manual. On the whole, they were comprehensive and relatively easy to find one's way round, although the programming manuals were not as easy to follow as the user manuals. I noticed some omissions, particularly in the Basic Manual.

The format for the use of GETR and PUTR was not given, for instance. Also some of the manuals would have benefitted from the inclusion of indexes at the back — especially the Program Development Manual and the ASMZ Manual. Also, the Wordflow manual did not have an index, although it had useful lists of all the commands.

Operational configuration

So that I could see an Equinox 200 in operation, Microtek introduced me to one of its customers, Chemical Bank International which has a 32Mbyte system with five Elbit VDUs, a Tally 1602 serial printer and floppy discs for data transfer to an IBM system 32.

The system has 224Kbytes of RAM, 32K for use with each VDU, 32K for use by the system and 32K for use by the batch monitor. Four VDUs are used for enquiries and one for entering file updates.

The system is designed to handle trading in Eurobonds, which are types of securities issued by large multi-national corporations and traded in by banks and other financial institutions. Like other forms of dealing in securities or commodities, this involves a good deal of intense activity at certain times of the day.

During peak dealing times, there must be no appreciable degradation in response to enquiries. Up to 1,000 securities may be held on the system, which is designed to handle up to 350 deals per day, and a record of the previous 28 days dealings is maintained on the history-monthly file.

In a demonstration of the system capabilities selecting all deals for a customer in the past month, it took 21 seconds to locate and display 12 records from 9,800 on the history file.

At about 5 pm each day, the end-of-day program is run to update the daily profit and loss fields, and up to four yields for each security on file. This process takes an average of 12 seconds per security. The calculation of yields, in particular, is very complex as the method used is an iterative process requiring successive approximations to reach the final value.

The technique is to make an initial guess at the answer to the problem and use this value to calculate a new value which is closer to the required result. When the results of two successive approximations are close enough together, within some margin of error, the last value is taken as the correct result. The end-of-day program also updates the history-monthly file with the day's dealings, prints various daily reports and performs the file security copying.

It is a 32Mbyte system because Chemical Bank International required the faster response available, even though it has only 4Mbytes of data. Therefore, it has all its files on the fixed disc and uses the cartridge to copy data.

All that is run under the control of the batch monitor. The bank is lucky in having a night shift operating its mainframe who switch-off the Equinox system when the end-of-day processing is finished, although there is no reason why computers should not be left on 24 hours a day. Indeed, in many cases, leaving a computer on continuously can improve the life of a system.

The bank decided to buy the Equinox 11 months ago, when it had already been waiting six months for an IBM system 38. At that time, it knew there was still a six-month wait for the IBM system and business pressures forced it to look at microcomputer systems. The Bank looked at several systems, including Cromemco, Zilog and DEC 11/23 systems.

The Equinox was the only system which met its criteria, which were to have a multi-user system with a Basic compiler. Having decided on using Equinox equipment in June, 1980 the Bank bought an IMS 8000 system complete with applications package in August. In September, 1980, the Bank decided to upgrade to a hard-disc system and re-designed applications software, which it received on November 15. The staff were very pleased with the Equinox and with Microtek's service and support, and are considering enhancing the system to link into the Geisco time-sharing network.

Conclusions

- **Equinox has a wide range of systems, ranging from small, single-user systems to multi-terminal, hard-disc systems.**
- **The Equinox 200 systems are compatible with the IMS 5000 and 8000 because they use the same processor. With a maximum configuration of 20 terminals, two printers, up to 96Mbytes of hard-disc mass storage and, say, 256Kbytes of memory, which allows 32K for each terminal plus 32 for the operating system and 32 for a batch processor, it is a very powerful system.**
- **I believe there have been some problems with the S-100 bus on the hard-disc systems recently, but they have since been solved.**
- **Equinox also supplies a wide range of operating systems and support software to use with its hardware. None of the software is actually developed by Equinox.**
- **Both the CAP-MicroCobol business operating system, and MVT-Famos are suitable for multi-user business systems. MP/M can also be used but has no file-protection or security features as standard, and neither does it have automatic record lock-outs; these facilities would have to be built-in by the programmer.**
- **MicroCobol seems rather expensive compared to the other operating systems on offer.**
- **Famos is an extremely powerful and versatile operating system well suited to multi-user systems; the user accounting security and file security systems are very useful: Famos has been designed to maintain file integrity as much as possible while allowing multi-user access to files and dynamic file extension and contraction.**
- **The batch-processing and multi-task handling features of Famos are both extremely useful and I would advise having the user-accounting version of Famos even with a single-terminal system so that it is possible to use batch processing; also, the single-user version has no protection against unauthorised people using the system.**
- **MVT-Basic seems to be a reasonable implementation of Basic. Being compiled, MVT-Basic programs run faster than interpreted programs. Transcendental functions are rather slow but they are rarely used in business data processing.**
- **I found terminal input awkward to use in Basic; for many applications, the GBYTE function looks more appropriate than the INPUT statement. I think an Input Line command would have been a useful addition.**
- **File input/output is very flexible but it must be used with caution as ASCII file access and internal format can be used on the same file and also record or byte positioning.**
- **Because of the points described, Famos is not a system for the inexperienced programmer: if you are an inexperienced user who just requires a business system it is best to have the applications programs, or package, provided by an OEM systems house. That is true of most interactive multi-user systems because of the care which must be taken to prevent users updating the same record at the same time, and also to allow those users adequate response. To a large extent, Famos prevents the first problem by using the automatic record locks, but it can still occur if PUTR and GETR are not used for records which overlap blocks.**
- **Wordflow is a useful word-processing package, but I did not like the double-character control codes, and I would have preferred to see a correct display at all times. However, it is a powerful package. The list processing facility is particularly useful for producing multiple copies of letters with different addresses.**

Sharp's cut-above-average MZ-80K hardware

The Sharp MZ-80K computer was first marketed in the U.K. in 1979; before that, it had been available only as a kit in Japan. In the 18 months the machine has been on sale in Britain, the price for a model equipped with 20K RAM has fallen substantially to £380.

THE SHARP MZ-80K is advertised widely, often with an emphasis on its suitability for business or office use. It is also used for laboratory and industrial process control by firms such as 3D Digital Design and Development. Three units are available as part of the MZ-80K package; an input/output interface unit, a dual floppy disc drive and a tractor-feed dot-matrix printer.

The commercial reputation of Japanese firms is based very largely on often clever precision engineering and high-quality control during production. The ability of the Japanese to write ingenious software is, however, less certain.

by John Dawson

The high-quality engineering in, for example, the MZ-80K double-track disc drives may suggest that the Japanese have sought hardware solutions to compensate for their software failings.

The dimensions, weights and power consumption for the review equipment are set out in table 1. The review MZ-80K had been fitted with a Xtal CP/M adaptation. The machine consists of four printed circuit boards: the main CPU board, tape recorder, keyboard, and visual display unit/audio frequency amplifier. The CPU board is the largest and is mounted inside the base of the steel case with the other boards mounted on the upper section of the case.

The power supply is enclosed within a ventilated metal case and is mounted beside the CPU board. Power is supplied through a two-pin connector which is standard for all the units in the system at the rear of the computer and there is a second opening, with a screwed metal cover, which allows access to a 50-pin Scotchflex connector. The CPU bus is brought out to the connector and is the sole signal input and output pathway to the computer — the 50 lines are shown diagrammatically in figure 1.

The MZ-80K has a three-octave sound generator and a real-time clock which is re-set when the machine is switched-on. There are pre-set controls for the VDU and the volume of the internal loud-speaker mounted on the front edge of the printed circuit board below the VDU. The CPU board has vacant connections for a re-set switch.

The steel case of the computer is strongly constructed with a piano hinge connecting the upper and lower sections which are normally secured by four screws. The strut supporting the upper section of the computer when it is opened has a retaining thumbscrew on the lower leg which can be screwed-in to prevent the upper section of the case collapsing accidentally.

	Dimensions			Weight
MZ-80K	41W	47D	28H	13kg.
MZ-80I/O	20	32	13	5
MZ-80FD	20	32	20	7.9
MZ-80P3	41	38	19	10

Software serial numbers	
Sharp/Xtal monitor	SP 1002
Sharp tape Basic	SP 5025
Sharp disc Basic	SP 6015
Xtal CP/M	Version 2.21
Xtal CBasic	Version 2.061

Dimensions are quoted in centimeters and exclude cable-bending radii. Total power consumption for the four units is given as 215Watts.

Table 1. Equipment dimensions.

The visual display unit produces a white-on-black image 40 characters wide by 25 lines deep in an eight-by-eight format. A wide range of graphics characters are available including electronic symbols for drawing circuit diagrams on screen and a good number of games and general-purpose shapes. The lower-case letters have true descenders and there is a pseudo-high-resolution graphics capability which will display 50 by 80 pixels.

Both the stability and definition of the display are excellent, although there was some pin-cushion distortion in the picture symmetry on the review machine, which meant that the last six characters on the right-hand side of the bottom line were almost illegible because they had curved off the screen.

This fault is not apparent on two other newer MZ-80K machines where the picture symmetry is good — good enough for you to take direct photographs of the screen and use them as slides in lectures.

The cassette tape recorder in the MZ-80K uses a pulse-width modulation recording technique and transfers information at 1,200 bits per second. A mechanical tape counter is fitted and the recorder is controlled both by mechanical keys and the system software.

The tape counter is fitted in the cassette recorder and programs or data on the cassette tape can be located accurately and reasonably quickly using the fast forward and rewind controls with the counter. The data-transfer rate for the recorder is impressive — it allows the 14 kilobyte Sharp Basic tape to be loaded in about 1.5 minutes.

On microcomputers, the keyboard and the visual display unit are the interface between machine and user. The level of ambient lighting in an office environment, the reflections from a VDU screen and the angle at which it slopes, the ability to separate the keyboard from the screen so that a typist or operator can be comfortable are all important considerations in designing a machine which will allow a user to operate it for long periods without fatigue or unnecessary strain.

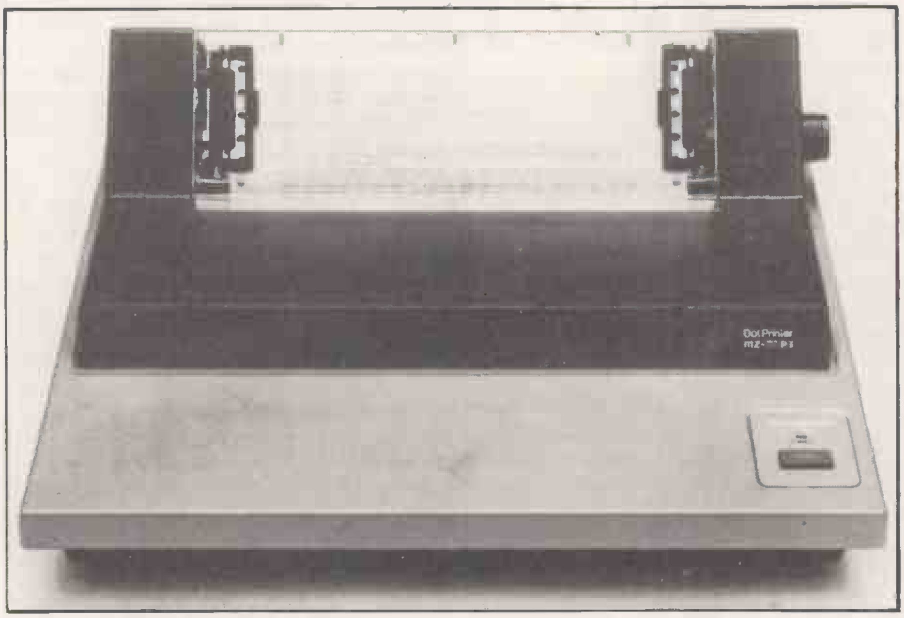
Similarly, a considerable amount of work has been done on the ergonomics of keyboard design and this is apparent now in both computers and word processors from firms like IBM and Logica at one end of the scale to more modest machines such as the Tandy TRS-80 at the other. Those who use keyboards as part of their work develop strong preferences and this allows room for variations such as the extended front on the IBM 5120 machine on which an operator can rest the palm of his hand. These variations are made, however, within well-defined limits of good design.

The keyboard of the MZ-80K is markedly at variance with the rest of the machine, is outside any concepts of good design and surely can be neither intended nor used for serious typing. The spacing of the keys is the same as an ordinary offices typewriter — 0.75in. from key centre to key centre — but the relative positions of the keys are non-standard although the board uses a normal QWERTY lay-out.

In particular, the position normally occupied by the space bar contains the cursor control, carriage return and insert/delete key in addition to a small space key. The key-tops are transparent plastic caps marked with graphics characters as well as the alpha-numeric characters. The main alpha-numeric markings do not stand out clearly enough which makes identification of a particular key more difficult.

Under the original Sharp monitor, the keyboard also has non-standard functions. Lower-case letters are produced after the SML/CAP key has been pressed but the comma and full stop keys then produce characters with umlaut accents. This is an infuriating idio-

The Sharp MZ-80K.



Sharp's MZ-80 P3 dot-matrix printer.

syncrasy whenever text is being entered.

The MZ-80P3 printer is a tractor-fed dot-matrix printer capable of handling paper widths from four to 10in. The normal characters are printed in a six-by-seven dot format and there are no descenders on lower-case letters. The printer will produce double-width characters in a 12-by-seven format and the print-head is driven across the paper by a peg in a slotted drum. This has the important consequence that the print-head must complete a full line's travel however short the line printed. In other words, a line-feed character still requires the print head to traverse the full width of the paper and return.

The print-head prints in one direction only and will produce 80 characters per line on 10in. paper. The printer accepts parallel eight-bit ASCII data and will produce 255 ASCII and graphics characters. There is an 80-character print buffer inside the MZ-80P3 and it is possible to lose the last line of print under some circumstances in which case it may be output, disconcertingly, at the top of the next print run.

The MZ-80FD floppy disc unit contains two 5¼in. single-sided, single-density, double-track disc drives, storing 143 kilobytes per disc. The disc drive mechanisms are very smooth and well made. the 70-track format is unusual and non-standard in the U.K. and means that software which might otherwise be regarded as standard, e.g., CP/M-based programs, is not directly transportable from other machines to the MZ-80K.

Like all the peripheral units forming part of the MZ-80K system, the MZ-80 I/O unit is housed in a smart steel case, containing a five-slot mother board and a discrete power supply unit. The mother board uses double-sided connectors with 30 pins on each side. The pitch of the connector appears to be 0.125in. — a non-U.K. standard. The I/O interface unit is connected to the MZ-80K by approximately 18in. of shielded 50-way ribbon cable.

Part of the MZ-80K configuration is a real-time clock which starts counting from zero when the machine is switched-on. The clock can be synchronised with GMT and could be used to control external devices. If personal computers are to continue their present penetration into the home market, it will be because they are seen to have a useful function around the house.

Machine durability

The computer will have to run continuously — with tighter electrical-engineering and safety requirements — if, for example, it is to operate a burglar alarm, deal with incoming telephone calls, process the family budget, and act as a facsimile transceiver for letters and mail-order catalogues. The MZ-80K and its peripherals ran continuously for three days during the review period without signs of overheating or distress in any of the units.

Software has two important parts; the program itself and the accompanying documentation. Good documentation is not the myth it often seems to be and companies such as Hewlett-Packard, IBM and Rockwell produce excellent written explanations to support their products. The U.K. armed forces also understand the importance of clear, simple and concise English in their instruction manuals.

Comment on the CP/M manuals supplied with the Xtal adaptation for the Sharp should start on a long rising note of hysteria and frustration. The abundance of jargon and virtual absence of worked examples throughout the CP/M documentation made the system almost wholly obscure for a user without access to a source of CP/M folklore.

Moreover, the CP/M 2.21 version fitted to the MZ-80K is still cluttered with sediment from the past. CP/M originated, for example, with machines which used Teletypes for input and output. Consequently, the delete key on the Sharp repeats characters entered on a line in

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reverse order, erasing them from the line memory at the same time. To correct a mistyped letter in the word MUSACBOX, you must either delete the whole line or delete and type the following:

MUSACBOXXOBCAICBOX

which is then entered as MUSICBOX. The Research Machines CP/M version 1.4 has a patch which simply erases a letter when the delete key is presed and I wonder how this anachronism has survived into the 2.21 version offered by Xtal.

More seriously, the assembler/disassembler included on the CP/M disc is an 8080-based program which demands that the user should learn a new set of mnemonics, also denying the use of the additional Z-80 specific instructions, many of which are particularly powerful. When the disassembler is used to list Z-80 code, it produces the results shown in figure 2 in which the double question marks presumably indicate instructions beyond the scope of the disassembler.

Figure 2.

```
DDT VERS 2.2
?
-L1200
   1200  CALL 1BDA
   1203  MVI  C,01
   1205  CALL 1BC9
   1208  LXI  B,1DF7
   120B  DAD  B
   120C  SHLD 1C3F
   120F  NOP
   1210  LXI  H,06A4
   1213  MVI  A,FF
   1215  XRA  M
   1216  MOV  M,A
-L
   1217  JMP  0705
   121A  NOP
   121B  NOP
   121C  NOP
   121D  NOP
   121E  NOP
   121F  NOP
   1220  ??=  20
   1221  SUB  B
   1222  NOP
   1223  MOV  B,B
-L
   1224  NOP
   1225  ??=  08
   1226  LXI  H,9210
   1229  ??=  10
   122A  LXI  H,4212
   122D  MOV  C,B
   122E  NOP
   122F  DAD  B
   1230  ??=  10
   1231  STAX B
   1232  MOV  B,B
```

Research Machines, once again, has written a Z-80 assembler called ZASM for its own CP/M package. I found the editor program difficult to use and, when I was unable to make one instruction perform any function at all, the manual compounded my confusion.

One good feature in the CP/M adaptation to the MZ-80K made by Xtal is its modest claim to have made "what we consider to be some standardisations and improvements on the . . . keyboard". The SML/CAP key toggles between upper- and lower-case and lower-case characters are given their normal ASCII value. Full stops and commas can be typed normally in both upper- and lower-case mode and, as far as is possible by altering software, the keyboard is greatly improved when the machine is running CP/M.

Xtal supplies the Rodney Zaks CP/M handbook with Xtal CP/M discs and manuals. Although the book provides an alphabetic list of CP/M commands presented consistently, the text is often a paraphrase of the original manuals rather than a complementary overview and introduction to the system.

Tape Basic

The Sharp tape Basic is supplied with the machine so the main question in a review must be whether the additional cost of the Xtal Basic is worthwhile.

Without sacrificing any instructions or suffering any loss of speed, the Xtal Basic occupies 5K less RAM. There are more than 12 additional commands packed into the reduced interpreter including the following:

DEEK	DOKE
PRINT @	ON ERR GOTO/GOSUB
WAIT	SPEED
POP	POS
AND OR and NOT	
IF THEN ELSE	

The Xtal Basic works with six significant figures instead of eight, but has an extended exponential range. The PRINT @ command in the Xtal Basic allows graphs and tables to be plotted easily on screen and is accompanied by less snow than the more primitive Sharp POKE command. A disadvantage for some prospective buyers will be the lack of any printer routine in the Xtal Basic.

The documentation with the Xtal Basic tape consisted of a printed pamphlet describing the general features of the language and its application to the Nascom computer and a photocopied booklet setting out modifications specific to the Sharp version.

There are instructions for adding to the Basic instruction set in the original Nascom booklet and the conversion

A		B
A15	1	G
A14	2	INT
A13	3	G
A12	4	MREQ
A11	5	G
A10	6	IORQ
A9	7	G
A8	8	RD
A7	9	G
A6	10	WR
A5	11	G
A4	12	M1
A3	13	G
A2	14	HALT
A1	15	G
A0	16	RESET
G	17	G
D7	18	G
D6	19	G
D5	20	G
D4	21	G
D3	22	G
D2	23	G
D1	24	G
D0	25	G

Mark

Bus Connector Detail

Figure 1. MZ-80K connection details for the 50-way system bus.

leaflet supplied with the tape has some information about port numbers, relevant memory locations and an example of a printer subroutine. A major advantage of the Xtal Basic is the additional program — Xtalbug — which allows machine-code modifications and insertions to be made to the Basic interpreter. The facility is powerful, well worth having, and a complete contrast to the jealous approach taken by Sharp, which prohibits the user from taking even a security copy of the master tape, both in writing and in the software.

Also on the second side of the Xtal tape is a conversion program for translating programs recorded in Sharp Basic to Xtal Basic. The program worked successfully although the one command not translated — GET — required some syntax changes in the converted program. There are suggestions for modification in the Xtal manual.

The major improvement in disc Basic is that it permits sequential and random-access storage of data on disc and contains two commands — CHAIN and SWAP — which allow whole programs to be called from a disc, with execution and existing variables transferred to the new program. The SWAP command returns the first program to the CPU at the completion of the second, and the first program continues its execution.

The error handling of the disc Basic is enhanced greatly in comparison to the tape version. There are one or two additional instructions but no PRINT USING command or IF THEN ELSE, both of which might have been expected in a disc version.

Conclusions

- The MZ-80K is mechanically and electrically well designed and constructed with the exception of the keyboard.
- Particularly at discount prices, the machine offers an impressive specification.
- Although the machine has no inherent input/output capability, the Sharp bus is well buffered and is readily available for proprietory or home-built expansion units.
- The machine needs a re-set switch for assembly language and machine-code programming as there is no way out of loops or Halt (76H) instructions other than by switching the machine off, when the RAM contents are lost.
- A volume control on the outside of the case would improve the usability of the computer.
- The MZ-80K, floppy disc, printer combination can be locked up in too many ways; for example, if by accident, there is stored in a disc directory two quotes without an intervening space, "", attempting to save any file by any name gives error 42, i.e., tried to register under an existing name.
- The price/performance ratio of the Sharp peripherals is not in the same class as the MZ-80K itself. The MZ-80 I/O interface unit is expensive for what it does and although the floppy disc unit is well made, it also looks expensive in comparison with other reputable units.


The MZ-8FD floppy disc unit.

- The printer matches the system both in its graphics set and styling but is definitely not in the van of equipment.
- There is often much to be said for using a well-tried and reliable design rather than a bug-ridden designer's dream and in those terms, the MZ-80P3 is a successful, hard-working printer but as such, its price is high.
- The Xtal Basic tape is good value for money, releasing RAM and offering an enhanced instruction set.
- When Xtal incorporates a standard printer routine into its tape Basic, I hope it will include a command to print the contents of the VDU screen — a comparatively rare but valuable facility lacking in both the Sharp versions of Basic.
- The Sharp Basic manuals are bad translations but offer many examples to illustrate individual instructions and programming techniques.
- The service manuals for the MZ-80K and printer are excellent — a stark contrast — containing fault location flowcharts, test programs and waveform illustrations for various test points as well as the usual circuit diagrams.
- The Sharp machine language manual is good apart from poor-quality translation.
- The Basic Sharp system back-up is not the worst of its kind but it is far from adequate and cannot match in any way the documentation supplied with, for example, the Apple II.
- The keyboard prohibits the use of the MZ-80K in any environment where typists will switch from a normal typewriter to the computer and back again.
- A word-processing package for the MZ-80K would appear a wasted effort as the machine does not seem suitable for business use of this kind.
- On the other hand, the bus is well buffered and the computer strongly constructed, and with the addition of D-A and A-D converters of the kind produced by 3D Digital Design and Development among others, the MZ-80K offers good hardware value for laboratory workers who wish to control experiments and for engineers, most of whom will be unable to touch type.

Versawriter II: an inexpensive line in graphics drawing

VERSAWRITER II is a low-cost — about £150 — add-on peripheral for the Apple II. It consists of a perspex sheet attached to which is a pivoted arm and cursor point. The arm is connected via a ribbon cable to the games input/output socket inside the Apple. In addition to the hardware, there are two floppy discs containing the software routines for sensing and driving the drawing tablet. The product requires a 48K Apple with two floppy disc drives and ROM-based Apple-Soft. A 12-page manual is provided.

Versawriter reproduces the movement of the cursor on the perspex tablet on to the screen under the control of the Apple using high-resolution graphics mode. The cursor movement is translated by the x and y movements which are detected by two potentiometers mounted in the pivots of the cursor arm.

by Mike McDonald

Apart from just drawing pictures on the screen, shapes may be defined and stored away in shape tables and may be recalled at will to be used to assemble a picture or diagram.

On loading the master program from disc a main menu offers the following functions:
1. Draw with Versawriter
2. Calibrate system
3. Recall a stored picture
4. Catalogue this disc
5. Add text to picture
6. Calculate area and distance
7. Electronic drawing
8. End session

Our first job was to calibrate the system. A calibration chart is provided and had to be mounted on the tablet — it has a transparent cover sheet under which documents may be placed — and the calibration program prompts for a series of alignment movements with the cursor arm.

The parameters of the alignment are stored on the master program disc for future reference. We were then able to select the "draw with Versawriter" option from the menu. This option caused a program to be loaded offering the following functions:

P point cursor — draw line
S scale of drawing
T transfer picture to disc
R recall picture from disc
C centre on screen current point
F smoothing factor
E erase screen
Z colour closed figure in current colour
D draw with brush or edit
M make a shape table
I inspect shape table
L list of commands
Q quit program
Colours: W white
O orange
G green
0 black
B blue
V violet

If you hit any key, the screen blanks and displays a tiny flashing pixel — picture element — to represent the position of the cursor. Any of the commands given, may then be entered through the keyboard to affect the display. If left in its default mode, the cursor flashes and follows any movement entered via the cursor on the tablet assembly.

If a colour key — i.e., the letter representing the colour — is hit any movement is then reproduced as a solid line in the appropriate colour on the screen. A solid line will continue to be produced until the P key is hit to release that function. The scale of the movement may be magnified through the "S" option and a scaling factor between 1 and 5 may be entered. Movements are then multipled by this on the screen.

The smoothing factor is a damping effect which reduces any jerkiness of movement or sudden change in direction. Having drawn a few random patterns on the screen, one option is that closed shapes may be filled with colour automatically. This is achieved by placing the cursor point in the area to be filled and selecting option "Z". The user is then prompted for a colour number and offered a test fill or reversed-out background before proceeding. The facility seemed to work well except that very irregular shapes were not filled completely.

The draw with brush allows a brush size between 1 and 5 to be defined and results in a pulsating blob which can be moved around, depositing any selected colour as it goes. Once a picture has been produced, it may be saved on disc — this did not

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work very well in our case — and subsequently recalled. The screen is erased by entering "E" and confirmation that you want to blank all efforts.

Shape tables may be created and used and this is where Versawriter becomes a more viable proposition for commercial applications. A number of shape tables is provided on disc, including electrical shape, electronic shapes, geographic shapes, chemical symbols, chemical apparatus, landscape shapes, plumbing shapes, and so on.

A picture may be formed up on the screen of a series of specific shapes or items while in the drawing mode. Once complete, the items may be compiled one by one for storage into a shape table. The shape table may then be accessed and will allow the user to step through the stored shapes and dump each shape on to the screen wherever the cursor is positioned.

Hence, from the electronic shape table, we were able to produce reasonably sophisticated circuit diagrams at high speed with little or no drawing ability. The applications here are endless for any profession or discipline which utilises drawings or diagrams.

We loaded an electrical shape picture an put a series of shapes into a table. The screen is cleared and the table recalled with the I function. The bottom of the display shows the following options:

S scale = 1
D drawing number 1 or CTRL D
X fix S   Y fix Y   U undraw
R rotate

When you call a shape table on to a blank screen, the first shape stored is flashed on the screen continuously at the present cursor location. By pressing the space bar, it may be deposited in its position as a drawn object. Otherwise, some of the options may be used to alter its characteristics.

The scale may be increased although we found that irregular shapes lost quality once enlarged past double their table size. If R is pressed, the shape rotates through 45 degrees and will continue to do so if R is held down. D causes the system to move on to the next shape in the table in a sequential fashion or control d allows the user to go directly to a specific shape number.

Either an X axis or Y axis may be set and fixed with the X and Y function keys. That is very useful if creating regular shapes and diagrams and produces a neat picture. Once an axis is set, cursor movement will be possible only along it. N returns the user to normal movement.

There is also an undraw or U option whereby a mistakenly-placed shape may be removed by placing the same shape over it and pressing U. This masks the offending part of the diagram. You must put the blanking shape exactly on the old version to obliterate it completely.

Three shape tables on the master disc where English, Greek, and Electronic shapes. The English and Greek were alphabets which could be used to label diagrams. Hence the system could be used for foreign-language character generation. Once the shapes have been accessed and used to form a picture, the user may return to the normal free-hand mode of drawing to make additions, amendments, or deletions. The resulting picture may then be stored on the disc.

In addition to using a text shape table to put letters on diagrams, there is also an "add text to picture" function which allows the user to type directly in through the keyboard labels of varying size and colour, again positioned with the cursor.

There was a very interesting routine on one of the discs which produced standard shapes for drawing i.e., triangles, squares, rectangles, rhomboids, trapezoids, and so on. Each shape was defined by selecting a letter and the cursor was then placed at the start position and end position. Versawriter would do the rest.

We were able to create some amazing multi-dimensional diagrams with very little effort and the feature is a dream come true for those who have ever had to produce an isometric drawing of a complex shape in engineering drawing classes.

Another facility of the package is a calculate area and distance function. This routine allows the operator to draw a picture or recall a picture on to the screen and then proceed to map the form through scaling calculations.

A scale is calibrated in terms of the two extremes of movement of the cursor on the screen and the user is prompted for a scale factor and the units of scale, for example, 10m. Any subsequent cursor movement is measured and a display given of distance — or perimeter in the case of a closed object — and an area calculation may be requested to produce a square measurement of an enclosed shape.

Demonstration programs are provided with the package and produce some amazing pictures someone surely spent years producing.

Conclusions

- **Versawriter would appear to be an extremely useful facility for the educational market and possibly the commercial market if there were some way of producing an enlarged hard-copy print of the screen.**
- **With the several versions supplied to *Practical Computing*, we had difficulty storing a picture on disc and retrieving it again intact.**
- **The programs also suffered from a lack of consistency which, was somewhat irritating at first.**
- **The screen graphics are certainly of a good quality and some very complex diagrams and pictures can be produced with a little patience and a good deal of practise.**
- **Notes are provided for those interested in producing their own programs for use with the drawing tablet.**

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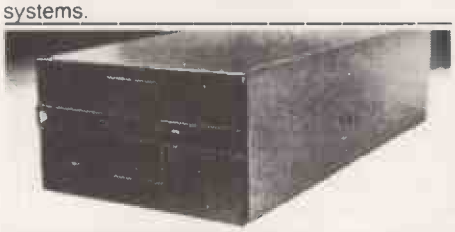

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THINKING SYSTEMS

Drawing on examples which range from the laws of supply and demand to sociology, Boris Allan shows how mathematical techniques can bring feedback into computer programs.

MY SUBJECT matter is not easily specified. Consider what Thinking Systems could mean:

- Systems which think
- Thinking using a systems approach
- Thinking about systems
- Thinking systematically

There are many meanings to the word system and this quotation from Jorge Luis Borges highlights the abstractness of these many ideas of system.

> A system is nothing more than the subordination of all aspects of the universe to any one such aspect. *Tlon, Uqbar, Orbis Tertius.*

The way in which I approach the topic means learning by doing; and I hope to stress the integrity of the approach by showing how graphs, mathematics, paths, and programs all say the same things. I shall look in detail at two examples, and

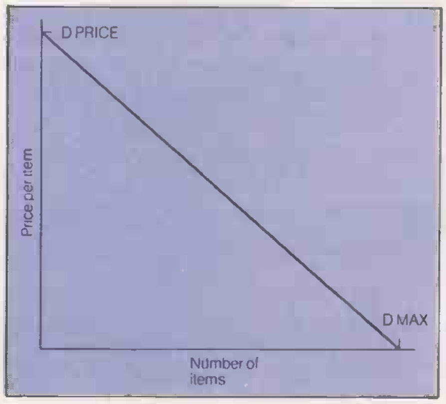

Figure 1. A demand curve.

show how we have to reduce the universe to the system we are studying. Following the examples, I give definitions and explanations of some system concepts.

We shall start with an example which appears in the teaching of economics at all levels, from CSE upwards. Consider the following hypothesis:

- The less a commodity costs, the greater the number of items of that commodity will be desired.

or, the lower the price of a retailer's microcomputers, the more people will buy from him. However, there is a limit to the number of, say, TRS-80s people can use, even if they are given away. We show this in economics by a demand curve with price on the y axis and the quantity of items demanded on the x axis. The curve is one which slopes down from top left — high price, no demand — to bottom right — low price, high demand. A specimen demand curve is shown in figure 1.

The next hypothesis to consider is:

- The greater the price at which a commodity can be sold, the greater the number of items which will be produced

or, the greater the price that computer games for the Pet fetch, the greater the number of computer games for the Pet produced. That can also be shown on a graph: a supply curve with price on the y axis and the quantity of items supplied on the x axis. Figure 2 shows how the curve slopes upwards from bottom left — minimum price, no supply — to top right — high price, high supply.

A classical French economist Le Say formulated a law about supply and demand. Economists, being of an original turn of mind called it Say's Law:

- Supply creates its own demand

or, if you swamp the market with useless software, there is a price at which some fool will buy some.

If we look at these two curves in conjunction, we begin to see the operation of a market. Say's Law suggests that if we supply a large number of items, the price charged for those items will be the one given for that number of items on the demand curve. The two curves are amalgamated in figure 3.

Suppose that S(0) items are produced — because the producers think the items will each fetch a price of P — then "as supply creates its own demand" the number of items sold will be D(0) where D(0) = S(0), but the price for each item will be P(0) and not P. As P(0) is less than P then the suppliers have done less well than they predicted. This is the story told by figure 3.

Continuing a little: the producers will only produce S(1) items at a price of P(0), but the demand (D(1) = S(1)) for this

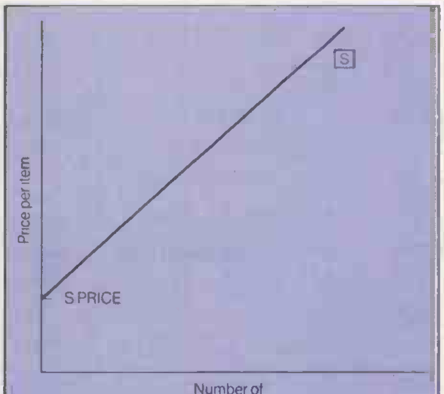

Figure 2. A supply curve.

number of items is such that the price each fetches is P(1) — and P(1) is greater than P(0), so the suppliers have done better than they expected. This continues until the point of intersection of the curves is reached — that point is the equilibrium price for those supply and demand curves.

At one time, the supply-and-demand mechanism was thought to assure a fair, i.e., equilibrium, price for all goods. That is, subject to random fluctuations, or the shapes of the curves changing over time. For our purposes the key, and erroneous, conclusion from graphs such as figure 3

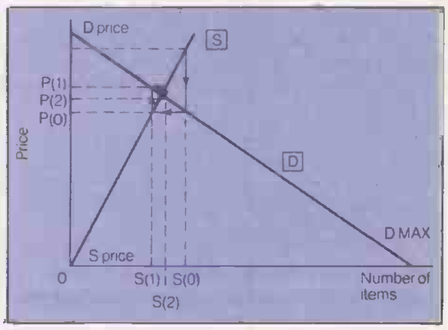

Figure 3. Supply and demand curves.

was that the path of price and supply changes always spiralled in to the equilibrium point.

An astute reader will see that this is not necessarily true, and the program, Say's Law, is designed to investigate just this phenomenon. First, however, some computer use is demanded.

To gain some practical experience of supply and demand before we learn more about its theory, we shall use the program, Say's Law. It is written in Applesoft Basic for the Apple II, and though such commands as HOME, i.e., clear screen and GET, i.e., input a character from keyboard, without echoing, are not common to all Basics, the logic is clear, and the REMarks copious. If the multi-statement lines are too long for, say, Pets, space out the statements — I have left 20 between line numbers.

The Say's Law program is a simulation of what the classical market is supposed to be — the equations, as programmed, try to copy what happens under the classical scheme or model.

When you run the program, in response to the first query set, your maximum demand to 100. You will then be told that the demand equation is

. . D(T) = 100 — 1*P(T)

and you will have to wait for the next subsection to discover what that means. You will then tell the machine that the Supply Gradient is .2. The supply equation will be given as

. . S(T) = 10 + .2*P(T—1)

Multiplier = —.2		
Time	**Price**	**Supply**
0	50.00	50.00
1	80.00	20.00
2	74.00	26.00
3	75.20	24.80
4	74.96	25.04
5	75.01	24.99
6	75.00	25.00
7	75.00	25.00

Table 1. Quick convergence to equilibrium.

with some mysterious quantity called the Multiplier being equal to (.2)/(—1) or —.2. You will have set up two lines: the supply curve, and the demand curve with the equations given. These two lines will intersect at a certain equilibrium point and you will be informed that the Equilibrium Supply is 25. The next stage in your ride comes when you are asked how much is sold in year zero, to which you should answer 50.

A table under three headings is formed. The first heading is Time, period, the next Price, at which items are sold, and third heading is Supply — of items. This simulation starts at Time 0, Price 50, and Supply 20; and at Time 2, Price is 80, and Supply — based on the price of 50 in the last time period — is 20.

To continue output of results,,hit any key, except F. F stops output of that series and the user can re-run using different values. When Time period 7 has been reached, the Price has stabilised at 75, and the Supply has stabilised at the equilibrium supply of 25 — see table 1. The classical economists would be satisfied with this result.

If the program is re-run with a maximum demand of 100, a supply gradient of .8 — giving a multiplier of —.8 — and a supply in year zero that is not 50 — because 50 is the equilibrium supply — then, even after 30 time periods, the supply and price are still not quite stable. I show this in figure 4, which graphs Supply against Time. A supply gradient of .95 is even longer in reaching equilibrium — try it.

For fun, try a supply gradient of 1 — still keeping the maximum possible demand at 100 — with an initial supply of 80. Supply alternates between 80 and 30, with price alternating between 20 and 70 — our spiral has become a rectangle. Not so re-assuring for the classical economists as our earlier simulations.

When the supply gradient is 2, the equilibrium supply is 70 — for a maximum demand of 100 — the multiplier is —2. If we start with a near-equilibrium supply of 72, then after five time periods, the supply should be 134 which exceeds the maximum possible demand — which is 100 — a highly unstable result which would not please the ancients.

Try various combinations of maximum demand, supply gradient, and initial supply, to see if you can discover what makes a system stable or unstable. In doing so, you will be studying a phenomenon which in economics is called the cobweb model, and is called negative feedback in other fields.

As we are dealing with quantities which vary over time, we emphasise the dependence on time by indexing our variables: P(T) is the price at which items are sold at time T; S(T) is the number of items supplied at time T; and D(T) is the demand for items at a price of P(T) — Say's Law postulates that D(T) must equal S(T).

The demand line shown in figure 1 has the following equation which demonstrates

1. D(T) = DMAX — DCOEFF*P(T)

with DMAX being the maximum possible demand, and the gradient DCOEFF being given by

.. DCOEFF = DMAX/DPRICE

where DPRICE is the price at which demand is zero. The supply line stretches upwards without any clear limit, unlike the demand line. The supply equation is

2. S(T) = SPRICE + SCOEFF*P(T—1)

with SPRICE being the price at which supply is zero, and SCOEFF is the gradient of the supply line — see figure 2. P(T—1) is the price level of the previous

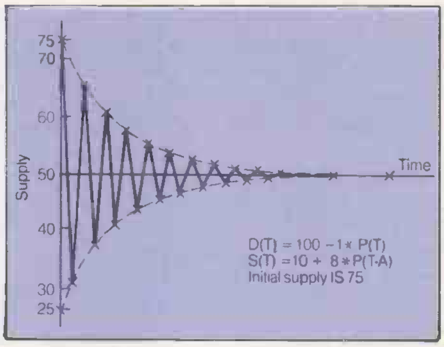

Figure 4. Reaching equilibrium.

period which influences the present level of supply.

If we add the further equation D(T) = S(T), equation 2 becomes

3. D(T) = SPRICE + SCOEFF*P(T—1)

and when equation 1 is re-arranged we produce

.. P(T) = DMAX/DCOEFF — D(T)/DCOEFF

so that

.. P(T—1) = DMAX/DCOEFF — D(T—1)/DCOEFF

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```
100  REM
110  REM ***********************
120  REM
130  REM
140  REM  S A Y ' S   L A W
150  REM
160  REM  A SIMULATION PROGRAM
170  REM
180  REM
190  REM  BY
200  REM
210  REM  G J BORIS ALLAN
220  REM
230  REM
240  REM ***********************
250  REM
260  REM THIS PROGRAM IS ONE OF
270  REM THE SET TO ACCOMPANY
280  REM
290  REM
300  REM T H I N K I N G
310  REM S Y S T E M S
320  REM
330  REM ALL RIGHTS IN THIS
340  REM PROGRAM ARE RESERVED.
350  REM
360  REM (C) G J B ALLAN, 1980
370  REM
380  REM ***********************
390  REM
400  REM
410  REM
1000  DEF  FN F(X) = ( INT (100 * X + .5) / 100)
1020  DIM S(30),P(30): REM  'S' IS THE SET OF QUANTITIES SUP
     PLIED, AND 'P' IS THE CORRESPONDING PRICE. BY ASSUMPTIO
     N - SAY'S LAW - DEMAND ALWAYS EQUALS SUPPLY
1040 DPRICE = 100:SPRICE = 10: REM   DPRICE IS PRICE AT WHIC
     H DEMAND IS ZERO AND SPRICE IS PRICE AT WHICH SUPPLY IS
      ZERO
1060  HOME : GOSUB 1840: PRINT "WHAT IS THE MAXIMUM POSSIBLE
     ": PRINT "DEMAND (BETWEEN 100 AND 10000) ";: INPUT DMAX
     : IF DMAX > 10000 THEN 1060
1080  IF DMAX < 100 THEN 1060
1100  GOSUB 1840:DCOEFF = DMAX / DPRICE: PRINT "DEMAND EQUAT
     ION IS :": PRINT : PRINT  TAB( 5);"D(T) = ";DMAX;" - ";
     DCOEFF;"* P(T)"
1120  GOSUB 1840: PRINT "WHAT IS THE SUPPLY GRADIENT": PRINT
     "(GREATER THAN ZERO) ";: INPUT SCOEFF
1140  IF SCOEFF < 0 THEN 1120
1160  GOSUB 1840: PRINT "SUPPLY EQUATION IS :": PRINT : PRINT
      TAB( 5);"S(T) = ";SPRICE;" + ";SCOEFF;"* P(T-1)": GOSUB
     1840
1180  GOSUB 1840: PRINT "MULTIPLIER = (";SCOEFF;")/(-";DCOEF
     F;") = "; - SCOEFF / DCOEFF: GOSUB 1840
1200  GOSUB 1840: PRINT "EQUILIBRIUM SUPPLY IS ";(DMAX - SPR
     ICE) / (DCOEFF + SCOEFF) * SCOEFF + SPRICE: GOSUB 1840
1220  PRINT "HOW MUCH IS TO BE SOLD IN YEAR ZERO ?": PRINT "
     (REMEMBER THE MAXIMUM POSSIBLE": PRINT "DEMAND IS ";DMA
     X;") ";: INPUT S(0)
1240  IF S(0) <  = DMAX THEN 1280
1260  GOSUB 1840: PRINT "SUPPLY IS GREATER THAN MAXIMUM": PRINT
     "DEMAND, SO ";S(0) - DMAX;" ITEMS ARE NOT USED": GOTO 1
     220
1280 P(0) = (DMAX - S(0)) / DCOEFF: REM   PRICE AT TIME ZERO
      ASSUMING ALL THE SUPPLY IS TAKEN
1300  IF P(0) > SPRICE THEN 1340
1320  GOSUB 1840: PRINT "THE PRICE (";P(0);") IS LESS THAN "
     : PRINT "THE MINIMUM SUPPLY PRICE (";SPRICE;")": PRINT
     "SO THE MARKET COLLAPSES ": GOTO 1220
1340  GOSUB 1840: PRINT "TIME","PRICE","SUPPLY": PRINT
1360  PRINT 0, FN F(P(0)), FN F(S(0))
1380  FOR T = 1 TO 30
1400 S(T) = SPRICE + SCOEFF * P(T - 1): IF S(T) <  = DMAX THEN
     1480: REM  CALCULATE THE NEW LEVEL OF SUPPLY
1420  GOSUB 1840: PRINT "SUPPLY EXCEEDS MAXIMUM DEMAND": PRINT
     "BY ";S(T) - DMAX;" ITEMS, THUS MARKET COLLAPSES": PRINT
     "DO YOU WANT A RE-RUN (Y/N)?": GET A$: IF A$ = "Y" THEN
     1040
1440  IF A$ = "N" THEN 1800
1460  GOTO 1420
```

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which, on substitution in equation 3, gives the result

4. D(T) = (SPRICE + DMAX/DCOEFF) — (SCOEFF/DCOEFF)*D(T—1)

This is fundamental: equation 4 shows how demand at time T can be exactly predicted at time T—1, and how a variable feeds back on itself to alter its own future value, though perhaps indirectly as in this case. We can also notice the key element in this fundamental result — the size of the multiplier, i.e., (SCOEFF/DCOEFF), would seem to be crucial.

Those who have tried the program will recognise the importance of the multiplier. I am using the names of the variables in the program in this mathematical section, as far as is possible, so that direct correspondences can be made.

If equation 4 is true, equation 5 must be true:

5. D(T—1) = (DPRICE + DMAX/DCOEFF) — (SCOEFF/DCOEFF)*D(T—2)

and a combination of equation four with five produces an interesting result

.. D(T) — D(T—1) = — (SCOEFF/DCOEFF) *(D(T—1) — D(T—2))

which explains many things. The left-hand side of this last equation equals the difference between successive values of the demand (D); and, if we define DDIFF(T) to be D(T) — D(T—1), then suddenly

6. DDIFF(T) = —(SCOEFF/DCOEFF)* DDIFF(T—1)

or, successive differences in the values of demand are in a constant ratio —(SCOEFF/DCOEFF). So: if the multiplier is between 0 and —1 in value, the series converges to a fixed value. If the multiplier is less than —1, the series diverges — and at —1 the series alternates between two values. The justification for these assertions lies in mathematical analysis work concerned with the sums of power series.

Equation 6 defines negative feedback:

- Negative feedback occurs when a change in value over one period produces a change in value in the reverse direction for a later period — for some series of values.

and from our investigations in practice, and in theory, we are able to define

- Simple stable negative feedback generally occurs when the multiplier for successive differences is between — but not equal to — 0 and —1 for some series of values.
- Simple unstable negative feedback generally occurs when the multiplier for successive differences is less than —1 for some series of values.

The term negative feedback does not mean adverse feedback, or stable feedback: negative feedback is defined by the sign of the multiplier, and the consequences are ours to evaluate.

Consider the three following cases:

A. A pupil, D, is perceived by her teacher, O, to be of above normal intelligence. O expects, therefore, more from D, and this affects the way he acts towards D. The result of O's behaviour is that D is encouraged in her work, does better, and thus begins to appear relatively more intelligent. This apparent increase in ability by D reinforces O's belief in her intelligence, and so he encourages D even more — and so the story continues. This case is so common in schooling that it has been given the name, the self-fulfilling prophecy, by sociologists — that is, if you act as if someone is intelligent then frequently the person begins to act more intelligently.

B. People in the industrial society, D's, have many, too many, illnesses. Administrators and politicians, Os, perceive the illness of the Ds, and the Os decide to increase expenditure on technological medicine. Unfortunately the result of the increased amount of technological medicine, e.g., more large hospitals with centralised facilities, at the expense

(continued on page 78)

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```
1480 P(T) = (DMAX - S(T)) / DCOEFF: IF P(T) > SPRICE THEN 16
     00: REM  PRICE AT NEW LEVEL OF SUPPLY
1500  GOSUB 1840
1520  PRINT "NEW PRICE AT A SUPPLY LEVEL": PRINT "OF "; FN F
     (S(T));" PRODUCES A DEMAND AT A": PRINT "PRICE OF "; FN
     F(P(T));" WHICH IS LESS THAN": PRINT "THE MINIMUM PRICE
      FOR SUPPLY": PRINT "OF ";SPRICE;" - THE MARKET COLLAPS
     ES"
1540  PRINT "DO YOU WANT A RE-RUN (Y/N)?";: GET A$: IF A$ =
     "Y" THEN 1040
1560  IF A$ = "N" THEN 1800
1580  GOTO 1520
1600  PRINT T, FN F(P(T)), FN F(S(T)): GET A$
1620  IF A$ <   > "F" THEN 1700
1640  GOSUB 1840: PRINT "DO YOU WANT A RE-RUN (Y/N) ?";: GET
     A$: IF A$ = "Y" THEN 1040
1660  IF A$ = "N" THEN 1800
1680  GOTO 1640
1700 TCOUNT = T: REM  'TCOUNT' CAN BE USED IN GRAPHICS ROUTI
     NES, ETC.
1720  NEXT T
1740  GOSUB 1840: PRINT "DO YOU WANT A RE-RUN (Y/N) ";: GET
     A$: IF A$ = "Y" THEN 1040
1760  IF A$ = "N" THEN 1800
1780  GOTO 1740
1800  GOSUB 1840: GOSUB 1840: PRINT "*******   PROGRAM ENDS
      *******": GOSUB 1840: GOSUB 1840: REM  A GRAPHICS ROU
     TINE CAN BE INSERTED AT THIS STAGE, USING 'S', 'P', AND
      'TCOUNT'
1820  END
1840  FOR I9 = 1 TO 3: PRINT : NEXT I9: RETURN
```

• Circle No. 163

(continued from page 76)
of small neighbourhood, cottage hospitals, is to increase illness of the Ds. This increase in illness of the Ds leads the Os to increase expenditure on the high-technology medicine — which in fact produces illness. This is a condensed version of a series of arguments about medicine and health care in industrial society. These arguments are often phrased in terms of social iatrogenesis, medical nemesis, small is beautiful, etc.

C. A group of young people, Ds, are perceived by some police officers, Os, to be behaving suspiciously — the Ds are labelled as potential or actual delinquents by the Os. The Ds react towards this perceived antagonism of the Os by becoming more delinquent. The increase in deliquency by the Ds produces, of course, an increased level of harassment and surveillance by the Os. I do not think I need continue the story called in sociology deviance amplification, or the cycle of deviance.

What can we say about these three cases, other than that they are systemically almost identical? All three show that social behaviour can contain intrinsic conflict — whereas the economic model assumed an equilibrium state at the end, these cases all seem to point towards an unstable end.

In cases B and C, the result is contrary to that originally intended by the Os: in B illness is increased rather than decreased as a result of the action of the Os — though many dispute this. In C, delinquency is increased rather than decreased for this group of Ds — though in other cases, the action of the Os will have the desired effect.

In society in general, this conflict of expectations, and actions, is far more common than one would think despite the emphasis one finds in the relevant literature on negative feedback at the expense of positive feedback.

Nothing is that simple. We saw with negative feedback that we could have very unstable systems, and so we find with the cycle of deviance that stability can be reached — and it is the system multiplier that matters. Before you go any further just think back to Say's Law.

Deviance amplification

We have isolated two elements, the Ds and Os, and have seen how the value of some characteristic of the Ds, and the value of some characteristic of the Os, are mutually dependent; what are relevant elements and characteristics for the simple market? Details of how the program, deviance amplification, is structured can be seen from the REMarks, and the mathematical analysis I shall give.

The program uses the general term deviance for what in the examples A, B and C were different things — perhaps that is why one side was always called D? In A, the deviance might be measured in IQ points above some norm. In B, the deviance might be measured in terms of some compound health index greater than some idea of what would be an acceptable value for the health index.

Finally, in C, the deviance might be measured in terms of some compound quantity made up of age, colour of skin, number of convictions, and type of neighbourhood. Most of our deductions from these models are qualitative, and the ideas are more important than the numbers.

In the program, we have "other(s)" who have a social reaction to deviance — called Os in the examples. For A, the reaction can be measured in some form by an index of teacher encouragement above the average. In B, the reaction can be measured in terms of extra, i.e., above the basic, money spent on medical technology. For C, the reaction could be gauged by the number of times the police arrest or pick up on suspicion.

When we run the program and are asked what is the effect of deviance on social reaction, we enter 1. The program responds by giving the information that the multiplier DR = 1. Next we enter the effect of social reaction on deviance, 1, and find that multiplier RD = 1. The system multiplier, SM, is given as RD*DR and is 1.

A little story is then told about the deviant(s). We assume that the deviant(s) are perceived to be different by 100 arbitrary units. The reaction by the other(s) to this deviance is 100*DR units of reaction — = 100*1 = 100.

This level of reaction increases the level of deviance by 100*RD units — that is, 100*DR*RD = 100*SM — the new level of deviance is thus 100 + 100 = 200 units of deviance. The program stops at this stage so that you can digest what has happened, and to continue any key is pressed.

The levels of deviance and of reaction, are then calculated for 30 time periods and an F stops the output at any point. For the values DR = 1 and RD = 1, both deviance and reaction steadily rise to 3100 — an explosive situation. Running the program with values of SM >= 1 will always lead to calamitous outcomes, but if we try DR = 0.5 and RD = 0.5, SM = 0.25, stability is reached resonably quickly — deviance is stable at 166.67, and reaction is stable at 133.33.

The key is, again, the size of the multiplier, SM. Stability is reached if 0 < SM < 1 — so to suggest that positive feedback cannot, by itself, produce a stable system is incorrect. All depends on the multiplier.

Before I discuss the mathematics, one final point you may care to consider; in the program there is a function 'FNT' defined in line 1040, set it equal to

```
1040 DEF FNT(T) = EXP(—T)
```

and re-run some of your earlier values of DR and RD. FNT is the 'boredom' function, it tries to give some way of allowing the other(s) to get bored with the deviant(s). There are many other functions you could try, e.g., FNT(T) = K/(K—1 + T) where you chose the value of constant K.

As in the analysis of Say's Law, we index by time, and, as in the case of Say's Law, we will use the same names for the variables in the Basic program as we use in this mathematical analysis.

D(T) is the absolute level of deviance at time T, R(T) is the absolute level of reaction at T. The change in deviance from T—1 to T, i.e., D(T) — D(T—1), is shown as DD(T), and the corresponding change in reaction is shown as RD(T).

We start with an initial level of deviance D(0) = 100, and DD(0) = 100 — as we assume that D(—1) = 0: the change in deviance, not the absolute level, produces a change in reaction given by the formula:

1. RD(T) = DD(T—1)*DR

which in English, says that the change in reaction is proportional to the earlier change in deviance. The change in deviance at time T comes from:

2. DD(T) = RD(T—1)*RD

which says an equivalent thing about deviance being proportional to reaction change at an earlier time. Note that RD by itself is just a multiplier. An amalgamation of equations 1 and 2 produces

3. DD(T) = DD(T—2)*SM

so that we can see how the change in deviance feeds back on itself at a later time, SM = DR*RD. By a little thought we can see that

.. RD(T) = RD(T—2)*SM

which shows the importance of the multiplier SM. It is very easy to show that if SM < 1, assuming SM is positive, then the series will always converge to some fixed value. Compare equation 3 to the earlier equation 6 and consider the differences and similarities.

In a sense, equation 3 defines positive feedback

- Positive feedback occurs when a change in value over one period produces a change in value in the same direction for a later period — for some series of values.
- Simple stable positive feedback generally occurs when the multiplier for successive differences is between — but not equal to — 0 and 1 for some series of values.
- Simple unstable positive feedback generally occurs when the multiplier for successive differences is 1 or greater for some series of values.

If equation 1 is compared to the corresponding equation in line 1320, we find that the program the equation is given as the equivalent of

.. RD(T) = DD(T—1)*DR*FNT(T)

The extra function 'FNT(T)' is a function of time — set normally to unity, line 1040 — so that as the value of T increases, we can make the value of the multiplier relatively smaller. In this way, we can see that with boredom setting in, e.g., women's lib excites people less and less, most systems with positive feedback end up in stability, given time.

To finish off the mathematical analysis, I will suggest two books which have been found to have good sections on the mathematics used so far, i.e., linear graphs, and power/geometric series. The first book is directed towards A-level mathematics students; Sherlock *et al.*, 1979: 1-35, especially 24-27; 126-155, especially 139-146. The second is for applied mathematics courses at degree level; Green, 1964: 1-32. Both books are well written: Sherlock *et al.*, 1979, is excellent in this respect and though Green, 1964, is more demanding, an A-level student should have little difficulty with this text. For any reader who would like to be slowly introduced to mathematical thinking, Northrop, 1948, is unsurpassed.

I have not defined a system yet, though we have looked at four systems, and my definition of feedback has been very mathematical. Feedback has become a vogue word: it is in all the best, and worse, books. In one, we read a confusion of negative feedback with feedback, and positive feedback being confused with no feedback:

> As a result, even if Germany had won the war — which it should have done on paper — it is hard to see how it could have survived the peace. If an organisation denies feedback, it becomes unrealistic and unstable, apt to break up into rival dogmatic factions. If it allows feedback, it eventually has to placate so many rival interests that it becomes motionless and no threat. *Laurie, 1980: 270-271.*

I finish with one other example on which you can exercise your critical faculties:

> Negative feedback is inherently stabilising because it decreases the error while positive feedback is inherently destabilising and the error gains explosively in magnitude. *Entry on feedback, Stafford Beer in Bullock and Stallybrass, 1977: 230.*

I still have not defined system.

References

Bullock A and Stallybrass O, 1977, The Fontana Dictionary of Modern Thought, Fontana/Collins: London.

Green J A, 1964, Sequences and Series, RKP: London.

Laurie P, 1980, The Micro Revolution: A change for the better or for the worse? Futura Publications: London.

Northrop E P, 1948, Riddles in Mathematics, Penguin Books, Harmondsworth.


```
100  REM
110  REM ***********************
120  REM
130  REM
140  REM  T H E   C Y C L E
150  REM
160  REM  O F
170  REM
180  REM  D E V I A N C E  (1)
190  REM
200  REM
210  REM  A SIMULATION PROGRAM
220  REM
230  REM
240  REM  BY
250  REM
260  REM  G J BORIS ALLAN
270  REM
280  REM
290  REM ***********************
300  REM
310  REM THIS PROGRAM IS ONE OF
320  REM THE SET TO ACCOMPANY
330  REM THE SERIES
340  REM
350  REM T H I N K I N G
360  REM S Y S T E M S
370  REM
380  REM ALL RIGHTS IN THIS
390  REM PROGRAM ARE RESERVED.
400  REM
410  REM (C) G J B ALLAN, 1980
420  REM
430  REM ***********************
440  REM
450  REM
1020  DEF  FN F(X) = ( INT (100 *
     X + .5) / 100): REM  FORMATT
     ER
1040  DEF  FN T(T) = 1: REM  THIS
      LINE CAN BE CHANGED TO ACCO
     UNT FOR DIFFERENT EFFECTS OF
      TIME, EG FN T(T)=EXP(1-T)
1060  DIM D(30),R(30),DD(30),RD(3
     0): REM  'D' IS ABSOLUTE LEV
     EL OF DEVIANCE, 'R' IS THE A
     BSSOLUTE LEVEL OF SOCIAL REA
     CTION, 'DD' IS THE CHANGES I
     N LEVEL OF DEVIANCE, AND 'RD
     ' IS CHANGE IN LEVEL OF REAC
     TION
1080  HOME : GOSUB 1580: PRINT "W
     HAT IS THE EFFECT OF": PRINT
     "DEVIANCE ON SOCIAL REACTION
      ?": PRINT "(THE DEVIANCE TO
      REACTION": PRINT "MULTIPLIE
     R.) ";: INPUT DR: PRINT : PRINT
     "MULTIPLIER DR = ";DR
1100  GOSUB 1580: PRINT "WHAT IS
     THE EFFECT OF": PRINT "SOCIA
     L REACTION ON DEVIANCE ?": PRINT
     "(THE REACTION TO DEVIANCE":
      PRINT "MULTIPLIER.) ";: INPUT
     RD: PRINT : PRINT "MULTIPLIE
     R RD = ";RD
1120  GOSUB 1580: PRINT "THE SYST
     EM MULTIPLIER (SM) IS ";:SM =
     RD * DR: PRINT  FN F(SM): PRINT
     "(SM = RD * DR)"
1140  GOSUB 1580: PRINT "PRESS AN
     Y KEY TO CONTINUE";: GET A$:
      GOSUB 1580: PRINT "IF 0 (ZE
     RO) IS 'NORMAL', AT": PRINT
     "TIME ZERO THE OTHER(S) PERC
     EIVES": PRINT "THE DEVIANT(S
     ) TO BE 'DIFFERENT' BY": PRINT
     "100 UNITS."
1160  PRINT : PRINT "THE REACTION
      BY OTHER(S) TO A": PRINT "D
     EVIANCE OF 100 UNITS, IS AN"
     : PRINT "PERCEIVED REACTION
     OF 100*DR UNITS.": PRINT "TH
     AT IS, THE REACTION IS "; FN
     F(100 * DR);" UNITS."
1180  PRINT : PRINT "THIS IN TURN
      INCREASES THE": PRINT "LEVE
     L OF DEVIANCE BY "; FN F(100
      * DR);"*RD": PRINT "= "; FN
     F(100 * SM);" UNITS: THIS PR
     ODUCES ": PRINT "A NEW LEVEL
      OF DEVIANCE OF "; FN F(100 *
     (1 + SM));" UNITS"
1200  PRINT : PRINT "PRESS ANY KE
     Y TO CONTINUE";: GET A$
1220  HOME : GOSUB 1580: PRINT "T
     IME","DEVNCE","REACTN"
1240 DD(0) = 100:D(0) = DD(0):RD(
     0) = DD(0) * DR:R(0) = RD(0)
     : REM    INITIALIZATIONS

1260  PRINT : PRINT 0,D(0),R(0)
1280  FOR I = 1 TO 30
1320 DD(I) = RD(I - 1) * RD:D(I) =
     D(I - 1) + DD(I):RD(I) = DD(
     I - 1) * DR *  FN T(I):R(I) =
     R(I - 1) + RD(I)
1340  PRINT I, FN F(D(I)), FN F(R
     (I))
1360  GET A$: IF A$ <  > "F" THEN
     1140
1380  PRINT : PRINT "DO WANT A RE
     -RUN (Y/N)?";: GET A$: IF A$
      = "Y" THEN 1080
1400  IF A$ = "N" THEN 1540
1420  GOTO 1380
1440 ICOUNT = I: REM  'ICOUNT' CA
     N BE USED IN GRAPHICS ROUTIN
     ES, ETC.
1460  NEXT I
1480  GOSUB 1580: PRINT "DO YOU W
     ANT A RE-RUN (Y/N)?";: GET A
     $: IF A$ = "Y" THEN 1080
1500  IF A$ = "N" THEN 1540
1520  GOTO 1480
1540  GOSUB 1580: GOSUB 1580: PRINT
     "****** PROGRAM ENDS ******"
     : GOSUB 1580: GOSUB 1580: REM
     IT IS POSSIBLE TO INSERT GRA
     PHICS ROUTINES AT THIS STAGE
     , USING 'D', 'DD', 'R','RD',
      AND 'ICOUNT'.
1560  END
1580  FOR I9 = 1 TO 3: PRINT : NEXT
     I9: RETURN
```

Program angled to deal with class-room trigonometry

FOR MANY YEARS the computer has been used in a variety of ways in education, but even with the arrival of the microprocessor, the cost is still prohibitive for most schools. To make any significant contribution to the learning process, several terminals would be required and this immediately raises the price beyond the reach of a school budget. Many schools, however, now possess one terminal, run from a micro and soon many more will be similarly equipped. It is the aim of the Basic program which follows, to offer the teacher an opportunity to make more efficient use of such as terminal, not as a learning machine, but rather as a teacher's auxiliary.

It performs this function in two ways: firstly, by supplying an unlimited number of random examples — and answers if required — for the teacher's use; and secondly by making available individual examples for each pupil, who, on entering a personal code number, is offered a choice of problem. The answer is filed under the same code number, by means of which the pupil can check his own result later.

In this way a whole class can be accommodated, some individually at their own speed, others from specific examples on the black-board — but all quantities supplied when required by the computer. Most teachers would agree that in the subject of maths, few books supply a sufficient number or variety of questions; so the program fills a gap here, too. It will continue to churn out different sets of values as long as required, limited only by the random function of the Basic interpreter in use.

This month we offer a program in trigonometry, suitable for third-and fourth-year pupils and which supplies examples requiring a knowledge of the sine and cosine rule. Similar programs have been arranged to deal with other maths topics and a school with a library of these would be able to claim that the micro had more than justified its cost — especially as there is a bonus. The use of a personal number code appears to promote a greater interest in finding the correct answer and even the dispirited are inspired.

Robert Ferguson.

```
0010 PRINT "    CLASS  TRIGONOMETRY"
0020 PRINT
0030 PRINT
0050 PRINT "CODE NUMBERS ARE RESTRICTED"
0060 PRINT "TO VALUES FROM  100  TO  140"
0062 PRINT
0063 PRINT
0070  P$(1)="SINE RULE?"
0075  P$(2)="COSINE RULE?"
0080  P$(3)="UNITS"
0085  P$(4)=" (FOR THE COSINE)"
0090  P1=3.14159265
0092  P2=180/P1
0095  T$="ABCDEFPQRXYZ"
0110 DIM P(41),R(41),U(41)
0120 PRINT "        IDENTIFY YOURSELF"
0130 PRINT
0140 PRINT "        TYPE IN YOUR CODE"
0145 PRINT
0150 GOSUB 400
0160 PRINT "        WELCOME,  ";N$
0170 PRINT "    IF YOU PREFER EITHER"
0180 PRINT "  THE SINE OR COSINE RULE"
0190 PRINT "      TYPE  SIN  OR  COS"
0200 PRINT "IF NO PREFERENCE,  TYPE  NO"
0210 INPUT P$
0220  X=0
0230 IF P$="SIN" THEN X=1
0240 IF P$="COS" THEN X=2
0250 IF P$="NO" THEN X=3
0260 IF X=0 THEN 385
0265  P(N)=X
0270 ON X GOTO 500,850,1300
0275 PRINT " ... AND RETURN WHEN YOU HAVE'
0280 PRINT TAB(10);"THE ANSWER"
0285 PRINT
0290 PRINT
0295 PRINT TAB(11);"NEXT PLEASE"
0300 PRINT
0305 PRINT TAB(8);"WHAT IS YOUR CODE?"
0310 GOSUB 400
0312 PRINT
0315 IF P(N)=0 THEN 160
0320 IF P(N)<0 THEN 1350
0325 PRINT
0335 PRINT "THE RESULT OF YOUR EXAMPLE IS'
0345 PRINT TAB(5);R(N);"  ";P$(U(N))
0352 PRINT
0355 PRINT TAB(8);"ANOTHER EXAMPLE?"
0360 PRINT TAB(7);"TYPE  YES  OR  NO"
0365 INPUT Q$
```

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(continued from previous page)

```
0368 PRINT
0370 IF Q$="YES" THEN 1100
0375 IF Q$="NO" THEN 1400
0380 PRINT "TYPE YES OR NO ... RE-ENTER"
0381 INPUT Q$
0382 GOTO 370
0385 PRINT "TYPE  SIN COS OR NO"
0388 PRINT "RE-ENTER PLEASE"
0390 GOTO 210
0400 INPUT N$
0410 IF ASC(N$)<>49 THEN 450
0415  V=VAL(N$)
0420 IF V<100 THEN 450
0425 IF V>140 THEN 450
0430 IF V<>INT(V) THEN 450
0435 IF LEN(N$)>3 THEN 450
0438  N=V-99
0440 RETURN
0450 PRINT "I DO NOT RECOGNISE YOU"
0460 PRINT "CHECK YOUR CODE AND RE-ENTER"
0470 GOTO 400
0500 GOSUB 1000
0510  X1=INT(RND*200+300)/10
0520  Y2=INT(RND*1400+100)/10
0530  Z2=INT(RND*300+100)/10
0535 PRINT
0540 PRINT "IN TRIANGLE ";S$;","
0550 PRINT S$(2)+S$(3);" = ";X1
0560 PRINT "ANGLE ";S$(2);" = ";Y2;" DEGREES"
0570 PRINT "ANGLE ";S$(3);" = ";Z2;" DEGREES"
0580 PRINT
0590  U(N)=3
0600  X2=180-Y2-Z2
0610  X3=X2/P2
0620  Y3=Y2/P2
0630  R2=X1*SIN(Y3)/SIN(X3)
0635  R(N)=INT(R2*100+0.5)/100
0640 PRINT "FIND THE LENGTH OF ";S$(1)+S$(3)
0645 PRINT
0650 GOTO 275
0670 IF F$="NO" THEN 285
0850 GOSUB 1000
0860  A=RND(0)
0870 IF A<0.4 THEN 1200
0900  X1=INT(RND*200+300)/10
0910  Y1=INT(RND*250+300)/10
0920  Z1=INT(RND*200+300)/10
0925 PRINT
0930 PRINT "IN TRIANGLE ";S$;","
0935 PRINT S$(1)+S$(2);"=";Z1
0940 PRINT S$(2)+S$(3);"=";X1
0950 PRINT S$(3)+S$(1);"=";Y1
0960 PRINT
0970  U(N)=4
0980 PRINT "FIND THE VALUE OF ..."
0990 PRINT " THE COSINE OF ANGLE ";S$
0992  R1=(X1*X1+Z1*Z1-Y1*Y1)/2/X1/Z1
0993  R(N)=INT(R1*1000+0.5)/1000
0994 PRINT
0995 GOTO 275
1000  S=INT(RND*10+1)
1010  S$=MID$(T$,S,3)
1020 FOR I=1 TO 3
1030  S$(I)=MID$(S$,I,1)
1040 NEXT I
1050 RETURN
1100 IF P(N)=3 THEN 170
1105 PRINT TAB(5);"STILL THE ";P$(P(N))
1110 PRINT TAB(5);"TYPE  YES  OR  NO"
1115 INPUT R$
1120 IF R$="YES" THEN 1180
1130 IF R$="NO" THEN 1160
1140 PRINT "TYPE YES OR NO ... RE-ENTER"
1150 GOTO 1115
1160 PRINT TAB(6);"WHICH THIS TIME?"
1170 GOTO 190
1180  X=P(N)
1185 PRINT
1190 GOTO 270
1200  U(N)=3
1210  X1=INT(RND*200+300)/10
1220  Y1=INT(RND*200+300)/10
1230  Z2=INT(RND*1600+100)/10
1236 PRINT
1240 PRINT "IN TRIANGLE ";S$;","
1250 PRINT S$(1)+S$(3);" = ";Y1
1255 PRINT S$(2)+S$(3);" = ";X1
1260 PRINT "ANGLE ";S$(3);" = ";Z2;" DEGREES"
1270  Z3=Z2/P2
1275 PRINT
1280 PRINT "FIND THE LENGTH OF ";S$(1)+S$(2)
1285 PRINT
1290  R=SQR(X1*X1+Y1*Y1-2*X1*Y1*COS(Z3))
1292  R(N)=INT(R*100+0.5)/100
1295 GOTO 275
1300  B=RND(0)
1310  X=1
1320 IF B<0.5 THEN X=X+1
1330 GOTO 270
1350 PRINT "WELCOME BACK, ";N$
1360 PRINT "I THOUGHT YOU HAD FINISHED"
1370 PRINT
1380 GOTO 170
1400  P(N)=-1
1410 PRINT
1420 PRINT TAB(6);"HAS EVERYONE FINISHED?"
1430 PRINT TAB(8);"TYPE  YES  OR  NO"
1435 INPUT F$
1440 IF F$="YES" THEN 1480
1450 IF F$="NO" THEN 285
1460 PRINT "TYPE  YES  OR  NO ... RE-ENTER"
1470 GOTO 1435
1480 STOP
1490 REM R.E.L.FERGUSON
1500 REM ABERDEEN  1979

READY
#run
```

Pearls of wisdom from London bead business

Peter Sterry and the Hobby Horse Pet.

by Cathy Lane

WHAT BUSINESS manages to combine travel to exotic places on stockfinding missions, the daily handling of beautiful products — each with a detailed and characteristic history — a retail outlet in London's King's Road at the forefront of the fashion scene, and a mail order and wholesale business which exports thousands of products every month?

The answer, for those who have not already guessed, is beads. Peter and Karina Sterry opened their shop Hobby Horse 10 years ago, at the very start of the 1970s' crafts boom. As the business developed, though, they gradually dropped their other craft lines to concentrate on their best-seller.

Today Hobby Horse stocks 1,000 kinds of beads, and most of them are sold in 10 or 12 colours. For the last four years, Sterry has been riding a boom, expanding sales at a zooming 80 percent a year or thereabouts — for 1980 Hobby Horse is expecting a turnover above £500,000.

Beads are big business. Says Peter Sterry: "Fortunately for me beads are made in places like Africa, the Far East, India, South America. I have to go on buying trips quite frequently, and I'm always on the lookout for new lines". Regular customers for the beads include the toy manufacturers and the rag trade.

"In the last few years the jewellery boom has helped us considerably", says Peter, homing in on one of the key factors for his recent success. "Many of our retail customers make up ear-rings and necklaces and sell them on market stalls; I see our beads everywhere. Bo Derek's hairstyle in the movie *Ten* did us a great deal of good, too, and the U.S. Indian fashions last autumn worked for us as well — beaded moccasins in particular have resulted in huge orders from shoe manufacturers".

The shop in Chelsea and the warehouse just around the corner are both Aladdin's caves of glitter and colour. Sterry seems to like the aesthetics of his business: certainly he has a deep-seated dislike of bureaucracy and paperwork: "I have one lever arch file which will hold all my correspondence for a year, and that's about it".

At present, the total office staffing consists of one part-time bookkeeper — the 10 other employees are divided between the retail shop, the wholesale side, and packing for the mail order business.

For just 12 people to produce £500,000 is a reasonable ratio of sales to staffing, one that many stocking and selling operations would envy. So, what is the secret?

"We've only been able to do it because of the computer, though", says Sterry. "For instance, if I hadn't bought the Pet earlier this year, I would have had to take on four or five extra invoice typists by now".

Yet he is not just saving on new staff — that is a visible and quantifiable aspect of the case — but Hobby Horse is winning some equally important benefits in other directions, notably in increasing the speed and reducing mistakes in the invoicing and a tighter control of inventory.

The increase in the variety of beads sold and the problems presented by invoice typing were the key factors in buying a computer. Sterry admits cheerfully that he knew "absolutely nothing" about computers when he started looking around for one early in 1980: "I viewed them very much as fun toys". Still, he had ambition: "My objective was to buy a machine and program it myself to do the stock control and invoicing. It didn't look too difficult. I was quite confident. Besides, it looked interesting".

After talking to a few programmer friends, Sterry concluded that the Pet was the best buy at the low end of the market. It was widely available, tried and tested and generally well established, highly-rated by everyone, reportedly easy to use, and well supplied with ready-made extras in the form of games, business programs, and add-on goodies if the requirement for them were ever to arise in Hobby Horse's future.

So for £800, Peter Sterry bought a 32K Pet with a cassette unit but "the shop was totally unhelpful, and as a result they got no other custom from me".

The staff of Hobby Horse's Chelsea shop.

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The new Pet sat in Sterry's study for some time, while he discovered very quickly that he was not interested in programming it himself. At the time, however, he went as far as computerising his price list. "It wasn't too hard. All the beads already had three-figure product references, so I wrote a simple program which used these catalogue numbers".

It may not have been hard, but it still took him four months. On the other hand, it was a genuine and sensible use of the computer. The price list was intended only for reference use by staff in the shop and the business, not for customers, and it was exactly the same as looking up the prices in a book as before. Hobby Horse had previously handled price changes by cutting and pasting new information over the old material in the catalogue. Automating the price book produced a clearer and error-free reference.

Sterry may have been deciding that he was no programmer, "but in fact, most of the delay in making the system work was due to the Commodore users' handbook for the Pet. I found it particularly bad"

Invoicing system

Meanwhile, the invoicing system was becoming a pressing problem on which the computer could usefully be employed. Sterry realised that this would necessitate buying floppy disc drives — it is almost impossible to implement a fast-access business computing system using the tape cassettes that he still had on his Pet.

He was however anxious to find a local supplier. His bad experience of buying a computer and the obvious advantages of dealing with someone located conveniently close prejudiced him strongly in favour of a neighbourhood trader. Fortuitously, Logic Box had just opened shop in the vicinity. Sterry was quick to buy a printer, floppy disc drives and the ready-made Trader package written by the Bristol Software Factory.

Trader is a set of programs designed specifically for stock-holding retailers and wholesalers. Peter Sterry liked it, though not uncritically: "It is actually very good, but for me, there is one rather irritating thing about it — it doesn't sort data at all. This means that only the original input is grouped into product classifications. All new stock can't be entered into, say, the glass or bone bead group, but it does print our invoices very well".

Sterry reckons that if necessary he could do without the computer, and certainly he has not replaced the manual system. He does not depend on it 100 percent. Yet it is clear that the Pet has made a considerable difference to the running of his business.

That is the inventory question. Because the stock is so large and is expanding all the time, it is impossible to obtain a stock valuation without the computer. This meant that, in the past, Sterry never actually knew whether he was making a loss or a profit. The bank balance might well have been increasing, but his stock might have been falling so fast that the company might really have been approaching bankruptcy.

Hobby Horse employees in the wholesale and mail-order side of the business.

Now the Pet tells him when stocks are low, what the stock value is, and what the period sales have been. Previously, a stock take would have occupied two full days, involved all the staff and then would have taken Sterry a week of checking the costs back to source. In theory, the computer can now do all that at the press of a button. In theory, because Sterry qualifies its effectiveness: "It's never quite accurate because things do slip through without being recorded. It should be correct to within 10 percent — which, believe me, is a great improvement".

Sterry also finds that the Pet has vastly improved the company's public relations while helpfully doing something about receivables: "All our debtors have an invoice printed-out by the computer, then a statement, and they really seem to think, 'He's really right on top of things now', and they pay more promptly".

Equally, Sterry can see who owes money more easily. In the pre-computer days he would have had to go through the ledger page by page looking for red ink to draw up any kind of a debtors' list.

The system does however have its limitations, and he is keen to stress that he does not idolise it, but there have been no really major disasters while he has been using the Pet: "We had a few discs which wouldn't copy, and in the past, I've been lazy about doing the back-up copies properly. But we've never lost more than a few days' work and at least we've always known what's been lost".

Not exactly the most rigorous approach to operating procedures for the computer, but at least it is clear that Peter Sterry and his system have come to some kind of understanding.

Apart from the price-list problem, the only real complaint that Sterry has about the software is the fact that it does not maintain a complete ledger for each customer — it only records details of the last transaction. That produces, however, a useful audit trail, and it would be possible to construct an automated ledger from it if the Pet had more disc storage.

After his initial interest in microcomputing, Peter Sterry's views have matured somewhat into the kind of approach that typifies the first-time business user: "I think that microcomputers should be like television sets. I want to be able to press button one and watch BBC 1; I don't want to know how the television set works, all I really care about is receiving a good picture. Likewise, I'm not interested in the ins and outs of programming, I just want a machine which will do the job for me with a minimum of problems.

"To do that comprehensively on my system is impossible at the moment, because there just isn't enough memory for programmers to produce the kind of fail-safe programs that I would like to see, programs that do everything for you and which don't ever make mistakes. They would need far more memory than the current generation of micros seems able to offer. It's clear that the next generation will have considerable advantages, and they'll be able to be much more profligate with memory".

Typical day

The Hobby Horse computer is not exactly overused. It deals only with stock valuation, price lists, invoicing and statements: in a typical day it would do 12 invoices, change a few prices, update stock and record shop and mail order sales. Sterry now employs a part-time operator for a few hours a day on three days a week, for most of the input and anything very urgent he does himself.

"I think that I will eventually have to upgrade the system. Small systems are inherently less reliable and less flexible than bigger machines, and of course they can't do as much. Although I don't want to expand the business physically, I do want to continue increasing the turnover.

Sterry considers the costs he had borne — an outlay of some £2,500 for the Pet including software — a reasonable price to pay for the experience of learning about computers in business.

"When I buy a new system to do the complete ledger, I won't be at the mercy of any experts".

Counting manual methods out of the reckoning

FOR MANY small firms, stock control is a tedious and time-consuming job. One way around that problem is to use a computer to perform the task. You type-in on the computer the items you have removed from stock and periodically ask it for a list of the stock items requiring re-ordering. This program does just that and several other things as well. When run, the program displays a menu on the screen and will wait for you to type a command key from A to G.

Key A is pressed to type the items you have removed from the stock. Each item has a number to identify it which must be input

by Tony Edgecombe

during this part of the program. The amount removed from stock is entered. If the item was on the file, the program will continue to input the stock removals until all of the removed stock has been typed-in. If you make a mistake, however, and type a stock number which is not on the file, the program will display an error message and you will have to re-type the information.

The command key B is pressed to enter all of the stock that has been re-ordered. If you make a mistake, the program will again display an error message and the information will have to be re-typed.

When new stock items are introduced, they can be added to file using the command key C. Four variables have to be input into the system:

- A Stock number
- B Amount in stock
- C Minimum amount allowed in stock
- D Amount to be re-recorded when stock is too low

Once this data has been input, it will be printed on to the end of the file.

When a stock item has to be modified or will not be used again, it can be deleted by using the command key D. If the item is not on the file the program will tell you so. Periodically, the stock will have to be re-ordered. By keying E, all of the stock requiring ordering will be printed along with the amount to be ordered.

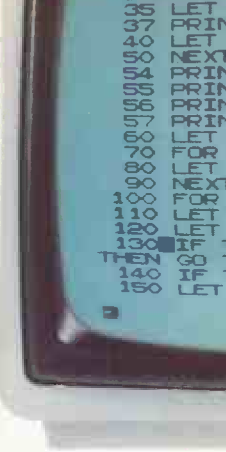
For some reason, the operator may wish to examine the details of a particular stock item. That can be done by using the command key F. The final key, G, terminates the program and leaves you in Basic.

```
100 LET M=10
110 DIM A$(72),B$(72),A(100,7)
120 FILES A
130 READ %1
140 LET I=1
150 MAT A=ZER
160 IF END% 1 THEN 180
170 MAT READ %1;I,A
180 FOR I=1 TO 20
190 PRINT
200 NEXT I
210 PRINT TAB(5);"STOCK CONTROL"
220 PRINT TAB(5);"----- -------"
230 PRINT
240 PRINT "1. INPUT NEW STOCK ITEM"
250 PRINT
260 PRINT "2. PRINT DETAILS OF STOCK ITEM"
270 PRINT
280 PRINT "3. DELETE OLD STOCK ITEM"
290 PRINT
300 PRINT "4. TYPE REMOVED STOCK"
310 PRINT
320 PRINT "5. TYPE STOCK ON ORDER"
330 PRINT
340 PRINT "6. TYPE STOCK RECEIVED"
350 PRINT
360 PRINT "7. PRINT ITEMS REQUIRING REORDERING"
370 PRINT
380 PRINT "8. FINISH STOCK CONTROL"
390 PRINT
400 PRINT
410 INPUT I
420 IF I<1 OR I>8 OR I<>INT(I) THEN 180
430 GOTO I OF 440,740,930,1060,1160,1270,1380,1570
440 PRINT
450 PRINT "PRODUCT NUMBER";
460 INPUT A
470 FOR I=1 TO M
480 IF A(I,1)=A THEN 530
490 IF A(I,1)=0 THEN 570
500 NEXT I
510 PRINT "OUT OF SPACE"
520 GOTO 180
530 PRINT
540 PRINT "INCORRECT PRODUCT NUMBER"
550 PRINT
560 GOTO 180
570 PRINT "AMOUNT IN STOCK ";
580 INPUT A(I,2)
590 LET A(I,1)=A
600 PRINT "QUANTITY ON ORDER";
610 INPUT A(I,3)
620 LET A(I,4)=A(I,2)+A(I,3)
630 PRINT "RE-ORDER LEVEL ";
640 INPUT A(I,5)
650 PRINT "RE-ORDER QUANTITY ";
660 INPUT A(I,6)
670 PRINT "SUPPLIER NUMBER ";
680 INPUT A(I,7)
690 PRINT
700 PRINT "ARE THERE ANY MORE NEW ITEMS (Y/N)";
710 INPUT A$
720 IF A$="Y"THEN 440
730 GOTO 180
740 PRINT
750 PRINT"PRODUCT NUMBER";
760 INPUT A
770 FOR I=1TOM
780 IF A(I,1)=A THEN 810
790 NEXT I
800 GOTO 530
810 FOR J=1TO21
820 PRINT
830 NEXT J
840 PRINT"PRODUCT NUMBER      ";A(I,1)
850 PRINT"PHYSICAL STOCK      ";A(I,2)
860 PRINT"QUANTITY ON ORDER   ";A(I,3)
870 PRINT"FREE STOCK          ";A(I,4)
880 PRINT"RE-ORDER LEVEL      ";A(I,5)
890 PRINT"RE-ORDER QUANTITY   ";A(I,6)
900 PRINT"SUPPLIER NUMBER     ";A(I,7)
910 PRINT
920 GOTO 210
930 PRINT"PRODUCT NUMBER";
940 INPUT A
950 FOR I=1TOM
960 IF A(I,1)=A THEN 990
970 NEXT I
980 GOTO 530
990 FOR J=I+1TOM
1000 FOR K=1TO7
1010 LET A(J-1,K)=A(J,K)
```

(continued on next page)

(continued from previous page)

```
1020 NEXT K
1030 NEXT J
1040 LET A(J,1)=0
1050 GOTO 180
1060 PRINT"PRODUCT NUMBER";
1070 INPUT A
1080 FOR I=1TOM
1090 IF A(I,1)=A THEN 1120
1100 NEXT I
1110 GOTO 530
1120 PRINT"AMOUNT REMOVED";
1130 INPUT A
1140 LET A(I,2)=A(I,2)-A
1150 GOTO 1250
1160 PRINT"PRODUCT NUMBER";
1170 INPUT A
1180 FOR I=1TOM
1190 IF A(I,1)=A THEN 1220
1200 NEXT I
1210 GOTO 530
1220 PRINT "AMOUNT ON ORDER";
1230 INPUT A
1240 LET A(I,3)=A(I,3)+A
1250 LET A(I,4)=A(I,2)+A(I,3)
1260 GOTO 180
1270 PRINT"PRODUCT NUMBER";
1280 INPUT A
1290 FOR I=1TOM
1300 IF A(I,1)=A THEN 1330
1310 NEXT I
1320 GOTO 530
1330 PRINT "AMOUNT RECEIVED";
1340 INPUT A
1350 LET A(I,2)=A(I,2)+A
1360 LET A(I,3)=0
1370 GOTO 1250
1380 FOR I=M-1TO1 STEP -1
1390 FOR J=1TOI
1400 IF A(J,7)<A(J+1,7)THEN 1460
1410 FOR A=1TO7
1420 LET B=A(J,A)
1430 LET A(J,A)=A(J+1,A)
1440 LET A(J+1,A)=B
1450 NEXT A
1460 NEXT J
1470 NEXT I
1480 PRINT "PRODUCT", "ORDER AMOUNT","SUPPLIER"
1490 FOR I=1TOM
1500 IF A(I,4)>A(I,5)THEN 1530
1510 IF A(I,1)=0 THEN 1530
1520 PRINT A(I,1),A(I,6),A(I,7)
1530 NEXT I
1540 FOR I=1 TO 10000
1550 NEXT I
1560 GOTO 180
1570 LET I=1
1580 READ %1
1590 MAT PRINT%1;I,A
1600 END
```



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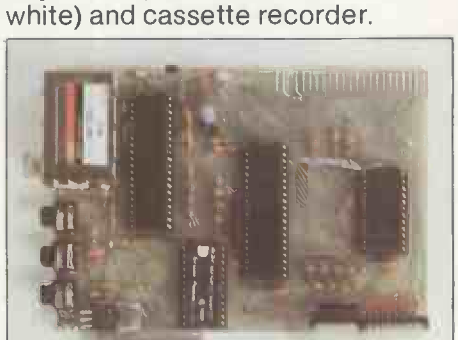

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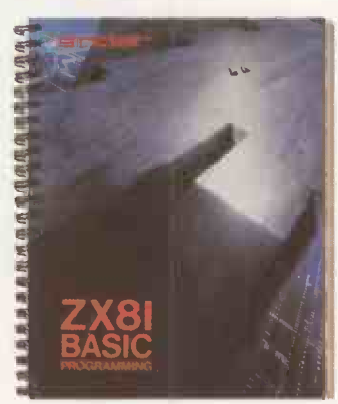

Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs.

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Minimum keystroke editing functions.

The main editing functions involve the least possible number of keystrokes—generally only two. Thus to delete any character(s) under the cursor, you simply press the DELETE function key the appropriate number of times. Then the CLEAR key is pressed to close up the text around the deletion. Similarly if you want to add a letter, word or sentence into the middle of your text, you simply move the cursor to the position required and press the EXPAND key. This opens up a "window" into which you can type the additional material. When you have finished, you just press the EXPAND key again to close up the text around the addition. Correcting mistyped characters simply involves positioning the cursor over the characters involved and retyping them.

Automatic checking of drastic commands.

If you type in a potentially drastic command (like a command to delete part of your file, or kill the entire file), the Sorcerer Word Processor will automatically query you before it carries out the command—by asking "REALLY?". Only if you type Y for yes does it go ahead and execute the command. This protects your files against accidental damage.

Powerful special functions.

The Sorcerer Word Processor provides some really powerful special editing functions. One of these is the Marker function, which lets you insert non-printing "marker" characters in your text to identify places where future changes are needed. Then when you want to make the changes, you can tell it to jump to the next marker (either forward or backward in the text) simply by entering a 2-keystroke command.

There is also a Search and Replace function, where you can tell the processor to search for a specific string of characters (say a persons' name) and replace it with another string. This can be done repetitively, so that the string is replaced whenever it occurs in the text, and you can have the processor either replace the string at all locations automatically, or stop at each location to give you the option of skipping over it. You don't even have to specify all of the string to be replaced, you can specify either all 7 letter words ending in 'ing', for example, or all 12 letter words beginning with 'anti-'. The processor also provides a holding buffer, separate from the main text buffer, where you can store material from one file for use in another.

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Micros find important role at heart of large-scale industry

A MAJORITY of microcomputer applications we see in use or whose software we hear about is for small businesses. Large-scale heavy industry tends to have a great deal of computing power already, and full-time dp departments. Such micro-based equipment as they dispose of may be outlandish to the amateur, who sees little connection between the desk-top machine on which he plays Dungeons and Dragons and the much-trumpeted robots of a Fiat assembly shop. Yet the micro can still be used, in a more or less standard fashion, to improve industry's profitability.

by Martin Hayman

This much is shown by a visit I paid recently to Marconi Space and Defence Systems in Portsmouth, where systems analyst Des Breach has installed a multi-user Altos micro system with four terminals to tidy up the running of the factory's £5 million machine shop. Building and using machine tools has long been a field in which the British have claimed pre-eminence, though much of the equipment at Marconi is in fact U.S.-built.

It is, of course, precisely this area of industry which has received some of the recession's worst battering. High interest rates have made it very desirable to either maximise the productivity of existing plant or make intelligent and economical plans for replacing it — preferably both.

Marconi is better placed than many smaller concerns since it has many Government contracts which were placed some time ago and which are still providing work. Components for defence equipment are still needed, since this is one area in which there have been few spending cuts. The fear that all the fat has been burned off industry and that it is now losing its muscle does not seem to be shared by people I talked to at the Marconi Broad Oak Works.

Machine tools are generally operated by numerical control, NC. Paper tapes are typed on IBM typewriters with paper-tape readers and punches. These tapes are fed to an optical reader which translates them into machine instructions — move the cutter of a lathe so-and-so far along the longitudinal axis of the workpiece, so-and-so far on the horizontal — and so on. This final stage, which in former times, before the introduction in this country of NC, would have been performed by hand by a machine operator, is now achieved by hydraulics and reciprocating ball screws.

That aspect of machine-shop work usually runs well, but machines break down and job priorities change mid-run, requiring that one machine be re-programmed for a different job, with a different paper tape. Obviously, once a tape has been used and is effective for a particular component, it is stored so it can be used again in the future with a magnetic tape back-up copy.

An Altos multi-user system.

Highly specialised

Many of Marconi's jobs are, however, highly specialised and only a short run is needed. What happens if a machine breaks down in the middle of a job and there is no tape for use on a different machine? The tape must be re-written for a different machine.

In the past, that had caused considerable delays at Broad Oak Works. It was not necessary to convert programs manually, which would have taken an age, but the Transdata 4000 terminal linked by telephone to an IBM mainframe at Marconi headquarters in Chelmsford, Essex, was not altogether a satisfactory solution. The IBM does indeed convert programs, but was available only during office hours, whereas the Broad Oak Works in Portsmouth functions on a shift system, working from 6am to 10pm — there were bound to be breakdowns when the mainframe was not running.

There were also further inconveniences: new program development work required the Transdata to drive a plotter. Sometimes such work would be interrupted two or three times a day when a conversion routine required that the Transdata talk to the Chelmsford mainframe — time-wasting, since the run would have to be re-started from scratch.

However, such are the economics of this kind of operation that it is judged better to waste programmers' time than machine time, which on the largest milling machines is costed at £28 per hour. Even so, machine-floor downtime is calculated at 15 percent.

Eventually, the IBM typewriters, on which the fundamental paper-tape development work was done became due for replacement. An identical set-up was going to cost around £9,000. Des Breach asked himself why a micro, or several micros, could not be bought for the same money and used to improve flexibility and free his department from dependence on the Chelmsford mainframe link and from its attendant frustrations for program development. Micros would have better editing facilities, would be less noisy, and would offer a host of other advantages.

Breaking new ground

Although Marconi is, of course, a microprocessor manufacturer, its products tend to be for dedicated applications and it does not manufacture any kind of micro itself; and nor is there a ground-level policy for microcomputer acquisition. Hence Des Breach found himself breaking new ground when he proposed to replace the IBMs with the machine which he had winnowed from the

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rest as the most suitable for the job. He had to go to headquarters to argue the case for the Altos machines, which would be paid for from the plant acquisition funds.

Why Altos? I asked Breach: "At the time I started looking, at Compec two years ago, there wasn't a great deal available in the multi-user field; we wanted to keep compatibility with the Transdata, which had been installed by my predecessor, but using mini-floppies. It also had to based on the 8080 processor".

To a great extent, then, his decisions were based on ensuring continuity with an existing system which had been chosen for its IBM communications protocol to talk to the mainframe and had facilities for NC. This last feature, caused some headaches with the Altos, which is interrupt-driven; they had to be disabled to interface with the paper-tape writers, which need to be continuously driven. Yet, so far as he was concerned, it was all part of a "reasonably, obvious way to go", shifting from dumb terminals to intelligent ones.

The Altos machines were supplied in the normal commercial way, by the local Altos agent, Profac Computer Services in Camberley, Surrey. The Altos itself is a U.S. machine, the main agency for which is held by nearby Logitek of Chorley, Surrey. Profac's Jim Reid installed the system which operated on MP/M 1.12, and wrote some of the software to adapt it for the NC application, though Des Breach says that he had to tune it a little before he could rely on it.

Ultimately, there is no reason that the micro should not control the machine tools directly, without the need for the intermediate paper-tape stage, but this is surely some way in the future. At the moment, each user can call routines from a common base of subroutines, which is much more efficient and less frustrating than queuing for the mainframe.

Race of inventors

Neither Jim Reid nor Des Breach seemed surprised that Marconi, as a British microelectronics manufacturer, should be buying micros from the States; they look at it in the same way as buying a typewriter or photocopier, which would equally likely be U.S.-built. "We are a long way behind the U.S. in terms of building micros, but we can catch up in the area of applications and industrial control — we are, after all, a race of inventors", claims Jim Reid, who admits that he is very keen to win the order from Marconi.

The Altos system is used for four principal tasks: preparation and editing of paper tapes; conversion of tapes for different machines; prior plotting of completed tapes; and calculation of run times for costing purposes. The design process works like this: a blueprint for an assembly arrives at the Broad Oak Works. It is assigned to one of the drawing office staff, who sits down at a board and with the skill of knowledge and experience, calculates roughly how best the machine tool should make the passes over the billet of raw material.

These billets are usually of high-grade alloy, and extremely expensive. The blueprints, along with materials' specification are straight from the design office at Stanmore or from the Ministry of Defence. Usually, there will be no indication as to what kind of component it is, or to what machine it belongs. This is a curious aspect of the work at Broad Oak, where everybody signs the Official Secrets Act.

After deciding what kind of machine — there are two types, milling machines and lathes — the drawing office engineer moves on to the paper-tape punch, or the Altos if he can program it, or if neither, then writes it all on a process form. He may at this stage be assisted by the mainframe which will define the geometry of the part.

This stage of the work is usually done in APT language and entered on to one of the Altos machines by the NC engineer. It is stored on an Altos hard disc and sent via Des Breach's own software to the Transdata 4000, configured as an internal terminal, and loaded on to its 8in. single-density floppies. This machine can then talk to the IBM 3032 or 370 — at a price. As in many large companies, services are internally billed, so there is an element of cost-saving, too, in the processing power introduced by the Altos set-up.

There are two stages here: the intermediate processor, which defines the basic geometry of the part, and the post-processor, "which does the frilly bits to interface with each controller". The design of a component can involve elaborate and lengthy calculations: for example, the specification for the part may require an elliptical external section and a wall thickness of such-and-such. Interpreting these criteria involves a good deal of computation since the internal section will not in fact be elliptical.

When the paper-tape image is returned over the line from Chelmsford, Des Breach's department sets to work to put in as many safety checks as possible. APT itself is a well-tried language and unlikely to introduce errors but post-processor routines can be prone to errors until they are thoroughly de-bugged — in some cases this has taken as long as three years. They are long programs, usually supplied by the machine-tool manufacturer but refined in the light of experience.

The paper-tape routine so created is then read on to the Altos which drives a Hewlett-Packard plotter to give a physical representation of the passes a cutter will make on a particular workpiece.

Here there is not substitute for experience. It takes a trained eye to spot an abnormality in a plot, but in this kind of application there is literally no margin for error. With a £3,000 billet of high-grade alloy flying around on a lathe, a wrong routine which sends the cutter in at an impossible angle can cause grievous injury to man and machine if the chuck bolts shear.

Even though every test is preceded by a "fresh-air pass", the proof of the program is in the slicing. "I don't think you'll find any programmer who won't admit to a 50 percent increase in heart-rate every time at a try-out", Breach's colleague Jim told me. "It might be six or nine months since you wrote the program that the job is tried on the shop-floor, and it's a fraught moment. You know that if you've missed out a zero somewhere, something catastrophic could happen". In the background lurks the possibility of a power failure: "A power cut is enough to wipe out a RAM and if the processor goes wild, so does the machine".

Spectacular time-savings

Some of the time-savings made by the Altos are spectacular. Translating instructions for one machine for another involves re-sequencing blocks of commands; it may be one, several, or all the blocks. One program searches for a block and re-sequences the numbers. Where previously it might have taken a morning to re-sequence 400 blocks, it can now be done at a rate of three minutes for 1,000 blocks. Where a complete routine on the biggest milling machine, the ZIP might take 9.5 hours to plot on the Transdata, it can now be done in 4.5 minutes. Best of all is the low-cost time-sharing, where a plotter program can continue uninterrupted while the essential converter programs are run.

Des Breach says that, to his knowledge, it is the first application of a micro system in this kind of numerical-control machine-shop. Others will doubtless disagree — I am told that Cincinnati Millicron in the States does just this, though I've a feeling it probably uses a dedicated microprocessor rather than just an adapted off-the-shelf micro. What is especially interesting about the Marconi installation at Broad Oak Works is that the micro which is bought straight from a retailer can be used to improve radically the performance of heavily capitalised plant.

After all, the first cost of the micro system works out at something like 0.2 percent of the machines on the shop-floor. It is vaguely disquieting, though, that these ideas must struggle up from the grassroots, and that there exists no overall policy in a firm which specialised in electronics, to use micros wherever possible.

It is reassuring, though, that once Des Breach, had argued his case, this kind of equipment has been approved for future use on other Marconi plants. Even if the hardware is American, at least the ingenuity which brings it to life is homegrown.

Ethernet or Cambridge Ring?

THERE ARE fashions in communications technology, as there are fashions in anything else. If you had said data communications in the mid-sixties, the technology gurus would have immediately responded by discussing two problems, problems whose solutions they would then tell you were "just round the corner". The first was the high-speed transfer of large files, sited as remotely from each other as possible.

The second problem was that of real-time interactive computing — a problem which was in practice of concern only to defence and airlines, for most of commercial computing was still largely batch. Where there was interactive traffic, most of it was still low speed — about 300 baud. The VDU was nowhere near so ubiquitous; users in the main worked with Teletypes or Teletype-like terminals, and response times were slow.

By the late-sixties and early-seventies, the fashionable talk concerned networks and resource sharing, either nationwide or on a continental scale. It was the start of the era of packet switching and of the concept of resource sharing. We would soon, we were told, be able to share computer resources irrespective of distance or manufacturer's name tag.

In the mid-seventies, the literature was suddenly full of star networks and communications architecture was all the rage: how did a manufacturer make its systems talk to each other; what communications could it offer the market?

Satellite communications

That was followed rapidly by the question of satellite communications. Satellite communications became a common topic long before the major manufacturers had arrived at suitable communications architectures.

The first ideas about satellite communications proposed star networks, with an orbiting central node. At first sight this may seem odd. Is not after all one of the major characteristics of a satellite that when it broadcasts, any ground station may communicate with any other point also so equipped? That may be so, but it is not how the use of satellites was initially envisaged. It was looked at as a method of high-speed, high-volume communications between headquarters, and outlying branches, plants and offices — a method of reinforcing central control.

That may, of course, have been a reflection of the initial military communications uses to which satellite communications were put. However, with satellites emerged a difference — the experts were talking about the management of all communications. If you could send data, why not also voice, facsimile, and image.

Of course, as the initial satellite ground-stations were likely to be costly, we had returned to the area of shifting mass volumes. The larger the volumes, the better the economics looked.

Meanwhile, the fashion has changed yet again. The next bandwaggon is the local communications network. Such is the pace of the bandwaggon that SBS has already stated that it will eventually provide a service to link local communications networks via satellite.

Yet why such networks at all? Why not continue as we are doing now? Such networks have their origins both in technology and economics. In the technology, because as solutions began to be found for the long-distance networking problem, it became apparent that many of the real problems were no longer concerned with long-distance transmission, but with much shorter distances.

by Rex Malik

The concept of distributed computing was beginning to take hold and even where it had not, organisations now had many devices to link to each other or to CPUs. The problems needing solutions were now the linking of devices locally to access the communications medium, and the efficient use of that medium.

Now, a new discipline enters. It is known as communications analysis and management. That it exists at all is hardly recognised yet, but it can be seen more and more particularly in large, international operations, in technologically-aware companies and organisations.

It is the result of three pressures: costs, technology, complexity. Communications costs have been increasing, partly because of inflation, partly because of massive investment programmes by post offices internationally. Visible communications costs have, too, been increasing with continual substitution of machine power for man power.

The export revolution of the last 20 years has meant that more and more communications take place and often over longer distances. Thus 20 years ago, British industry only dabbled in the U.S. market, while the amount of trade with the Far East was low.

Second, technology: the amount of technology in communications has increased. Then — 20 years ago — there were only posts, telephone, Telex. Today, there are posts, telephone, Telex, data, facsimile. Direct-dialling internationally has arrived, and there are now a wide variety of services available within each category, and an even wider range of devices.

Third, the result of this has been an increase in complexity. Not five years ago, even in the best-managed companies, the communications function was handled by a low-level manager. He negotiated with post offices for data connections, telephone connections, and new Telex machines. The rest was beyond his control. The content of communications did not concern him, and neither did the fact that many of the devices for which he obtained links overlapped in function.

Now, mounting costs and new devices have given communications a new prominence in organisations which they never had before and have created a new management function; communications analysis and management. At its best, the new discipline tries to look at and quantify all forms of communication in an organisation and between that organisation and the outside world.

It measures the quantity and tries to assess the quality as well as investigating the costs. It is not just concerned with digital technologies, but also older methods still in use — internal mail, messenger services. It deals, too, with the newer technologies: how will word processing, image processing, video be used? Do we need intelligent digital exchanges? It deals with the future. The planning function has been added and it can now become a serious management job.

Few surprises

Communications analysis has produced surprises. Very few organisations knew — indeed, many still do not know — how much they spend on communications. This has been because communications bills were seldom identified and analysed before. Most costs were usually subsumed under the title of overhead, with one or two clearly identifiable expenses — most noticeable was the telephone bill.

As organisations have begun, however tentatively, to identify where the communications budget is spent, so the composition of that budget has been changing. Postal systems and messengers distributing paper around offices are being replaced increasingly by a need for computers, terminals, word processors and other devices to intercommunicate, for remote files to be accessed on line, and for printers somewhere in the organisation to output material.

The need to mix types of data if one is to build a local communications net which will provide solutions into the future, the mainstream digital technology trends, the types of devices which are appearing on the market, have all forced the network designer to make use of packet switching. Packet switching, for those not familiar with it, consists in essence of a technique for breaking data into packets of code,

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each of which carries an also coded address and other instructions.

Messages of whatever length are broken-up into packets, cast on to the network, and recognised by the device to which they are addressed — it has an interface — where they are collected and re-assembled into the full message or text.

Packet switching is, in principle, a technology which is transparent as far as the type of electronic communications is concerned. It can be data, voice, picture. What determines whether it is any one or all three is the bandwidth available. There are various ways of achieving such objectives using packet switching. Currently the two leading commercial candidates are the Cambridge Ring and Ethernet.

Ethernet was originally the product of Xerox. Ethernet Mark One was developed by Xerox at its Palo Alto, California laboratory, and was under development for seven years — with some use within Xerox — before it surfaced recently as a commercial product, the Mark Two, from Xerox, DEC, and Intel.

Image transmission

The Ethernet Mark Two is a 10 megabit per second data-rate system where Ethernet One was at three megabit. The Mark Two offers a capacity which will, in the relatively near future, permit image transmission and eventually also voice transmission.

The three companies are not, however, just selling equipment: they are also selling a standard — a way of doing things. They will be able to generate the volumes between them to make the economics acceptable. Thus Intel will do the basic LSIs, including that for the controller, while DEC will build the transceivers.

The Cambridge Ring also had its origins in a research laboratory, the computer laboratory of the University of Cambridge. It was devised to allow them to interconnect computers and similar devices, and by early 1979 they had inter-connected an experimental computer of their own, a PDP-7, two PDP-11s, a Nova, and LSI-4, a free-standing plotter, and a number of Z-80-based devices.

The Cambridge Ring has since been taken up by Cambridge-based Orbis Computers which has already shipped a trial installation to ICI at Runcorn, Merseyside, a four-node ring to which initially were attached an LSI-4 and a PDP-11. It has also since been taken up by Logica VTS, the word-processing arm of the Logica consultancy group. It is interested in its use largely in the context of office information systems.

So, how do Ethernet and the Cambridge Ring differ? Firstly, they differ in basic architecture. The Ethernet consists of a coaxial cable run through a site to which devices are then attached by means of cable-TV-technology clamp connectors. There is no central control or switching mechanism.

All the attached devices listen all the time for passing packets. When the device recognises that a packet is addressed to it, it copies it into its own controller. The convention is that a packet with a zero address is taken to be broadcast and all linked devices then copy.

If a device wants to transmit a packet, it waits until there is no passing traffic. Provision is made to alert devices if a collision between packets has taken place. The switching functions are performed by the devices attached, leaving the Ethernet cable as a passive communications backbone.

In topology, the Ethernet can be thought of an an unrooted tree: unrooted, because it can be extended from any one point in any direction. New stations can tap in at any point, yet one avoids multi-path interference — there is, of course, always only one path between source and destination.

In terms of devices and parts, the Ethernet has four components. The cable or Ether; the transceivers which drive that Ether; a device-specific interface which does the packet switching calculations for the device; and a controller, firmware or software for sending the packets in and out of the Ether.

An example of Ethernet One at a very heavily loaded site had 120 hosts connected, including two time-sharing processors, a large number of personal computers, shared files, shared printers, and gateways to other sites. In a single day, it carried about 300 million bytes of data — the majority of packets are about 30bytes long — but the majority of volume is in much larger packets, about 500bytes.

The Cambridge Ring consists of a number of nodes connected cyclically to form a closed circuit. One part of each node is concerned with the regeneration of incoming data signals for onward transmission. To maintain this function when the station is not switched on, 28VDC is distributed around the ring from attached power supplies.

Ring cable in the Logica VTS version is telephone-grade, triple-twisted pair, with at present a maximum length between stations of 100m.

The Cambridge Ring is what is known as an empty slot ring. In it, data travelling around the ring is delayed — a delay can be thought of as temporary storage of data in transit. The circulating storage is so marked that it can be recognised as empty. To gain access to the channel, a station finds a slot currently marked empty, grabs it, marks the slot as full land loads its data.

When data is transmitted, it reaches the addressed receiver where it is copied. The packet with original data continues to go round the ring, however, and the packet is marked empty only by its original transmitter. The receiver marks the packet as it passes, either accepted or rejected because busy. Two response bits are included in each packet which allow the detection of a third stage, namely that no station of that address was found. This stops packets which are wrongly addressed from circulating for ever.

To prevent a station from hogging all the empty slots on the ring, a round-robin scheme has been built into each station so that a returning used slot must be passed downstream and cannot be used immediately again by the same transmitting station. Provision has however, also been made for fast devices to communicate rapidly, while slow devices transmit at a speed which matches their output performance.

The Ring components are the stations — which include the repeater powered by the ring — logic which provides the interface and controls transmission and reception, access logic which is individual to the type of device and matches its interface to the station interface, slave power supplies, connectors, and a monitor. The monitor provides padding via a shift register of 40 bits. That is necessary in very short rings where there is insufficient cable and repeater delay to provide even one circulating empty slot.

Logica VTS is to produce a number of products which will include the ring components and devices to be attached to rings, including a ring bridge which will allow datagrams to be shipped between two rings, and a ring gateway which will allow data to be interchanged between the ring and X-25 networks.

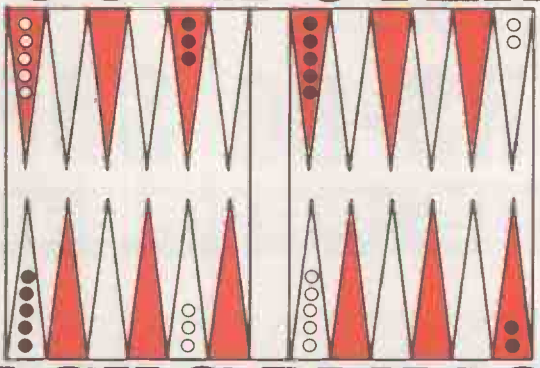
It needs to be remembered that Logica VTS is primarily in the business of inter-communicating word processors. With current technology, it would not be unfair to write that all ring systems suffer one disadvantage: the usable packet length set against the size of the address and control bits is small. It is no disadvantage when considering the movement of computer data only, clever engineering can fix that.

Long-term solution

There is some doubt as to whether one could expect a ring system to meet all communications requirements within a single location. Ring systems are for situations where a decision has been made to concentrate most of the message traffic in digital computer-like devices. Or where indeed a ring on its own will repay its investment from the greater utility it gives to digital computer devices.

Not to be unfair, there is some doubt as yet as to whether Ethernet will provide the total answer. Or that if and when it does it will be recognisably Ethernet as we know it. All that we can say is that both are brave attempts to answer at least part of the problem. The long-term solution in which one communications medium is transparent to all forms of communication is still in practice some way away.

COMPUTER



BACKGAMMON

A COMPUTER program has beaten the world champion backgammon player — the first time a computer has defeated a world champion at his own game. Unlike other strategic computer games, e.g., computer chess, the backgammon program used positional judgment rather than searching algorithms. Writing such a program presents an interesting problem for the hobbyist.

If you decide that you would like to use the code of a working program as a starting point, or prefer just to play the game, a Basic program for Pet is listed. The program is packed as tightly as possible and just fits on an 8K Pet. We can give only brief ideas on backgammon strategy; a number of books have been written on the subject and one of the most authoritative and readable is by Magriel.

Backgammon is a game for two played on a board divided in 24 regions, known as points, plus a central region, known as the bar. Each player starts with 15 pieces which are moved round the board according to the roll of a pair of dice. Eventually the pieces are removed from the board altogether. The game is won by either forcing one's opponent to resign or being the first player to remove all one's pieces from the board.

The stake, i.e., a number of units, won and lost for a single game may increase during the game, and if neither player resigns, the amount won depends on the distribution of the pieces of the losing player. Thus the objective of a game of backgammon is not just to win, but to win as many units as possible. The overall winner is the player who emerges with most units over a number of games.

Figure 1 shows a standard backgammon board with the pieces in the starting positions. The points have been numbered from 1 to 24 to aid description of the rules. Player A's pieces are represented by • and player B's by o. The bar is the central vertical region between points 6 and 7. The general direction for movement of B's pieces is from point 1 to point 24, whereas A's pieces go in the opposite direction — point 24 to point 1.

At each turn, you are required to attempt to make either two separate moves corresponding to the dice throws, or if the dice throws are equal, four separate moves. For example, suppose player B's throw was a six and a one in the starting position. He can either move one piece six places and another piece one place, e.g., a piece from point 12 to 18 and a piece from point 17 to 18, or alternatively, he can move one piece a total of seven places — though this must be done in two moves, e.g., a piece from point 12

by Bob Snell and Barbara Colley

to 18 and then from point 18 to 19. Remember that if the dice throws are equal, you have four, and not just two, separate moves to make.

There is, however, the restriction that you must not move a piece on to a point occupied by two or more of your opponent's pieces. This restriction will mean that there will be times when you are unable to make full use of your dice throws. The rules that apply in this situation are:

- You must make full use of the dice throw if possible.
- If you can make only one move when two are normally required, you must use the higher throw if possible.

If you move to a point occupied by a single piece of your opponent, your opponent's piece is sent to the bar, which is equivalent to going to a point beyond the first point — 24 for player A or one for player B. A single piece on a point is called a blot and if it is sent back to the bar, the piece is said to have been "hit".

When you have a piece on the bar you are not permitted to move any other pieces on the board. It is essential, therefore, to move your pieces from the bar as soon as possible. As far as player B is concerned, the bar may be treated as point 0, e.g., for a throw of three he may move to point 3, assuming that point 3 is not occupied by two or more of his opponent's pieces. Similarly, player A can assume that the bar is equivalent to the 25 point.

Removing your own pieces from the board is called "bearing off". To do it, you must first have all your pieces in your own inner table, i.e., on your last six points. For example, player B must have all his pieces occupying point 19 or higher. To bear off, player B can assume that he is trying to move to point 25, player A to point 0. Thus a throw of three will enable player B to bear off one piece from point 22.

If you have a throw which would normally enable you to bear off from a point which is now unoccupied by your pieces and there is none of your pieces further out, you must bear off from the furthest point occupied. For example, if player B throws a three and all his remaining pieces are on points 23 and 24, he must bear off from point 23.

At the beginning of the game, the basic stake is one unit. Either player may, however, before knowing his dice throw, opt to double the stake. His opponent has the choice of refusing the double, thereby conceding the game for the current stake, or accepting the double, in which case the game continues. The stake may be doubled again, but not by the player who last doubled.

The stake may also be doubled on the first throw of the game — one die per player — which is used to determine which player has the first move, the higher score earns this privilege. If the dice scores are equal, the stake is automatically doubled.

If one player refuses a double, the units won and lost are equal to the current stake. If the game ends because one player has borne off all his pieces, the units won and lost may be higher. If the loser has not borne off any piece and still has one or more pieces in his opponent's inner table — points 1-6 for player B, 19-24 for player A — the winner has backgammoned his opponent and has won treble the current stake.

If the loser has not borne off any piece but the winner does not qualify for a backgammon, he has won a gammon which is worth twice the current stake. If the loser has borne off a piece, he loses only the current stake.

You can see from this that if you are heading for a gammon or backgammon, it is not prudent to offer your opponent a double thereby enabling him to escape with the loss of fewer units. A player may resign only when a double is offered to him.

The first consideration when designing an interactive program should be the user interface — in this case, how the mechanics of the game will be presented to the player. The player needs to know the current position and requires a method to input his moves, including the ability to offer a double at a suitable time and to reply when doubles are offered by the computer.

He must also be able to decide whether dice throws are to be generated automatically by the computer or manually by the player. To the programmer, it seems natural to make the program generate dice throws both for its own use and for the player. However, if the program is able to beat a particular player consistently there can be the doubt in the mind of the player confronted by a series of defeats that dice throws are being fixed for the computer's benefit.

Perhaps the answer is to allow an option at the beginning of the game so that the player may choose whether he wants to enter the dice throws for each move himself or to allow the computer to generate them.

With modern displays, it is possible to use eye-catching graphics to construct a diagram showing the current position of the pieces. However, we believe, like all serious game player-programmers, that the most important factor of a strategic game such as computer backgammon is how well the program plays rather than how good it is at telling you what it has done.

Pretty diagrams are all very well providing that their construction does not take perceptibly longer than a basic but adequate display, nor use valuable program space which otherwise would be available for improving strategy. What is acceptable depends on the size and capability of the computer used — clearly it is not the same for an 8K Pet and a 100K DEC-10.

A basic display, which can be reproduced on a printer, is shown in figure 2. The computer now takes the place of player A and its opponent of player B. One symbol is used for the computer's pieces and a second for the player's. Points are numbered for easy reference. Note that in theory, each point may contain up to 15 pieces. As shown in figure 2, if there are more than five pieces on a point, a digit is displayed. For representing 10 pieces, A is used, for 11, B is used and so on.

Moves can be input and output using point numbers. For the computer, 25 can be used to mean the bar and 0 for bearing off and *vice versa* for the player. In this way, each move may be individually represented.

```
                    X
               COMPUTER
12 11 10  9  8  7  6  5  4  3  2  1
       0           "X  0  X  X  X  X
                   "X  0  X  X  X  X
                   "X
                   "X
                   "7
                   "
                   "            DD BAR
                   "             4   0
                   "
                   "
                   "
                   "   0  0  0  0  0
 0                 "   0  0  0  0  0
13 14 15 16 17 18 19 20 21 22 23 24
               OPPONENT
                  0
```

Notes:
- Doubling die — stake — is set to 4 and is in possession of opponent.
- Opponent has one piece on the bar.
- Computer has seven pieces on point 6.

Figure 2. Simple computer display suitable for production on a Teletype.

It is also vital for the program to ensure that the rules of the game, which are precisely defined, are obeyed. Some writers of commercial programs take the view that if the player wants to cheat by entering an incorrect move, it is up to him — the program will not attempt to check. We absolutely abhor this attitude.

Firstly, it is of no help to the player learning the game if he is allowed to make illegal moves; in fact, even reasonably expert players are unaware of the application of the rules in certain cases, so even they can be helped. Secondly, the player may have entered an incorrect move by mistake. In this case, a perfectly good game could be ruined by the program's inability to detect the error. It is vital that all moves, including null moves, are checked for validity and that doubling is permitted only at the appropriate time.

To simulate dice throws, a pseudo random-number generator is required. It is often already provided for the programmer by means of a function which outputs a real number between 0.0 and 1.0. A number thus obtained needs to be multiplied by six, truncated to an integer to which one is added to give a suitable throw. If a random number generator is not provided it is possible to write your own by using arithmetic to overflow values — see *Computer Simulation Techniques.*

Given that we can now generate a sequence of pseudo random numbers and hence dice throws, we still need to give different values for each game. That may be achieved by discarding some of the random numbers to give a different starting point in the sequence. The number to be discarded can be based on the current time, unless it is available on the computer being used, it must be input by the player.

The next item of software to write is the move generator. Given a particular dice throw and position, the move generator should be able to generate every valid move. Obviously, this can be done only by considering the scores of both dice.

This piece of software is probably the most difficult to write because the programmer must be certain that every possible position and move is catered for. It does not matter that the move generator gives a particular move more than once, providing that it is not taking too long over redundant moves. It matters greatly, however, if it omits to find a particular move. The move it omits could on some occasions turn out to be the best move or even the only move. Even worse than allowing the player to cheat is allowing the program to cheat.

Having written the move generator, the dice generator and the user interface, the programmer has the fundamental ingredients of the program. It is then necessary to write an algorithm which will choose the best move from those available. Although on average there are about 20 ways of playing a particular throw, there could be more than 1,000 possibilities. Depending on the computer being used, it may not be feasible to consider them all.

One way to write the program is to allow a certain number, variable between program runs, of move possibilities to be considered from those available. In this way, a program run might be geared to suit the level of competence of the player, e.g., the beginners' level might process two moves whereas the experts' level could allow up to 50 possibilities to be considered — even more if computer speed permits.

The normal way for the computer to select a move is for a value to be given to

(continued on page 99)

Table 1. Recommended opening moves by first player.

Throw	Move, computer	Throw	Move, computer
6-6	—	5-1	13-8, 24-23 or 13-8, 6-5
6-5	24-18, 18-13	4-4	—
6-4	24-18, 18-14 or 24-18, 13-9	4-3	13-9, 13-10 or 24-20, 13-10
6-3	24-18, 18-15 or 24-18, 13-10	4-2	8-4, 6-4
6-2	13-7, 7-5 or 24-18, 13-11	4-1	13-9, 24-23 or 13-9, 6-5
6-1	13-7, 8-7	3-3	—
5-5	—	3-2	13-10, 13-11 or 24-21, 13-11
5-4	13-8, 13-9 or 24-20, 13-8 or 24-20, 20-15	3-1	8-5, 6-5
		2-2	—
5-3	13-8, 13-10	2-1	13-11, 24-23 or 6-5, 13-11
5-2	13-8, 13-11	1-1	—

(continued from page 97)

each move considered; the move given the highest value is the one adopted. This value is derived from several other values each of which reflect the assessment of the move and subsequent position according to various strategic factors.

Backgammon is a race and as such may be likened to a middle-distance athletics race in which, during the early stages, the participants engage in tactical manoeuvres before finally sprinting to the finishing line. Yet in athletics, the length of the race is known beforehand — not so the case in backgammon. It is possible at any stage to determine how far off the finishing line is by summing the number of points which must be traversed by each piece. This is

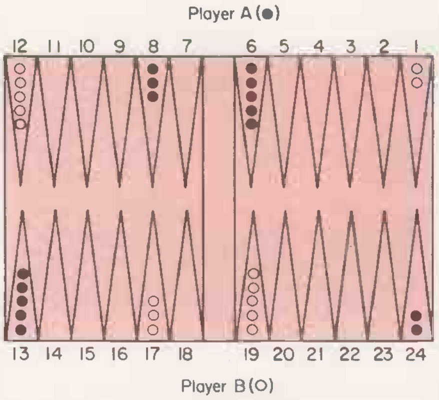


Figure 1. Diagram of a backgammon board with the pieces in the starting positions.

called the point count and is 167 at the beginning of the game.

Knowing the point count for the player and the computer, it is possible to determine who is ahead in the race and by how many turns since the average number of points moved in one turn, assuming none is wasted, is 8¹⁄6 — it is not 7 because doubles require a move through double the normal number of points. If contact between the two sides is still possible, the point count is able to rise because pieces can be hit; if contact is impossible, the point count can only decrease.

It is important to know whether you wish to maintain contact or not as this affects the assessment of whether particular moves are good or bad. Once contact has been lost, the race enters the sprint phase and the players are at the mercy of the dice. If a player is sufficiently far ahead and the distribution of the pieces means that a gammon or backgammon is unlikely, he would be happy to enter this phase.

On the other hand, his opponent would gladly raise his own point count if the alternative was to lose contact and thereby the game. In that situation, he would try to leave blots so that the tactical stage of the race would be prolonged with the possibility that he could then hit back and thus improve his position.

However, he must be careful that his position does not deteriorate to such an extent that a gammon or backgammon becomes a possibility; at some stage it might be necessary to abandon all hope of winning and instead attempt to lose by as little as possible.

Hitting an opponent's piece increases his point count but also prolongs contact. It is of positive value unless you are anxious to avoid contact or unless you already have a sufficient number of your opponent's pieces on the bar. The further back a piece is sent and the more difficult it is for your opponent to re-enter the better — because inner table points are unavailable.

Leaving blots is only a good move if you wish to be hit or if contact has been lost, when it does not matter. Otherwise, it should be assigned a negative value which takes into account the probability of being hit, how far back the piece would be sent and how difficult it would be to re-enter. On a slow computer, we recommend evaluating the approximate probability only.

Making points is the alternative of leaving blots but becomes of positive significance when the point made is on the active side of an opponent's piece. Not only does it hinder his movement past the point, but it threatens him should he leave a blot without moving past. Clearly, not all points are of equal worth. At the beginning of the game, the most important points for the computer to capture, in probable order of value, are: 20, 5, 21, 7, 4, 22 and 18.

The hindrance value clearly increases as consecutive points are made, up to six. When six consecutive points are made, it is called a prime and an opponent's piece is unable to move past. Note that a seventh point adds nothing.

A builder point is one containing a piece which is in a position to move to a desirable point not already made, using the throw of one die should it be suitable. The piece should also be one the player would not mind moving. In figure 3a, points 10 and 8 are builder points with respect to point 7, whereas in figure 3b, points 11, 10, 9 and 8 are builder points and therefore in this respect figure 3b represents the better distribution.

During the end-play, where you are homing in on your inner table and bearing off, some further considerations regarding the distribution of your pieces are necessary. First, the case where contact has not been lost. If you are in the end-game, you must be ahead and therefore wish to play safely. Thus, you should avoid leaving blots and maintain continuity, two aspects already covered. In addition, to avoid leaving blots on future moves, you should try to keep spare pieces on the points furthest out and an even number on the last two points.

Alternatively, if you are trying to avoid a backgammon, then obviously you move your pieces from your opponent's inner table as quickly as possible. To avoid a gammon, maximise on cross-overs between tables and move your pieces into your own inner table as quickly as possible, if necessary piling them up on to the 6 point. However, if there is a race to bear off first and all your pieces are piled up on the 5 and 6 points, you will not be in a good position to bear off easily.

Thus, when homing in, you should aim to distribute your pieces evenly within your inner table. It is also undesirable to strip the higher points too early. For example, it is better to have one piece on each point in your inner table than to have three pieces on each of your three and four points even though both distributions have the same point count, i.e., both need a total dice score of 21. This is because if a six is thrown in the second case, two of the dice score is wasted.

At first glance, it may appear that the best policy to adopt is to play safe always; but you are unlikely to win many games if you do. Safe play is fine when you are ahead in the race and do not want to let your opponent back in.

Leaving blots means that you are more likely to be hit, but also that you are more likely to hit your opponent if he leaves blots. Furthermore, provided you can re-enter once hit, you then win the chance of another crack at him.

Having constructed a formula, a useful test to apply is the set of opening moves given in table 1, which are generally agreed by backgammon experts to be the best. Of course, a look-up table can be used for them, but it is more satisfactory to be able to demonstrate that you have

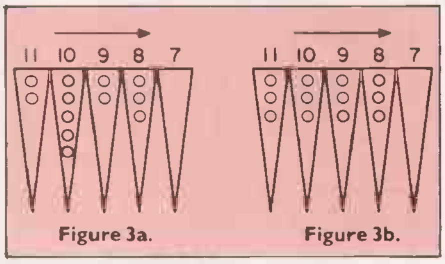


Figure 3. Builder points.

the best formula for the opening stages without recourse to a table.

Further formulae are necessary to decide when to offer a double and whether to accept one if offered. You should offer a double when you have a strong advantage, but not one so great that it might lead to a gammon or backgammon. You should accept a double if you consider that you have a greater than 25 percent chance of winning.

That is difficult to calculate, except when there are few pieces left. The doubling formulae should normally be based on the relative point counts and the length of the game plus an adjustment for the potential of the current position.

References

Hans Berliner, Computer Backgammon, Scientific American, June 1980, volume, 242, number 6 for details of the world champion's defeat.
Paul Magriel, Backgammon, Hamlyn, 1976.
Thomas H Naylor, Joseph L Balintfy, Donald S Burdick, Kong Chu, Computer Simulation Techniques, John Wiley & Sons, 1968.

(continued on next page)

(continued from previous page)

```
1 PRINT"□BACKGAMMON-8K"
2 PRINT"■WHAT LEVEL GAME (1-12) ";:INPUTH:H=H*H:A=30:D=1:DW=0:X=7/18:Y=1/9
3 DIMQ%(A),Z(2),V%(4,2),P%(A),R%(A),R(2)
4 FORI=1TOA:Q%(I)=0:NEXT:Q%(29)=167:Q%(A)=-167:F=25
5 Q%(1)=-2:Q%(12)=-5:Q%(17)=-3:Q%(19)=-5:Q%(24)=2:Q%(13)=5:Q%(8)=3:Q%(6)=5
6 PRINT"□12 11 10  9  8  7 ▐▌▐█▐ 6  5  4  3  2  1"
7 PRINT"■■■■■■■■■■■■■■13 14 15 16 17 18 ▐▌▐█▐19 20 21 22 23 24□"
8 PRINTSPC(18),:FORI=1TO15:PRINT"□▐    ■■■■▌",:NEXT:FORL=1TO24:GOSUB78:NEXT
9 GOSUB91:I=RND(-TI):O=-1
10 GOSUB39:PRINT"MY THROW"Z(1)" YOUR THROW"Z(2)
11 IFZ(1)=Z(2)THENGOSUB239:GOTO10
12 IFZ(1)<Z(2)THENI=Z(1):Z(1)=Z(2):Z(2)=I:GOTO 21
13 PRINT"MY GO WITH"Z(1)" "Z(2):GOSUB 99:PRINT"MY MOVES"
14 FORI=1TOM:PRINTV%(I,1)" "V%(I,2);:NEXT
15 GOSUB95:IFQ%(27)=15THENGOSUB97:X=1:GOTO29
16 O=1:GOSUB39:IFDW>0THENGOSUB96:GOTO21
17 GOSUB243:IFA$<>"D"GOTO21
18 GOSUB43:GOSUB97:IFO=1GOTO20
19 PRINT"DOUBLE REFUSED":O=1:GOTO33
20 DW=1:GOSUB238
21 PRINT"YOUR GO WITH";Z(1)":"Z(2):GOSUB157
22 IFO<>1THENPRINT"ILLEGAL MOVES - TRY AGAIN":GOSUB96:GOTO21
23 PRINT"YOUR MOVES":FORI=1TOM:PRINTV%(I,1)":"V%(I,2);:NEXT:I=FRE(0)
24 GOSUB95:IFQ%(28)=-15THENGOSUB97:X=0:GOTO29
25 GOSUB96:O=1:GOSUB39:IFDW<0GOTO13
26 GOSUB67:IFO=0GOTO13
27 GOSUB247:IFA$="R"THENX=1:GOTO19
28 DW=-1:GOSUB238:GOTO13
29 O=1:J=19-18*X:IFQ%(27+X)<>0GOTO33
30 O=2:IFQ%(F+X)<>0THENO=3:GOTO33
31 FORI=JTOJ+5:IFQ%(I)<>0THENO=3
32 NEXT
33 Y=O*D:IFX=1THENPRINT"I";:GOTO35
34 PRINT"YOU",
35 PRINT"'VE WON"Y"UNIT";:IFY>1THENPRINT"S ";
36 IFO=2THENPRINT"(GAMMON)",
37 IFO=3THENPRINT"(BACKGAMMON)";
38 PRINT:END
39 FORI=1TO2:Z(I)=INT(6*RND(1)+1):NEXT:IFZ(1)=Z(2)THENM=4:RETURN
40 M=2:IFZ(2)<Z(1)GOTO42
41 IFO>0THENI=Z(1):Z(1)=Z(2):Z(2)=I
42 RETURN
43 O=0:GOSUB65:IFL<50GOTO46
44 IFQ%(29)+Q%(A)<(3*L+220)/40THENO=1
45 RETURN
46 GOSUB48:IFP<Q+2THENO=1
47 RETURN
48 P=0:Q=0:FORI=1TO24:IFQ%(I)>0THENP=P+Q%(I)*INT((I-1)/4+1)
49 IFQ%(I)<0THENQ=Q-Q%(I)*INT((24-I)/4+1)
50 NEXT:P=P+Q%(F)*7:Q=Q-Q%(26)*7:RETURN
51 C=1:K=0:R(1)=K:R(2)=K:J=C:IFP%(26)<0THENJ=2
52 FORI=1TO24:IFP%(I)<0THENJ=2
53 IFP%(I)<=0THENC=1:GOTO58
54 IFJ=2THENK=1
55 IFP%(I)=1THENC=1:GOTO58
56 E=X5+5-I:IFE<1ORE>X5THENE=1
57 R(J)=R(J)+E*C:C=C+.5
58 NEXT:B=R(2)+Q%(A)-P%(A)+.01*(P%(27)-Q%(27)):IFK>0THENB=B+XP*R(1)+WK
59 IFB<=GTHENRETURN
60 R(1)=X:R(2)=Y:FORI=1TOLP:IFP%(I)<>1GOTO64
61 FORS=1TO2:L=I-6*(S-1):FORJ=1TO6:K=L-J:IFK=0THENK=-S:J=6:S=2:GOTO63
62 IFP%(K)<0THENB=B-R(S)*(F-I)
63 NEXT:NEXT:IFK<0THENIFP%(26)<0THENB=B-R(-K)*(F-I)
64 NEXT:RETURN
65 L=-Q%(A):IFL>Q%(29)THENL=Q%(29)
66 RETURN
67 O=0:GOSUB65:IFL>99GOTO77
68 J=1:IFQ%(28)<0THENJ=100
69 IFL<50GOTO72
70 N=-Q%(29)-Q%(A):IFN<(3*L+100)/40ORN>35*JGOTO77
71 GOTO73
72 GOSUB48:N=Q-P:IFN<2ORN>16*JGOTO77
73 FORI=1TO7:J=F-I:IFQ%(J)>0THENJ=I:I=7
74 NEXT:IFJ>7THENO=1:RETURN
75 K=0:FORI=JTO12:J=F-I:IFQ%(J)<-1THENK=K+1
76 NEXT:IFK<4THENO=1
77 RETURN
78 IFL=0ORL=FTHENRETURN
79 PRINT"■":J=Q%(L):P=ABS(J)
80 IFL>12THENPRINT"■■■■■■■■■■■■■■"SPC((L-12)*3-2);:GOTO82
81 PRINTSPC((13-L)*3-2);
82 IFL>18ORL<7THENPRINTSPC(4)
83 FORK=1TO5:IFP<KTHENPRINT" ■▌";:GOTO89
84 IFJ>=KANDK<5THENPRINT"●■▌";:GOTO89
85 IFJ<=-KANDK<5THENPRINT"○■▌";:GOTO89
86 IFJ=KTHENPRINT"●■▌";:GOTO89
87 IFJ=-KTHENPRINT"○■▌",:GOTO89
88 PRINT"▌"RIGHT$(STR$(P),2)
89 IFL>12THENPRINT"TT",
90 NEXT:RETURN
91 PRINT"■■"SPC(19);:P=7-INT(Q%(F)/2):J=P+Q%(F):R=7-INT(-Q%(26)/2)
92 K=R-Q%(26):FORL=1TO15:PRINT"   ■■▌";:IFL>PANDL<=JTHENPRINT"□●■▌";
93 IFL>RANDL<=KTHENPRINT"□▐○■▌",
94 NEXT:PRINT"■":RETURN
95 FORI=1TOM:L=V%(I,1):GOSUB78:L=V%(I,2):GOSUB78:NEXT:GOSUB91:RETURN
96 GOSUB250:PRINT"HIT RETURN WHEN READY":GOSUB251
97 GOSUB250:PRINT"TTTTTT":FORI=1TO6
98 PRINT"                                        ":NEXT:PRINT"TTTTTT":RETURN
99 M1=1:N=0:R=1:U=0:G=-999:FOR I=1TO8:R%(I)=U:NEXT
100 LP=18:X5=5:XP=.25:WK=U:I=Z(1)+Z(2):IFZ(1)=Z(2)THENI=I*2
101 I=I-Q%(29)-Q%(A):IFI<(3*Q%(29)+380)/40GOTO103
102 WK=-99:LP=13:X5=1:XP=1
103 GOSUB111:IFN<M1GOTO107
104 U=U+1:IFU>HANDN=MGOTO107
105 GOSUB51:IFB<=GANDN=M1GOTO103
106 G=B:M1=N:FORI=1TOM:R%(I)=V%(I,1):R%(I+4)=V%(I,2):NEXT:GOTO103
107 FORI=1TOM:V%(I,1)=R%(I):V%(I,2)=R%(I+4):NEXT
108 FORI=1TOA:P%(I)=Q%(I):NEXT
109 KP=1:FOR I=1TOM:A1=V%(I,1):A2=V%(I,2):GOSUB147:NEXT
110 FORI=1TOA:Q%(I)=P%(I):NEXT:RETURN
111 IFN>0GOTO136
112 R=1
113 N=1:Q=24:FORI=1TOA:P%(I)=Q%(I):NEXT
114 S1=Q:IT=Z(R):IFN<>1THENIT=Z(3-R)
115 IFP%(F)=0GOTO118
116 K=F-IT:IFP%(K)<-1GOTO133
117 V%(N,1)=F:V%(N,2)=K:GOTO131
118 P=0:FOR J=S1TO1STEP-1:Q=J:IFP%(J)<=0GOTO121
119 K=J-IT:IFK<=0THENP=1:J=1:GOTO121
120 IFP%(K)>=-1THENP=2:J=1
121 NEXT
122 IFP=0GOTO133
123 IFP=1GOTO125
124 V%(N,1)=Q:V%(N,2)=K:GOTO131
125 IFK=0THENK=7
126 IFK<0THENK=Q+1
127 P=0:FORI=KTO24:IFP%(I)>0THENP=1:I=24
128 NEXT
129 IFP=1GOTO133
130 V%(N,1)=Q:V%(N,2)=0
131 A1=V%(N,1):A2=V%(N,2):KP=1:GOSUB147:IFN=MGOTO146
132 N=N+1:GOTO114
133 IFN>M1GOTO145
134 IFN=1GOTO142
135 N=N-1
136 IFV%(N,1)=FGOTO142
137 IFV%(N,2)=0GOTO134
138 S1=V%(N,1)-1:IFS1<=0GOTO134
139 FORI=1TOA:P%(I)=Q%(I):NEXT:IT=Z(R):IFN<>1THENIT=Z(3-R)
140 K=N-1:IFK=0GOTO118
141 KP=1:FORI=1TOK:A1=V%(I,1):A2=V%(I,2):GOSUB147:NEXT:GOTO118
142 IFM=4ORR=2GOTO144
143 R=2:GOTO113
144 N=1
145 FORI=NTOM:V%(I,1)=0:V%(I,2)=0:NEXT:N=N-1
146 RETURN
147 IFA1=A2GOTO156
148 L=(59-KP)/2:P%(L)=P%(L)+A2-A1:IFA1=0THENP%(26)=P%(26)+1:GOTO152
149 IFA1=FTHENP%(F)=P%(F)-1:GOTO151
150 P%(A1)=P%(A1)-KP
151 IFA2=0THENP%(27)=P%(27)+1:RETURN
152 IFA2=FTHENP%(28)=P%(28)-1:RETURN
153 IFP%(A2)<>-KPTHENP%(A2)=P%(A2)+KP:RETURN
154 P%(A2)=KP:L=55-L:P%(L)=P%(L)-KP:L=4+L:P%(L)=P%(L)-A2
155 IFL=29THENP%(L)=P%(L)+F
156 RETURN
157 FORI=1TOM:V%(I,1)=0:V%(I,2)=0:NEXT
158 B$=""
159 GOSUB251:IFA$=CHR$(13)GOTO164
160 IFA$=CHR$(20)GOTO165
161 I=VAL(A$):IFI=0ANDA$<>"0"THENA$="-"
162 B$=B$+A$
163 PRINTA$;:GOTO159
164 PRINT:GOTO168
165 B=LEN(B$)-1:IFB=0THENPRINTA$;:GOTO 158
166 IFB<1GOTO159
167 B$=LEFT$(B$,B):GOTO163
168 B=LEN(B$):K=0:L=1:FORI=1TOM:FORJ=1TO2
169 K=K+1:IF K>BTHENI=M:J=2:GOTO174
170 A$=MID$(B$,K,1):IFA$<>"-"GOTO173
171 IFL=1GOTO169
172 L=1:GOTO174
173 V%(I,J)=V%(I,J)*10+VAL(A$):L=0:GOTO169
174 NEXTJ,I:O=0:FORI=1TOA:P%(I)=Q%(I):NEXT:R(1)=Z(1):R(2)=Z(2)
175 FORI=1TOM:M1=V%(I,1):M2=V%(I,2):IFM1<>M2GOTO192
176 IFI<>1GOTO182
177 K=Z(1):GOSUB223
178 IFO=0GOTO217
179 IFZ(1)=Z(2)GOTO188
180 K=Z(2):GOSUB223:IFO=1GOTO188
181 GOTO217
182 K=Z(3-J):GOSUB223:IFO=0GOTO217
183 IFZ(3-J)>=Z(J)GOTO187
184 K=Z(J):FORL=1TOA:R%(L)=P%(L):P%(L)=Q%(L):NEXT
185 GOSUB223:FORL=1TOA:P%(L)=R%(L):NEXT:IFO=1GOTO218
186 GOTO217
187 IFI=MGOTO218
188 O=0:J=I+1:R=0:FORK=JTOM:IFV%(K,1)<>V%(K,2)THENR=1:K=M
189 NEXT
190 IFR=1GOTO217
191 GOTO218
192 IFM1<0ORM1>24GOTO217
193 IFM2<1ORM2>FGOTO217
194 IFM1<>0GOTO200
195 IFP%(26)>=0GOTO217
196 J=0:FORK=1TO2:IFM2=Z(K)THENJ=K
197 NEXT:IFJ=0GOTO217
198 K=P%(M2):IFK>1GOTO217
199 GOTO215
200 IFP%(26)<0ORP%(M1)>=0GOTO217
201 IFM2=FGOTO206
202 J=P%(M2):IFJ>1GOTO217
203 R=M2-M1:IFR=Z(1)THENJ=1:GOTO215
204 IFR=Z(2)THENJ=2:GOTO215
205 GOTO217
206 R=F-M1:S=0:FORK=1TO2:J=3-K:IFR<=Z(J)THENS=1:K=2
207 NEXT
208 IFS=0GOTO217
209 FORK=1TO18:IFP%(K)<0THENS=0:K=18
210 NEXT
211 IFS=0GOTO217
212 IFR=Z(J)GOTO215
213 K=M1-1:FORL=19TOK:IFP%(L)<0THENS=0:L=K
214 NEXT:IFS=0GOTO217
215 A1=M1:A2=M2:KP=-1:GOSUB147:IFM=2THENZ(J)=0
216 GOTO219
217 O=2
218 I=M
219 NEXT
220 IFO=2THENZ(1)=R(1):Z(2)=R(2):GOTO222
221 O=1:FORI=1TOA:Q%(I)=P%(I):NEXT
222 RETURN
223 O=0:IFP%(26)=0GOTO226
224 IFP%(K)<2GOTO237
225 GOTO236
226 S=0:FORL=1TO24:IFP%(L)>=0GOTO229
227 KP=L+K:IFKP>24THENS=L:L=24:GOTO229
228 IFP%(KP)<1THENS=-1:L=24
229 NEXT
230 IFS=0GOTO236
231 IFS=-1GOTO237
232 IFKP=FTHENKP=18
233 IFKP>FTHENKP=S-1
234 S=0:FORL=1TOKP:IFP%(L)<0THENS=1:L=KP
235 NEXT:IFS=0GOTO237
236 O=1
237 RETURN
238 PRINT"DOUBLE ACCEPTED"
239 D=D+D:A$=RIGHT$(STR$(D),2):PRINT"■"SPC(19)"   ■▌";
240 IFDW>=0THENPRINT"■"A$"■■▌";
241 PRINT"■■■■■■■■■■■■■■  ";:IFDW<=0THENPRINT"■▌■"A$"■"
242 GOSUB96:RETURN
243 GOSUB250:PRINT"HIT D TO OFFER DOUBLE ELSE HIT RETURN";:GOSUB251
244 IFA$="D"THENRETURN
245 IFA$=CHR$(13)THENGOSUB97:RETURN
246 PRINT"□";:GOTO243
247 PRINT"DOUBLE? HIT A TO ACCEPT OR R TO REFUSE":GOSUB251
248 IFA$<>"A"ANDA$<>"R"THENPRINT"□";:GOTO247
249 RETURN
250 PRINT"■■■■■■■■■■■■■■■■■■■■■■■";:RETURN
251 GETA$:IFA$=""GOTO251
252 RETURN
READY.
```

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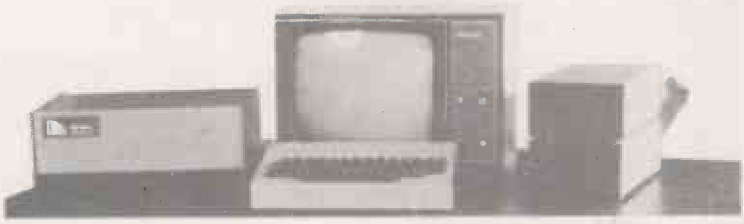

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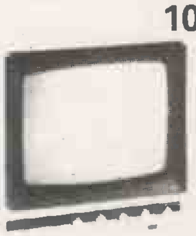

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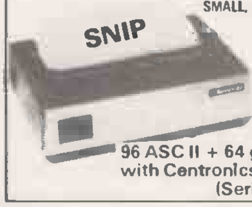

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Duncan, a high-level interpreter for Nascom 1, can run three to four times faster than an integer Tiny Basic and just begs to be used for real-time control applications. John Dawson reports.

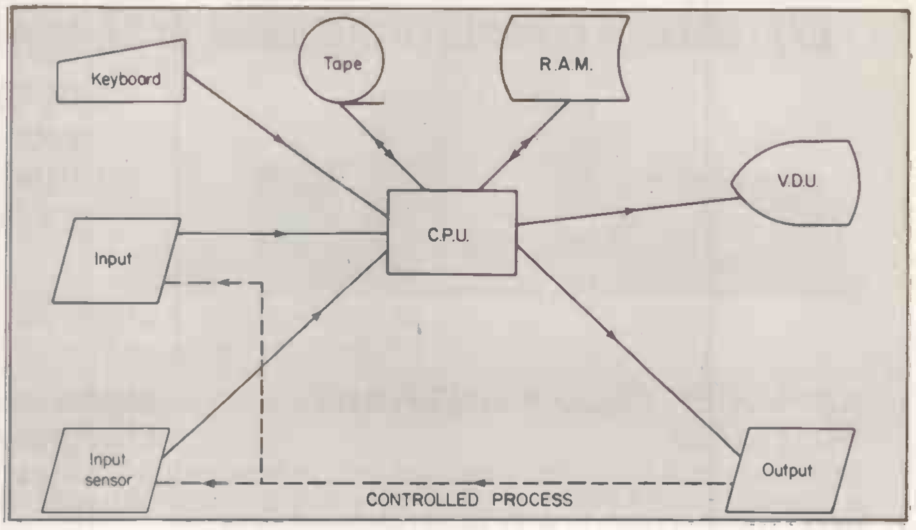

Figure 1.

Duncan brings a new economical simplicity to Nascom 1 programs

PEOPLE making initial contact with computers should be aware that computer languages take many forms. They can be designed for special or general purposes and are nothing more than a way of grouping fundamental machine-code instructions into statements and commands which can be used more easily by someone wishing to program a computer. For example, a language called Unkle has been introduced for possible use by British Telecom staff working with System X, while Mumps was developed by DEC specifically for medical information systems.

Common high-level languages are not well suited to microprocessor-control purposes as each has an emphasis towards the environment of the original user. Commercial languages are distinguished by their ability to handle files, perform decimal arithmetic and manipulate textual information. Scientific languages are usually able to handle floating-point numerical calculations and arrays of data.

High-level languages do not produce very efficient machine-language programs — most versions of interpreted Basic, for example, will execute only a few 100 instructions each second. Conversely, a high-level language may produce a program listing which conveniently describes the tasks the language will undertake. Far less time may be needed to write a program in a high-level language than in an assembler or machine-code-based system.

Command and control

Command and control languages have been developed for real-time processing on large computers — there is a language called Ironman or ADA which has been developed from a Pascal base for the U.S. Department of Defence and Coral 66 is claimed to be a real-time, high-level compiler. Coral is not readily available on microprocessors but has a number of extensions allowing bit manipulation and the control of unusual peripheral devices. It has, however, no mechanism for dealing with interrupts and it is a hallmark of real-time languages that they can respond to the asynchronous and unpredictable flow of information in the real world.

Many microcomputer applications involve the reception of data and other information from input devices and sending data and control information to output devices — figure 1. The circular path from the input sensor to the CPU, to the output device and through the controlled process back to the input is an ordinary closed loop feedback system in which the computer, CPU, may switch the process on or off, or modify it according to the data from the sensor. The CPU may scale the input and may, for example, output a linear control signal on the basis of a logarithmic input, or inject or remove hysteresis from the system.

Robotics aspects

Articles on shaft encoders and other aspects of robotics have been published in *Practical Computing*. Often the control and status information used in control systems is made up of a few binary digits with very precise hardware-related meanings. In these conditions, a machine-code program is attractive for its speed and ability to compare and manipulate individual bits in a byte of data.

We live mostly in a world of eight-bit accuracy. For many purposes, an incremental scale of 255 parts is entirely sufficient to describe the range of our experiences. We seldom need to know the temperature of our environment to better than one degree Centigrade — 40 degrees C to +40 degrees C is 80 increments — or the time for which an egg has boiled to less than five seconds — one part in 48 over a four-minute period.

Wind direction may be measured to two degrees using 180 increments by meteorologists and its speed to half a mile per hour, 250 increments. In amateur scientific applications, eight bits can produce a resolution of better than 1/20in. in 10in. on a graph plotter, and will locate a robot to within plus or minus 1in. of its target in a roof 20ft. square.

Duncan is a high-level interpreter for the Nascom 1 computer written in machine code and operating under the T4 monitor. It contains instructions for the acquisition, logging and processing of data in addition to the usual arithmetic and logical operators. Unlike Basic, Duncan has no line numbers and should be treated as a stream of source instructions to the computer in which labels act as points of reference for jumps and subroutine calls.

Duncan runs three or four times faster than an integer Tiny Basic. The language is aimed at the control of external devices and has many uses in schools, electronic service workshops, model control systems, and the home.

Structural analysis

A flowchart illustrating the structure of Duncan is set out in figure 2. The program executes at 0EF0; the program name is displayed and the entry table and a prompt are displayed on the next line. The eight command modes are set out in table 1 and they allow the creation of a new program, its subsequent printing, editing and execution, its storage and retrieval on cassette, and the storage and retrieval of data acquired during a program run.

The language occupies RAM from 0C50 - 1400 — 1968 bytes decimal —

which includes an area for the storage of variable values from 13C0 - 1400. Scratchpad RAM is located at 13A0 - 13BF. Instructions are stored from 1400 - 15FF and the area 1600 - 17FF is used for logging data. The program area is 512 bytes in size and will overlay the data log area if further instructions are entered. The existing memory allocation is, however, generous for the majority of applications.

The data log may be re-located on large systems and can be adjusted to store values to fill whatever RAM is installed. Details of a memory expansion board for the Nascom were published in *Practical Computing,* November 1980.

Indispensable aid

Hard copy is an indispensable aid to most computer applications and Duncan includes subroutines to format and print data on a teleprinter accepting CCITT five-element code. The instruction set has been designed for its mnemonic appeal within the limitations imposed by the character set available on Creed teleprinters.

Both the instruction mnemonics and their correlation with the equivalent printed character can be altered easily. The hardware and software for a Nascom/Creed interface were described in *Practical Computing,* July 1980.

Duncan works with 16-bit unsigned integers, 0 - 65535, and has I/O facilities for eight-bit data values. The sign of the result of a calculation is unimportant for control tasks as a D-A converter can be set up to output 0 volts with an input value of 128, swinging to the maximum positive and negative outputs at 511 and 0 values at the input respectively.

Circuit diagrams

The Ferranti ZN 425 E-8 data sheet contains practical circuit diagrams for both D-A and A-D converters. This chip can be connected easily to a PI/O port on an unmodified Nascom 1.

Duncan allows conditional jumps to be made and subroutines may be called although nested subroutines are not allowed. Duncan uses reverse Polish notation in which numbers are pushed up a stack and are brought down in the course of a calculation. The language uses number handling routines derived from M5, which was described by Raymond Anderson in the *Liverpool Software Gazette,* November 1979.

The theoretical program illustrates the simplicity and economy of a Duncan control sequence. The program should be read with the explanation of each step and in conjunction with the full instruction set which is listed in table 2. The program will turn off a dark room safelight, make an exposure in an enlarger after recovering the time in seconds from a keyboard entry, and then turn on the safelight.

The program assumes that D-A converters are connected to the Nascom PI/O and that the converters are used to switch relays for control of the lights. The safelight is connected to port 4 and the enlarger to port 5:

```
0 =x  255 =z LA
z   S4  ?  =t  .
x   S4  z    S5   t   W   x   S5
JUA:
```

The following steps occur when the program is executed:

- 0 =x The CV, which is explained in detail later, is set to 0 and this value is stored in variable x.
- 255 =z The CV is set to 255 and this value is stored in variable z.
- LA Label A — this is a reference point in the program.
- z S4 The CV takes the value stored in variable z (00255) and this value is et at port 4. The analogue voltage at port 4 will go high.
- ? =t The program looks for a number from the keyboard. The language handles 16-bit unsigned integers, 0 - 65535. The last five numbers entered are used, leading zeros are not required and the operation is terminated by any non-numeric character, e.g., 773 new line is acceptable. The screen is scrolled-up one line and the cursor set to the bottom left-hand margin.
- x S4
- z S5 The CV is set to the value stored in variable x, 00000, and this value is set at port 4. A similar process takes place at port 5, 00255. The safelight has been turned-off and the enlarger turned-on.
- t W The CV is set to the value obtained from the keyboard and previously stored in variable t. W is a programmable wait instruction and the computer waits for the length of time determined by t. 1W produces a wait of one second.
- x S5 The enlarger is turned-off after the computer has emerged from the wait state.
- JUA The program jumps unconditionally to label A and the safelight is turned on before a new number is requested from the keyboard.
- : Marks the end of the program.

This program is very simple, it does not set up the PI/O ports as outputs, for example, and could be made much more convenient. There should be no need for a new exposure time to be entered before

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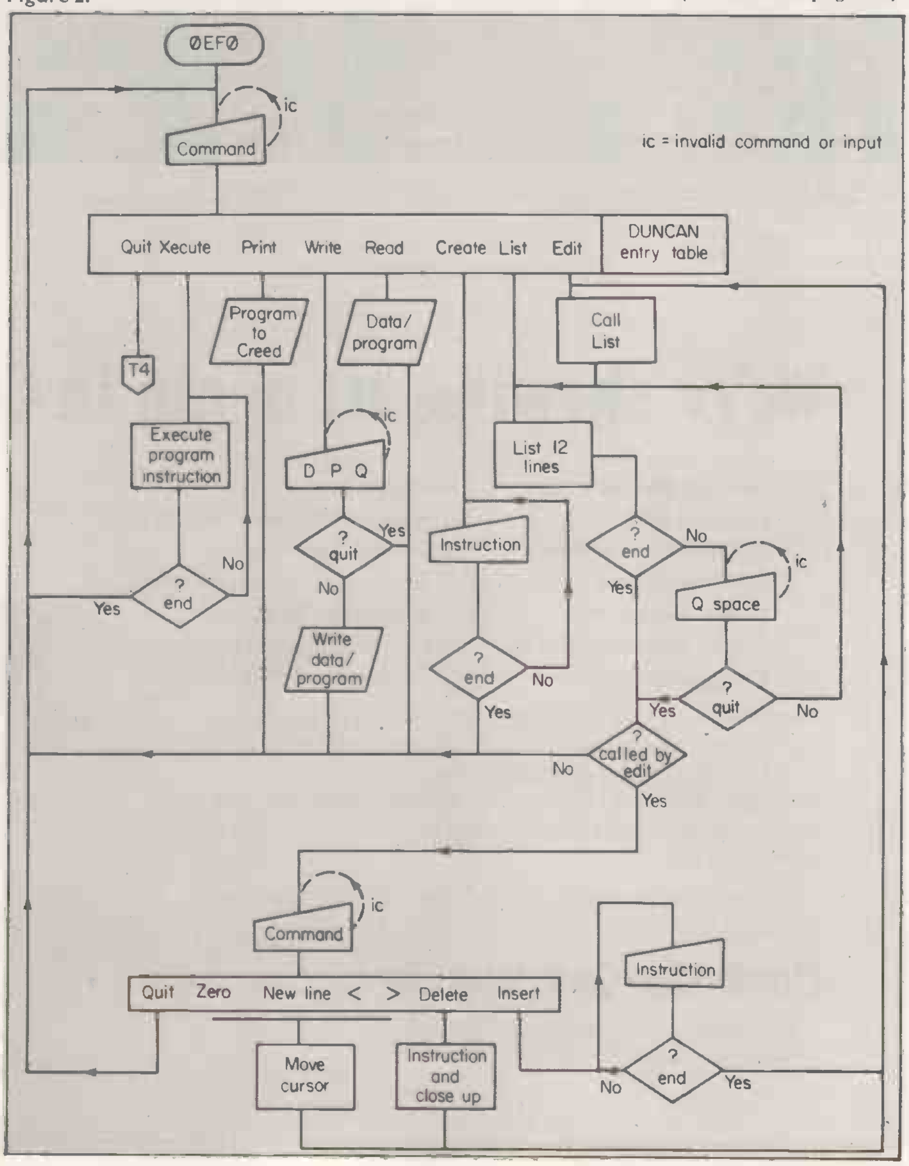
Figure 2.



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each print is made and the program could be modified to ask if a different time is necessary. It demonstrates a control system with a practical function and which uses only 32 bytes of program storage discounting spaces which can be removed from a practical version.

The current value, CV, is held in the register pair DE in the Z-80 CPU. The CV may be displayed at any time in the course of a program by the instruction =?. The CV is altered in the following circumstances:

- When a number is encountered in the course of a program the CV is replaced by the number.
- When a variable is encountered the CV is replaced by the value stored in the variable.
- The instructions I and D increment and decrement the CV respectively.
- After an arithmetic operation, the CV contains the result. When a ? instruction is encountered the program obtains a numeric value from the keyboard and the CV is replaced by the new number.

The stack is lifted by the comma instruction ',' and the CV is pushed up the stack — a second comma will lift the stack again pushing stack 1 to stack 2 and the CV to stack 1. The CV is unaltered by the lift instruction. The program sequence:

45 , , + + =?

will perform the following operations:

CV	Stack 1	Stack 2	
xx	xx	xx	
			45
45	xx	xx	
			,
45	45	xx	
			,
45	45	45	
			+
90	45	xx	
			+
135	xx	xx	
			=?
	Screen displays		00135

Similarly, the program sequence:

6 = V , ? * =?

will set the CV equal to 6, store the CV (6) in variable V, lift the stack, obtain a number from the keyboard and place it in the CV, multiply stack 1 by the CV, place the result in the CV, and output the result to the screen. The stack operations are shown below:

CV	Stack 1	Stack 2	
			6
6	xx	xx	
			=V
6	xx	xx	
			,
6	6	xx	
			?
Input (7)	6	xx	
			*
42	xx	xx	
			=?
	Screen displays		00042

Variables may be identified by any lower-case alpha character. Hence, Duncan allows 26 variables and there is a special remainder variable — upper-case R — which stores the overflow or underflow bits after multiplication or division. Overflowing bits in addition and subtraction operations are lost. The following program illustrates how the R variable works:

?	, ?	/	=?	( )	R	=?	:
9	3		Screen displays		00002	00001	
15	4				00003	00003	
141	12				00011	00009	

Leading zeros are displayed. The brackets define text which is to be output to the screen. In this case, the space between the numbers and the R variable contain the remainder of the division modulo, the divisor.

Ax	Acquire data from port x and place the value, 0 - 255, into the next sequential location in the data log. CV is maintained intact.
B	Bring back the value in the data log pointed to by the CV when the B instruction is entered. The CV is destroyed and replaced by the data value, 0 - 255.
Cx	Clear the data log area, CD, or clear the screen, CS. Each location in the data log, CD, is set to zero and the log pointer is set to the start address — 1600 Hex.
D	Decrement the CV by 1.
I	Increment the CV by 1.
Fx	Find the value, 0 - 255, at port x and place in the CV.
Sx	Set the value in the CV, 0 - 255, at port x.
Jcl	Jump if condition c is satisfied to label l:
	C - U Unconditional
	Z CV = 0
	N CV not = 0
	E CV = stack 1
	X CV not = stack 1
	L CV less than or equal to stack 1
	G CV greater than stack 1
	S Jump to start of program
	B Jump to Breakpoint and display Z-80 registers.
KH	KH causes the program to scan the keyboard and jumps to Hold if any key is pressed.
K$l	K$l causes the keyboard to be scanned and if a key is pressed the program will call at the
KA	subroutine identified by label l. KA does not scan the keyboard but causes the low byte of CV — values up to 255 are entered correctly, larger numbers are entered modulo 255 — to be placed into the data log at the next sequential location.
Lx	Label followed by identifier x to which jumps and subroutine calls may be made.
H	Hold program execution. Continue execution by pressing space bar. Press Q to quit program and return to the entry table.
W	Programmable wait instruction. The program halts for a time defined by the value in the CV when the instruction is entered. One wait instruction, 1W, lasts approximately one second.
Pc	Prints the character immediately following the instruction. Special functions are executed by four suffixes:
	S Prints the top 15 lines of the Nascom screen.
	L Prints the bottom line of the screen.
	. Prints carriage return and line feed characters.
	/ Prints a line feed character.
(t)	Text t between brackets is displayed on the Nascom screen starting at the current cursor position.
.	Full stop — scrolls the Nascom screen up one line and places the cursor at the bottom left-hand margin.
,	Comma — lifts each value in the stack and places the CV into stack 1. The CV is maintained intact.
$l	Program execution is transferred to the subroutine at label l. The CV is maintained intact into the subroutine. There is no provision for nesting SRs.
;	Return from subroutine. The CV is maintained intact.
?	Obtains a number from the keyboard. Entry is terminated by any non-numeric character. The largest number that can be handled by Duncan is 2^{16} or 65535 decimal. The value entered becomes the CV.
=?	Display the CV on the Nascom screen starting at the current cursor position. The CV is maintained intact.
=v	Replaces whatever value was stored in the variable v with the CV. CV is unaffected by the instruction.
+	Arithmetic operator — adds the CV to stack 1 — the value at the top of the stack — and places the result in the CV. Overflow bits from the operation are lost.
—	Arithmetic operator — subtracts the CV from stack 1 and places the result in the CV. Underflow is not detected.
*	Arithmetic operator — multiplies the CV by stack 1 and places the result in the CV. Overflowing bits are placed in variable R.
/	Arithmetic operator — divides stack 1 by the CV and places the result in the CV. Underflowing bits are placed in the variable R.
:	Colon — program terminator. Places three ASCII zero bytes in the program store and returns from the Create mode to the entry table. This character may appear only at the end of a program and is forbidden inside bracketed text.

Table 2. Duncan instruction set.

The port identifier following the find, set and acquire instructions may be any numeric character or upper-/lower-case alpha character. This allows the system to address 62 ports where port 0 = identifier 0. Ports 6 and 7 address the PI/O control ports and ports 4 and 5 are the I/O addresses. In extended systems port E, for example, addresses port 21 decimal, 15 Hex.

Error messages are displayed for faults in program construction. Jump commands for which no label can be found will generate the message, JUMP

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ERROR, following which the program enters the edit mode, listing the program on the screen with the cursor pointing to the incorrect jump label. The acquire command sets the PI/O ports to input data and generates an error message if an attempt is made to address the control ports.

Programs running under Duncan may be synchronised to external events by using the principle of deliberate error. The synchronisation may either be to an external time signal or to some other event. The control program is set to finish its task deliberately ahead of the time at which a reference signal is expected.

The program then enters a loop in which the value obtained from a port is compared to a value set in a program. When the reference signal occurs, the value obtained by the port is greater than the comparison value and the program jumps to the next phase.

Subroutine group

A standard Nascom 1 has no interrupt facility, but Duncan can poll a number of devices to see whether or not an event has occurred which requires some action. After obtaining a value from a port, the program can be diverted to one or another of a group of subroutines depending on the incoming reading. Although the subroutine may be called from several points in a program, it is not necessary for the subroutine to return to the instruction following the call.

Because the program does not allow subroutines to be nested, no problems are created when a jump is made from a subroutine back into a different section of the main program. The return address for the subroutine call is still available and will be destroyed and replaced when a new call is made.

Table 1. Duncan entry table.

P	Prints the current Duncan program and returns to the entry table.
W	Prompts for data, program or quit. Writes the data log area or the program to cassette and returns to the entry table. Quit returns directly to the entry table.
R	Reads either data or a program into the correct area for subsequent processing. Returns to the entry table.
Q	Quits the entry table to the Nasbug T4 monitor.
L	Lists the current program. If the program occupies more than 12 lines, the second page is displayed by pressing the space bar. Q will quit the list mode either to the entry table or, when list is called by the edit mode, back to the edit mode.
C	A new program is created and overwrites any instructions previously stored. The keyboard functions normally with the exception of the : (colon) which terminates the create mode and returns to the entry table.
X	Causes the stored program to be interpreted by Duncan and executed.
E	Edit mode. The stored program is listed automatically by the list mode and the edit functions set out in table 3 may be carried out. Q causes the termination of the Edit mode and a return to the entry table.

<	Moves the cursor one position to the left on the screen and one instruction towards the beginning of the program. The shift key should not be pressed as the < function is interpreted directly by Duncan.
>	Moves the cursor one position to the right on the screen and one instruction towards the end of the program. The shift key should not be pressed.
Z	Zeros the cursor to the first instruction in the stored program. The character at the position occupied by the cursor is displayed on the right-hand side of the top line of the screen.
N	Searches for the next new-line character and positions the cursor at this point in the program. If the end of the program occurs first, the cursor is placed on the terminating instruction.
D	Deletes the instruction at the cursor position and closes up the remainder of the program.
I	Instructions may be inserted into a program by typing I followed by the new instructions. The keyboard may be used to enter any character except a ':' which terminates the function and adds the instructions to the program.
Q	Quits the edit mode for the entry table.

Note: It is possible to move the cursor from the program area and into the variable-storage RAM. Beware of inserting or deleting characters if the cursor is not visible on the screen. The Z command will always return the cursor to the top-left position of a listed program at the first instruction.

Table 3. Duncan edit mode functions.

Hysteresis can be programmed into a switching operation so that a process is effected when the value obtained from an A-D converter exceeds one value, for example 200 on a scale of 255 increments. A second section of the program may then switch the device off or effect some other process when the value monitored by the A-D converter falls below 100 on the same scale.

Accurate meter

The Nascom 1 used with Duncan and a simple Creed teleprinter can act as an accurate digital printing volt meter using the hold and find instructions to measure a voltage when the space bar on the keyboard is pressed. A simple program can be written to find a value which may be scaled and processed by Duncan according to the volt meter scale in use and will then print either the value or an explanatory message followed by the voltage that has been measured. A more sophisticated alternative is to use Duncan to prompt for each test point in a test routine, print the expected voltage or other value and then print the value obtained during the test.

The wait instruction has many uses. One wait state lasts approximately one second and a program may be set to acquire data or carry out some other process at any speed between filling the Data Log, 512 values, in less than a second to the acquisition of one reading each day. If the CV is 65535 when the wait instruction is entered, the computer will do nothing for 18.2 hours before emerging to continue the program. 12 hours is 43200 seconds and the program sequence for a 24-hour wait is 43200 W W.

The acquire instruction stores incoming information in sequential order ready for subsequent retrieval by the bring-back instruction. Data can be acquired from one or a number of ports and can be interspersed with information such as time markers or values from calculations by using the KA instruction.

Program sequence

Putting the Ax instruction inside a program loop can log data at regular intervals while the addition of a hold or KH instruction to the loop will allow data to be gathered under the control of the user. The program sequence:

I = f   LA ? KA   fI = f,400 JGA

will put 399 values into the data log from the keyboard which can then be used as a look-up table for anything from playing a tune through to displays of normal and abnormal electro-cardiogram recordings for training nurses and intensive therapy unit staff. Information can be retrieved from the data log either sequentially or on a random-access basis using the bring-back instruction.

Using a minimum system with a D-A converter on one of the PI/O ports and an A-D converter on the other port, the Nascom/Duncan combination can be used to measure easily a variety of parameters in physical or electronic systems such as the signal characteristics of transistors or operational amplifiers, the efficiency of small electric motors, or an echo location display; either printing or plotting the results on a teleprinter.

Conclusions

- **Duncan shows how a high-level language can be developed for a particular purpose.**
- **The structure of the language is different from Basic but is appropriate for the control tasks for which it has been designed.**
- **Duncan is easy and satisfying to use with even a minimum I/O capability on the Nascom.**
- **Above all, Duncan provides an entry into the intoxicating world of real-time control of robots, laboratory experiments, electronic equipment and a diversity of domestic devices from model trains to intelligent vacuum cleaners using a very small computer.**

The listing for Duncan is too large to publish. However, a cassette with the program record in T4 dump or write format and back-up documentation may be obtained from John Dawson care of Practical Computing. *The package contains the cassette, a printout of a Hex dump and an annotated, disassembled listing of Duncan with additional notes on program reference points to help users who wish to modify the program for their own purposes. The package costs £7.50 inclusive of postage and packing.*

Raymond Anderson maintains that you should not develop too heavy a dependence on Pascal because it will repay you by letting you down just when you need most programming support from it. Here are what he considers to be its cardinal deficiencies.

Prolonged use of Pascal can seriously damage mental health

PEOPLE learning Pascal after using Basic for some time soon realise the advantages a structured language can give them, become proud of their mastery of Pascal and seem keen to castigate those who still use Basic. Unfortunately, Pascal is far from ideal, and by the time people realise it, they have to plod on as best they can to ensure their investment in old software is not lost — just as Fortran users have done for 20 years.

My view is that it is better to learn a language which allows expansion within itself as much as possible, so old investment is not lost by providing more facilities, and portability is ensured. Algol 68 is my personal choice, although ADA seems to have achieved this, and in their own ways so have APL, Lisp and Forth.

Some software houses push Pascal because the compiler is reasonably easy to write and easy to sell to somebody unfamiliar with the language. Pascal programmers push Pascal so more users will put pressure on software houses to sell better compilers, and compilers for more machines. Some teachers push Pascal because it is easy to teach, and their pupils will prefer a trendy language.

Burnt fingers

Algol 68 programmers worry that many people will get their fingers burnt on Pascal and lose faith in their climb up the Algol tree. Pascal has some rather interesting features, such as subranges, sets and packed records which I feel are good points, and many features which are common nowadays, and very useful such as records, recursion, data types and so on. Pascal is useful as a first step towards structured programming, but you must not wait too long on the first step or you will grow too weak to climb further.

Programmers in an applications environment find it useful if they can use a set of general-purpose routines provided by experts in some field. Examples of such sets are the Gino and Ginograf graphics routines and the NAG subroutine library for Fortran and Algol 68. There are also many cases where facilities are embedded in languages to make certain activities easier — for example handling databases or laboratory equipment.

Unfortunately, such useful facilities are very difficult to provide in Pascal. This is because a procedure which takes in an array as a parameter can only take arrays of size fixed in the procedure declaration. A procedure written for integer arrays of 100 elements could not be used with arrays of 101, 99 or 3 elements,

Even Fortran provides better facilities for making libraries available — indeed, this is one of its main strengths in engineering and scientific fields. Algol 68 allows new operator definitions for any data types. APL users in business often use a set of functions provided by programmers so they do not need to concern themselves with detail. This serious fault in Pascal was caused by an obsessive desire to simplify storage allocation, but the disadvantages are far too severe to justify the simplification.

When a program has been written and the algorithms checked using test data, it often has to be used by untrained users and on real data. Users will often feed in corrupt data — letters instead of numbers, blank lines, overlarge numbers or just gibberish, and a good program will give some indication of the error and try to continue to find more errors, rather than just bombing out.

Writing a robust program just to read a number from a file is very difficult in Pascal, because so many faults can occur which the program cannot sort out by using the inbuilt routines to read an integer. Consider some of the possible errors:

- The file is empty
- The file is a line of blanks
- There are blank lines before the number
- The file starts with the letter X
- There are superfluous characters after the number
- The number is too large or small to hold an integer variable

The Pascal programmer has to forget the system routines, and write his own new ones to read character by character. More room for error and more work. Algol 68, Cobol, and PL/1 allow checking on input, and Fortran 77 has a method of trapping errors.

Pascal has no facilities for opening and creating new files, and cannot enquire about the status of files to which it is connected except for detecting end of line, EOLN, and end of file, EOF. It is, in fact, so inadequate at file handling that almost all implementations have their own non-standard extensions, thereby reducing portability.

When Pascal was designed, it was decided that several restrictions would be made to simplify compilation, and increase efficiency on the processors of the early 1970s. One of these restrictions is that the bounds of arrays had to be constants available at compile time.

Wasted space

That means that a program or routine cannot declare the workspace it needs at a particular time. Instead, it has to declare an array which is as large as it should ever need every time, thus wasting space on most occasions. On microprocessors with a limited address space, a waste or space is worse than a slight reduction in speed.

Pascal requires that declarations of all procedures, variables, and so on, are made at the top of the main program body, and at the top of each procedure body. This is another example of how a restriction meant to make life slightly easier for the compiler writer is a problem for the programmer, especially when he is working on large programs. Once again, the result is a waste of space.

Suppose one block in the program uses some integers, and another uses some reals, and these variables are confined to their respective blocks. If the variables could be declared in their respective blocks, there would be re-use of store — saving space — no access to the variables outside their block — preventing errors — and the type of the variables is clear near where they are used. There is no run-time penalty, and hardly any increase in compiler complexity.

Procedures could be used in place of the blocks, but this can lead to a proliferation

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of small, 25-line procedures, and marked loss of speed.

The Pascal For/Do loop is very restricted and often has to be replaced by some open-coded equivalent using a While construct. There is no Step or By part, so the loop variable can go only up or down in steps of one. This petty restriction, supposedly for efficiency, is another area where Pascal hinders straightforward coding and obscures intentions — the loops may as well always start from 1.

A While part cannot be combined with the Do loop, so an exit from the loop on some condition — for example, the end of a search — has to be by a Goto to some label outside.

The final oddity is that the loop variable has to be declared in the normal manner at the top of the program or procedure. Apart from slowing down coding, it has the undesirable effect of making the variable accessible to code in the loop or in procedures declared "below it in scope" where it can be accidentally altered, causing chaos.

A useful feature of Pascal is its Case construction which allows the selection of one of several courses of action depending on the value of a variable, or which member of a set it is. Unfortunately, this feature is marred by the lack of a Default or Out part which is a way of specifying what to do if there is no relevant Case action.

Most Pascal implementations do nothing if the selector is not catered for, but one usually wants to take some action if an exception arises, and one has to use an If construction of some kind. This is yet another serious flaw in Pascal, which, this time, has no excuse.

Pascal does not provide access to the individual bits in integers to allow packing of data, logical operations or shifts — often very important for systems programming.

Insecure areas

Pascal is a rather more secure language than, say, Fortran, which means that not so many expensive runtime checks would be required behind the scenes to prevent accidental or deliberate but dangerous tampering with data.

Unfortunately, Pascal becomes insecure in the areas which many programmers are already having difficulty thinking about what should be happening if all goes well; the areas of variant, pointers, and heap storage.

Firstly, the mark and release scheme of storage management is completely unchecked, and allows easy corruption of store. Admittedly, a garbage collector is a complex beast, but it saves the programmer a good deal of work in storage management, one of the major parts of many problems.

Secondly, a variant record can be established with one type, and then assignments can be made to the fields of the record pretending it is some other type, possibly one which occupies more store, thereby corrupting neighbouring data.

Thirdly, since a procedure parameter does not have a "type" associated with it, checking of the number of arguments used by the procedure when it is called inside another procedure are highly difficult — perhaps impossible — at compile time, and usually never made at compile time. It is a similar problem to that encountered in Fortran where it is impossible to tell at compile time if subprograms are being called with the correct number and type of arguments.

Pascal has deficiencies in many areas, ranging from annoying omissions — Step in Do-loop, Out in Case construct — to serious design flaws — fixed size of array parameters.

Those deficiencies do not mean that the language is unusable, but they mean that difficulties arise just when the compiler and language should be helping most.

The insecurities mentioned in the final section mean that as things grow harder and harder to monitor, data corruptions can occur causing faults in unexpected places, and storage becomes more difficult to manage.

By all means use Pascal if you need a structured language quickly, but keep looking for a longer-lasting tool and invest in it as soon as you can.

Reverse Polish code

THE subroutine described converts a fully-parenthesised expression in algebraic form to its reverse Polish equivalent, writes D Elworthy of Wilmslow, Cheshire. It is relocatable, and should run on any Z-80-based system which uses ASCII codes for A to Z, full stop and parentheses.

The expression must end in a full stop. All other characters are treated as operators except "(", ")" and A to Z. In brief, the subroutine works by transferring all operands to the Polish string, and all other symbols to a delimeter list, except ")". When this is encountered, a symbol is pulled back from the delimeters and is added to the Polish string, unless it is "(".

The method can be understood in detail by running it with the registers pointing to parts of the screen. One use that springs to mind is a pre-processor for M5 on Nascom, although a little modification would be necessary.

Register usage is: BC, entry, start address of algebraic string; exit, one beyond end of algebraic string. HL, entry, start address of Polish string; (exit) one beyond end of Polish string.

HL and BC may point to the same places. DE, entry and exit, address of the start of a temporary area. The size of this area cannot be predicted accurately, but it will not exceed the number of operators and '(' symbols plus one.

```
CVTRPN  LD A '(         ;enter dummy         3E 28
                        end delimeter
        LD (DE) A                            12
        INC DE                               13
MAIN    LD A (BC)       ;pick-up next        0A
                        symbol
        INC BC                               03
        CP 40H          ;check for range     FE 40
                        A to Z
        JR C NOTOPR     ;otherwise it        38 08
                        is not
        CP 5BH          ;an operand          FE 5B
        JR NC NOTOPR                         30 04
PUT     LD (HL) A       ;add a symbol        77
                        to the Polish
        INC HL                               23
        JR MAIN         ;more                18 F2
NOTOPR  CP '(           ;not an operand      FE 28
        JR Z LPAREN                          28 0D
        CP ')                                FE 29
        JR NZ NOTPAR    ;must be an          20 0D
                        operator
        DEC DE          ;pull back last      1B
                        symbol from
        LD A (DE)       ;delimeters          1A
        CP '(           ;add to Polish       FE 28
                        unless parenthesis
        JR Z MAIN                            28 E4
        DEC DE                               1B
        JR PUT                               18 EB
LPAREN  LD (DE) A       ;add left-paren-     12
                        thesis to
                        delimeters
        INC DE                               13
        JR MAIN                              18 EF
NOTPAR  DEC DE          ;point to last       1B
                        delimeter
        CP '.           ;full stop means     FE 2E
                        end
        JR Z ENDIT                           28 11
        PUSH AF         ;save current        F5
                        symbol
        LD A (DE)       ;see what last       1A
                        delimeter was
        CP '(                                FE 28
        JR NZ NOTPA2                         20 04
        INC DE          ;if '(', append      13
                        new symbol
        POP AF          ;to delimeters       F1
        JR LPAREN                            18 ED
NOTPA2  LD (HL) A       ;previous de-        77
                        limeter to Polish
                        string
        INC HL                               23
        POP AF                               F1
        LD (DE) A       ;new symbol to       12
                        delimeters
        INC DE                               13
        JR MAIN                              18 C7
ENDIT   LD A (DE)       ;final tidying-up    1A
        CP '(                                FE 28
        RET Z                                C8
        LD (HL) A                            77
        INC HL                               23
        DEC DE                               1B
        JR ENDIT                             18 F7
```

Binary/decimal/hex

THIS IS a program for binary to decimal to Hex conversion for machine-code buffs, writes N R W Sargent of London, E7. I have formatted the printing specially for resolving bit patterns especially useful with Z-80, and straight conversion coding. The listing is in Sord EBasic.

```
10    /  HEXCON
20    /  FOR PRINTING ONLY
30    /  RE-WRITTEN FROM ORIGINAL SORCERER VERSION OF 1978  *NRWS
40    /  24-01-1981
50    OPEN "SOUTA" FOR OUTPUT AS FILE 1
60    VTCLEAR
70    DIM A$(16)
80    LET A$ = "0123456789ABCDEF"
90    LET U$ = "###"
100   LET D2 = 0
     :LET J = 1
     :LET K = 1
     :LET X = 0
110   GOSUB  360
     :PRINT #1
     :PRINT #1
120   FOR B = 1 TO 2
     :  FOR C = 1 TO 2
     :    FOR D = 1 TO 2
     :      FOR E = 1 TO 2
130           FOR F = 1 TO 2
     :          FOR G = 1 TO 2
     :            FOR H = 1 TO 2
     :              FOR I = 1 TO 2
140                   LET B1$ = MID(A$,B,1)
150                   LET C1$ = MID(A$,C,1)
160                   LET D1$ = MID(A$,D,1)
170                   LET E1$ = MID(A$,E,1)
180                   LET F1$ = MID(A$,F,1)
190                   LET G1$ = MID(A$,G,1)
200                   LET H1$ = MID(A$,H,1)
210                   LET I1$ = MID(A$,I,1)
220                   LET K1$ = MID(A$,K,1)
230                   LET J1$ = MID(A$,J,1)
240                   LET A1$ = B1$+C1$+D1$+E1$+F1$+G1$+H1$+I1$+"  "
250                   PRINT #1 , TAB(T) ; A1$ ;
260                   PRINT #1 USING U$ , D2 ;
     :                PRINT #1 , "  "+K1$+J1$+"   " ;
270                   LET T = T+25
     :                IF T > 75 THEN
     :                  LET T = 0
     :                  PRINT #1
280                   IF D2 <> 127 THEN
     :                  GOTO  290
     :                ELSE
     :                  PRINT #1 , CHR$(12) ;
     :                  GOSUB  360
290                   LET J = J+1
     :                IF J > 16 THEN
     :                  PRINT #1
     :                  PRINT #1
     :                  LET K = K+1
     :                  LET J = 1
300                   LET D2 = D2+1
310                   PAGE
320                 NEXT I
     :            NEXT H
     :          NEXT G
     :        NEXT F
     :      NEXT E
     :    NEXT D
     :  NEXT C
     :NEXT B
330   PRINT #1 , CHR$(12)
340   CLOSE 1
350   END
360   /  HEADER ROUTINE
370   LET X = 0
380   PRINT #1 , TAB(X) ; " BINARY   DEC    HEX" ;
390   LET X = X+25
     :IF X < 76 THEN
     :  GOTO  380
     :ELSE
     :  PRINT #1
     :  LET X = 0
400   PRINT #1 , TAB(X) ; "====================" ;
410   LET X = X+25
     :IF X < 76 THEN
     :  GOTO  400
     :ELSE
     :  PRINT #1
     :  LET X = 0
     :  RETURN
NO END MARK
```

Reverse characters

THE RECENT purchase of a 16K RAM pack for my ZX-80 has made me go through my 1K games programs and expand understated games responses, such as "Bang, you are dead" into more expressive, screen-filling white letters on a black background, writes Keith Berry of Newtown, Birmingham. The problem of how to overcome the tedium of having to enter CHR$(128) for every single black square produced the following idea which works well in practice.

Select a piece of graph paper and mark an area three blocks of 10 wide by two blocks deep. Put your design into this area, blocking in each small square with pencil where black is required in the final display. Number the three vertical blocks of 10, 1-3, and number each horizontal row of small squares, 0-9 — and 0-9 again in the second block down.

You now need 2,000 lines of unused program, say, 3,000 and 4,000. Enter:

```
3000 REM BANG YOU ARE DEAD
3001 PRINT CHR$(128);CHR$(128); 10 of
     them, ending with a semicolon
     — Newline —
```

Now Edit, Rubout, 2, Newline, Edit, Rubout, 3, Newline. You now have your first line of black background in lines 3001, 3002, 3003. Continue Editing to give you your next line numbered 3011, 3012, 3013 and then 3021, 3022, 3023, and so on until you arrive at 3091, 3092, 3093.

Repeat for 4001 and you have two blocks of black on which to Edit your white lettering. List 4082, Edit, for example, gives immediate access to the middle column of the second, lower block, line 8.

Using Shift 8, move along the line and Rubout 128 and replace it with 0 wherever a white space should appear. Remember to eliminate the last semicolon in every line whose number ends in three.

Any all black rows should be replaced by, e.g.,

FOR J = 1 TO 30, PRINT CHR$(128); NEXT J

and similarly a row of CHR$(0) should be replaced by "(Spaces)". It is a good idea to Run 3000 after Editing each line, to check how you are doing.

Telephone book

A LIST of names and corresponding telephone numbers can be recorded in code form in two single arrays: X and Y, writes Lloyd Tribello of Basingstoke, Hampshire. These are dimensioned at the beginning of the program. Each separate item in each array can be located using two access vectors; a position vector which gives the position of the first code of the item and a length vector which gives the number of elements in the item.

The first part of the program enables the data to be loaded into the arrays. M is the number of items to be recorded. The arrays P and T store the position vectors for the names and telephone numbers respectively. The arrays L and D store the length vectors. Subroutine 500 is the LEN subroutine submitted by Eric Deeson, January 1981 ZX-80 Line-up.

After recording the data it is useful to check that it has been entered accurately. The Check Program overwrites lines 90 to 220. All other lines can be removed except for lines 500 to 540 which house the subroutine. The Check Program is initiated by "GOTO 90".

Finally, the Search Program is entered. It will search the X array for an input name and, if the name is found, will locate the corresponding telephone number in the Y array. Both name and number will then be output.

```
90 PRINT"NAME",,"TEL.NO"
100 FOR N=1 TO M
110 FOR I=P(N)TOP(N)+L(N)-1
120 PRINT CHR$(X(I));
130 NEXT I
140 FOR I=1TO17-L(N)-1
150 PRINT" ";
160 NEXT I
170 FOR I=T(N)TO T(N)+D(N)-1
180 PRINT CHR$(Y(I));
190 NEXT I
200 PRINT
210 NEXT N
220 STOP
```

```
10 PRINT "HOW MANY ITEMS?"
20 INPUT M
30 DIM X(100)
40 DIM Y(50)
50 DIM P(M)
60 DIM L(M)
70 DIM T(M)
80 DIM D(M)
90 LET I=1
100 LET J=1
110 FOR N=1 TO M
120 PRINT "NAME?"
130 INPUT A$
140 LET B$=A$
150 GOSUB 500
160 LET L(N)=L
170 LET P(N)=I
180 FOR I=1 TO I+L-1
190 LET X(I)=CODE(A$)
200 LET A$=TL$(A$)
210 NEXT I
220 PRINT "TEL.NO."
230 INPUT A$
240 LET B$=A$
250 GOSUB 500
260 LET D(N)=L
270 LET T(N)=J
280 FOR J=J TO J+L-1
290 LET Y(J)=CODE(A$)
300 LET A$=TL$(A$)
310 NEXT J
320 CLS
330 NEXT N
340 STOP
500 LET L=0
510 LET B$=TL$(A$)
520 LET L=L+1
530 IF NOT B$=""
    THEN GOTO 510
540 RETURN
```

```
90 PRINT "NAME SOUGHT?"
100 INPUT A$
110 LET B$=A$
120 CLS
130 GOSUB 500
140 FOR N=1 TO M
150 IF X(P(N))= CODE(A$)
    AND L(N)=L THEN GOTO 190
160 NEXT N
170 PRINTA$;"NOT FOUND"
180 GOTO 290
190 LET B$=A$
200 FOR I=P(N)+1TOP(N)+L-1
210 LET B$=TL$(B$)
220 IF NOT X(I)=CODE(B$)
    THEN GOTO 160
230 NEXT I
240 PRINT A$,
250 FOR I=T(N)TOT(N)+D(N)-1
260 PRINTCHR$(Y(I));
270 NEXT I
280 PRINT
290 STOP
```

Screen poke

I NOTICE that in ZX-80 Line-up, many games which require movement use Print statements to move a ship, car, etc., writes Mark Lancaster of Carlisle, Cumbria. An example of this is Pete Rowan's animated display in February 1981 *Practical Computing*.

This can be a problem especially if you want something to move right to left across the screen. Here is how to Poke any character on to the screen. The ZX-80 can only Poke where something has already been Printed. So the first thing to do is to Print all the screen, i.e.,

```
10 FOR A = 1 TO 736
20 PRINT "  ";
30 NEXT A
```

736 is the amount of squares on the screen, but if you obtain an out of screen error code 5, just reduce the 736 until you no longer obtain the error. You can now Poke on to the screen. The top left-hand corner of the screen is Poke number 16485 and the width of the screen is 32 so the Pokes are:

16485 TO 16517 first line
16518 TO 16550 second line
- - - - - - - - - - - - - - - - - - - -
17211 TO 17243 last line

The second number in a Poke is the code for a character. Here is a small example program to make a snail crawl along from right to left:

```
10 FOR A = 1 TO 550
20 PRINT"__";
30 NEXT A
40 LET C = 0
50 LET B = 16856
60 POKE B,3
70 POKE B—1,136
80 POKE B + (C + 1),0
90 POKEB + C,3
100 POKE B + 3,0
110 IF C = 0 THEN POKE B + 2,0
120 LET B = B—1
130 INPUT A$
140 IF C = 0 THEN GO TO 170
150 LET C = 0
160 GO TO 60
170 LET C = 1
180 GO TO 60
```

Lines 10-30 Print enough space on the screen for the program. B is the present position of the snail and decreases by one after every move. Lines 80,100 and 110 remove the snail from the previous move.

The variable C determines the length of the snail's tail while crawling.

The only way to leave the program is when after pressing Newline to slide your finger on to the break key. To see the next move you have to press Newline.

String arrays

ZX-80 BASIC is not too user-friendly when it comes to string handling, writes George Gregson of London SE6. Many programs require the analysis of a string, extraction of a substring or concatenation of strings, none of which is directly possible in ZX-80. An indirect approach is required if such programs are to be written.

An effective technique, which also allows string space to be released from memory, is to substitute an array of ZX-80 character codes for the string. Such an array can then be subjected to numerical, arithmetical or logical processing. Whenever needed, the current string can be output by a PRINT CHR$(n); loop, n being read from the array.

It is useful to note that the code for null is 1 and the code for space is zero.

```
10 DIM A(50).........or any desired length.
20 LET A$ = "STRING"....or 20 INPUT A$.
30 FOR X = 1 TO 50
40 LET A(X) = CODE(A$)
50 LET A$ = TL$(A$)
60 IF CODE(A$) = 1 THEN GOTO 80
70 NEXT X
80 LET A$ = ""
```

At this point, the array A holds the ZX-80 character codes for STRING and X = 6. You will appreciate that X = LEN(A$) — a new function in ZX-80. Now suppose we wish to add the word BAG to STRING to form the concatenation STRINGBAG:

```
90 LET A$ = "BAG"......(or 90 INPUT A$)
100 FOR X = X+1 TO 50
110 LET A(X) = CODE(A$)
120 LET A$ = TL$(A$)
130 IF CODE(A$) = 1 THEN GOTO 150
140 NEXT X
150 LET A$ = ""
```

Now array A holds the codes for STRINGBAG and X is valued at 9, the new LEN(A$). In both operations, the string space has been released — lines 80 and 150 ensure this, even if the TL$ function has not already done so. To output the result:

```
160 FOR Y = 1 TO X
170 PRINT CHR$(A(Y));
180 NEXT Y
190 PRINT
```

Note that the loop variable is now Y to preserve X as LEN(A$). This method can be used to keep track of input characters in, e.g., Hangman-type games, by adding the code of the input letter to array A and outputting the entire array contents before each fresh guess is made.

Two further arrays would be used in Hangman; one to store the codes of the keyword and one of the same length to initially store a row of dash codes. Each dash code would be replaced with the code of a successful guess. I leave it to you to complete the program.

Pursuit ship

IN THIS program the idea is to shoot down the randomly moving space ship in front of you — the inverse space — by lining it up with your rocket sight, writes Chris Carr of Evesham, Worcestershire.

You have five commands; up, down, left or right — U,D,L or R — for thrust and F to fire. As you are in space, you will move in the opposite direction to the thrust and will continue to move until you counter balance the thrust of your ship.

The graphics routine in this program plots the vertical angle against the horizontal angle (VA and HA) and so could probably be a useful routine for plotting graphs. It is done totally in Basic, without the use of a "memory mapped screen" and so takes slightly longer but is much more reliable. The whole program takes approximately 480 bytes and so it fits easily on a 1K machine.

```
10 LET A$=" PURSUIT SHIP "
20 PRINT
30 FOR J=1 TO 14
40 PRINT CHR$(CODE(A$)+128);
50 LET A$=TL$(A$)
60 NEXT J
70 LET HA=RND(10)-5
80 LET VA=RND(10)-5
90 LET Q=0
100 LET W=0
110 INPUT B$
120 IF B$="R" THEN LET Q=Q-1
130 IF B$="L" THEN LET Q=Q+1
140 IF B$="U" THEN LET W=W-1
150 IF B$="D" THEN LET W=W+1
160 IF B$="X" THEN STOP
170 LET HA=HA+Q+RND(3)-2
180 LET VA=VA+W+RND(3)-2
190 IF B$="F" THEN GOSUB 430
200 CLS
210 FOR L=1TO13
220 IF L=7-VA THEN GOTO270
230 IF L=7THEN GOTO 350
240 PRINT
250 NEXT L
260 GOTO 110
270 FOR H=1 TO 20
280 IF H=10+HA THEN GOTO 410
290 IF VA=0 AND NOT H=10 THEN PRINT "-";
300 IF VA=0 AND H=10 THEN PRINT "+";
310 IF NOT VA=0 THEN PRINT " ";
320 IF H=20 THEN PRINT
330 NEXT H
340 GOTO 250
350 FOR M=1 TO 20
360 IF M=10 THEN PRINT "+";
370 PRINT "-";
380 IF M=20 THEN PRINT
390 NEXT M
400 GOTO 250
410 PRINT CHR$(128);
420 GOTO 330
430 IF ABS(HA)<2 AND ABS(VA)<1 THEN GOTO 450
440 RETURN
450 CLS
460 PRINT ,,,,,,"    HIT"
470 PRINT ,,,,,,"RERUN? Y/N"
480 INPUT Z$
490 IF NOT Z$="Y" THEN STOP
500 GOTO 70
```

Re-re-number

I TRIED Michael Whittle's re-numbering program for the UK101 given in the 6502 Special, September 1980 issue writes Graham Thomas of Hatfield, Hertfordshire, only to find several serious problems.

- The program will re-sequence Gotos, etc., only if there are no spaces between the Goto and the line number.
- Contrary to what is stated in the article, the program does not "give the line number for subsequent re-typing" when it needs to replace a five by a 10, and so on. In fact, it goes on to insert the longer line number, overwriting the GOTO on that line.
- If the program is used to re-sequence a program with more than 100 lines, it aborts on a "BAD SUBSCRIPT ERROR IN LINE 63140", and leaves the program being re-sequenced in an unrecoverable mess.

Here is a fully-debugged copy of the re-numbering program, which overcomes all of the above problems. It will change Gotos, etc., regardless of how many spaces separate the Goto and the line number. If it needs to replace a short line number by a longer one, e.g., Goto 5 to Goto 10, it prints:

CHANGE 5 IN LINE xxx TO 10

If the program is used to process a program with more than 100 lines, it prints an appropriate message and restores the program to its original condition before stopping. The program also includes a more comprehensible error message which is printed when a Goto to a non-existant line number is encountered.

In addition, the program can be modified easily to deal with longer programs by changing one of the three variable values in line 63005. ML is the maximum number of lines the program can deal with — limited by the amount of memory available. SP is the line spacing for the re-sequenced program, and OS is the "offset" for the re-sequenced program.

For example, SP = 2 and OS = 198 would cause the re-sequenced program's lines to be numbered 200, 202, 204, etc. This feature is useful for re-locating a program so that it can be placed at a specific point within another program.

```
63000 REM CORRECTED RENUMBERING PROGRAM
63005 ML=100:SP=10:OS=0
63010 DIMA(ML):AD=771:I=0
63020 GOSUB63230:IFLN>62999THEN63060
63025 I=I+1:IFI>MLGOTO63051
63030 N=I*SP+OS:NH=INT(N/256):NL=N-256*NH
63040 POKEAD,NL:POKEAD+1,NH:A(I)=LN
63050 AD=NA:GOTO63020
63051 PRINT"OVER"ML"LINES- RESTORING PROGRAM"
63052 AD=771:FORI=1TOML:NH=INT(A(I)/256)
63053 NL=A(I)-256*NH:GOSUB63230:POKEAD,NL
63054 POKEAD+1,NH:AD=NA:NEXTI:END
63060 AD=771:B=0
63065 B=B+1:GOSUB63230
63070 IFLN>62999THENPRINT"COMPLETE":END
63080 FORJ=AD+2TONA-4:C=PEEK(J)
63090 IFC<>136ANDC<>140ANDC<>160THEN63220
63100 L=PEEK(J+1):IFL>=48ANDL<=57THEN63110
63102 IFL=32ANDJ<NA-3THENJ=J+1:GOTO63100
63104 GOTO 63220
63110 C$="":FORK=J+1TOJ+8:C=PEEK(K)
63115 IFC=32ANDK=J+1THENJ=J+1:GOTO63110
63120 IFC<48ORC>57THEN63140
63130 C$=C$+CHR$(C):NEXTK
63140 L=VAL(C$):FORH=1TOI:IFA(H)=LTHEN63160
63150 NEXTH:PRINT"NON-EXISTANT LINE"L;
63151 PRINT"REFERENCED IN LINE"B*SP+OS
63152 GOTO63210
63160 N$=STR$(H*SP+OS):R=LEN(N$)
63162 IFK-R>=JGOTO63170
63164 PRINT"CHANGE"L"IN LINE"B*SP+OS"TO"N$
63166 GOTO63190
63170 FORX=2TOR
63180 POKEK+X-R-1,ASC(MID$(N$,X,1)):NEXTX
63190 IFK-J-R<=0THEN63210
63200 J=J+1:POKEJ,32:GOTO63190
63210 IFC=44THENJ=K:GOTO63110
63212 IFC=32THENK=K+1:C=PEEK(K):GOTO63210
63220 NEXTJ:AD=NA:GOTO63065
63230 NA=PEEK(AD-1)*256+PEEK(AD-2)+2
63240 LN=PEEK(AD+1)*256+PEEK(AD):RETURN
OK
```

String searcher

HERE IS a program written for the AIM65 but could be adapted for other 6502-based systems by changing the I/O subroutines writes Rob Wilson of Cirencester, Gloucestershire. The program is a string searcher. It will search memory within the entered limits for a given string of up to 10bytes. It is particularly useful for trying to decipher someone else's machine code.

Line trace

A FEATURE that the Superboard lacks is a Basic trace command writes Jack Pike of Chawston, Bedfordshire. So, here is a machine-code routine which prints the Basic line number every time it changes. It is assumed to be located in the unused RAM starting at $0222, but the code is re-locatable.

The trace routine works by patching it into the Basic GETCHR routine at $00BE. That means addresses $00BE to $00C1 are changed to 20 22 02 EA Hex, to give a jump to $0222. The trace is turned on by Poke 550,165 and off by Poke 550,96. By holding down the ESC key, the screen display can be frozen so that you can inspect the line numbers while running the program.

Replace code overwritten in GETCHR:

```
D002   BNE   ; IS C3 = 0?
E6CH   INC   ; Yes, add 1 to CH
```

Detect line number change:

```
60 87  RTN   ; Replace 60 with AS to
               run trace
C5 E8  CMP   ; is line number 10 the
               same?
F0 19  BEQ   ; yes, branch to test high
85 E8  STA   ; store new line number low
A5 88  LDA   ; load line number high
85 E9  STA   ; store high
```

Loop when ESC key is held down:

```
                  ; *********** STRING SEARCH PROGRAM ************
                  ; *** SEARCHES FOR A GIVEN HEX STRING **********
                  ; *** R.W.J. WILSON      2/10/80

                  ;ASKS FOR START AND END ADDRESS - HIT ESC TO
                  ;RETURN TO MONITOR.

                  ;ASKS FOR STRING TO BE FOUND (UP TO 10 BYTES)
                  ;ENTER SPACE TO REUSE LAST STRING.

                  ;IF STRING IS FOUND THE ADDRESS WILL BE DISPLAYED
                  ;ENTER SPACE TO CONTINUE OR CR TO RESTART

                  ;IF STRING IS NOT FOUND 'END' IS DISPLAYED
                  ;ENTER SPACE TO RETURN TO MONITOR OR CR TO RESTART

                  ;PROGRAM IS RELOCATABLE (NO INTERNAL JUMPS)

                  ;MONITOR SUBROUTINES AND ADDRESSES
                  CRCK   =$EA24    ;CLEAR DISPLAY
                  FROM   =$E7A3    ;PRINT 'FROM',GET ADDRESS
                  TO     =$E7A7    ;PRINT 'TO',GET ADDRESS
                  OUTPUT=$E97A     ;PRINT A
                  RD2    =$EA5D    ;READ,SET C IF SP OR CR OR NON-HEX
                  WRAX   =$EA42    ;PRINT HEX IN A AND X
                  MONIT  =$E182    ;MONITOR ENTRY POINT
                  ADDR   =$A41C    ;LOCATIONS USED BY 'FROM' AND 'TO'

0000:             *=0
                  ;DATA RESERVATION
0000:             STAD     *=*+2    ;START ADDRESS
0002:             ENAD     *=*+2    ;END ADDRESS
0004:             STRING   *=*+10   ;STRING VALUES
000E:             COUNT    *=*+1    ;NUMBER OF BYTES IN STRING

000F:             *=$F40
                  ;GET ADDRESSES
0F40: 20 24 EA    START    JSR CRCK
0F43: 20 A3 E7             JSR FROM        ;GET START ADDRESS
0F46: AD 1C A4             LDA ADDR        ;PUT IT INTO STAD
0F49: 85 00                STA STAD
0F4B: AD 1D A4             LDA ADDR+1
0F4E: 85 01                STA STAD+1
0F50: A9 20                LDA #$20        ;PRINT SPACE
0F52: 20 7A E9             JSR OUTPUT
0F55: 20 A7 E7             JSR TO          ;GET END ADDRESS
0F58: AD 1C A4             LDA ADDR        ;PUT IT INTO ENAD
0F5B: 85 02                STA ENAD
0F5D: AD 1D A4             LDA ADDR+1
0F60: 85 03                STA ENAD+1

                  ;GET STRING
0F62: 20 24 EA    ENTRY    JSR CRCK        ;CLEAR
0F65: A0 00                LDY #0
0F67: 20 F0 0F             JSR MSGOP       ;PRINT 'BYTES?'
0F6A: A0 00                LDY #0
0F6C: 20 5D EA    AGAIN    JSR RD2         ;READ
0F6F: 90 0C                BCC STORE       ;VALID ENTRY
0F71: C9 20                CMP #$20        ;SPACE?
0F73: F0 16                BEQ REUSE       ;YES,CHECK IF FIRST ENTRY
0F75: C9 0D                CMP #$0D        ;CR?
0F77: F0 0C                BEQ ENSTR       ;YES,END OF ENTRY
0F79: D0 E7                BNE ENTRY       ;NON-HEX, REDO ENTRY
0F7B: F0 C3       BRANCH   BEQ START       ;USED TO AVOID A JUMP FROM
                                           ; NOW2 ROUTINE
0F7D: 99 04 00    STORE    STA STRING,Y
0F80: C8                   INY
0F81: C0 0A                CPY #10         ;ALLOW 10 BYTES
0F83: D0 E7                BNE AGAIN
0F85: 84 0E       ENSTR    STY COUNT       ;END OF ENTRY
0F87: C0 00                CPY #0          ;NO ENTRIES?
0F89: D0 08                BNE SEARCH
0F8B: C0 00       REUSE    CPY #0          ;FIRST ENTRY?
0F8D: D0 F6                BNE ENSTR       ;NO
0F8F: A5 0E                LDA COUNT
0F91: F0 CF                BEQ ENTRY       ;MUST HAVE NON ZERO COUNT

                  ;SEARCH MEMORY FOR THE STRING
0F93: A0 00       SEARCH   LDY #0
0F95: B1 00       SLOOP    LDA (STAD),Y    ;GET BYTE FROM MEMORY
0F97: D9 04 00             CMP STRING,Y    ;COMPARE
0F9A: D0 1E                BNE INCR        ;TRY NEXT MEMORY BYTE
0F9C: C8                   INY
0F9D: C4 0E                CPY COUNT       ;FINISHED STRING?
0F9F: 90 F4                BCC SLOOP

                  ;FOUND MATCH--SHOW ADDRESS
0FA1: 20 24 EA             JSR CRCK
0FA4: A5 01                LDA STAD+1
0FA6: A6 00                LDX STAD
0FA8: 20 42 EA             JSR WRAX

                  ;GET COMMAND
0FAB: 20 5D EA    NOW1     JSR RD2
0FAE: 90 FB                BCC NOW1
0FB0: C9 20                CMP #$20
0FB2: F0 06                BEQ INCR        ;CONTINUE
0FB4: C9 0D                CMP #$0D
0FB6: F0 88                BEQ START       ;RESTART
0FB8: D0 F1                BNE NOW1        ;NON-VALID ENTRY

                  ;INCREMENT AND TEST ADDRESSES
0FBA: 18          INCR     CLC
0FBB: A5 00                LDA STAD
0FBD: 69 01                ADC #1
0FBF: 90 04                BCC CHECK
0FC1: E6 01                INC STAD+1
0FC3: F0 0A                BEQ ENDMES      ;HAVE REACHED $0000
0FC5: A5 02       CHECK    LDA ENAD        ;TEST
0FC7: C5 00                CMP STAD
0FC9: A5 03                LDA ENAD+1
0FCB: E5 01                SBC STAD+1
0FCD: B0 C4                BCS SEARCH      ;HAVE NOT REACHED END

                  ;END MESSAGE
0FCF: 20 24 EA    ENDMES   JSR CRCK
0FD2: A0 06                LDY #M2-M1
0FD4: 20 F0 0F             JSR MSGOP       ;PRINT 'END'
0FD7: 20 5D EA    NOW2     JSR RD2         ;GET COMMAND
0FDA: 90 FB                BCC NOW2
0FDC: C9 0D                CMP #$0D
0FDE: F0 9B                BEQ BRANCH      ;RESTART VIA BRANCH
0FE0: C9 20                CMP #$20
0FE2: D0 F3                BNE NOW2        ;NON-VALID ENTRY
0FE4: 4C 82 E1             JMP MONIT       ;RETURN TO MONITOR

                  ;MESSAGE DATA
0FE7: 42          M1       .TEXT 'BYTES'
0FE8: 59
0FE9: 54
0FEA: 45
0FEB: 53
0FEC: BF                   .BYTE $BF       ;'?'+$80
0FED: 45          M2       .TEXT 'EN'
0FEE: 4E
0FEF: C4                   .BYTE $C4       ;'D'+$80

                  ;MESSAGE OUTPUT SUBROUTINE
                  ;***MSB OF LAST CHARACTER IS 1***
0FF0: B9 E7 0F    MSGOP    LDA M1,Y
0FF3: 48                   PHA
0FF4: 29 7F                AND #$7F
0FF6: 20 7A E9             JSR OUTPUT
0FF9: C8                   INY
0FFA: 68                   PLA
0FFB: 10 F3                BPL MSGOP
0FFD: 60                   RTS
$:
```

```
A9 DE      LDA ; load ESC key code
CD 0C DF   CMP ; compare to keyboard
F0 FB      BEQ ; try again if ESC
```

Print line number:

```
A9 4C      LDA ; load character "L"
20 E5 A8   JSR ; print "L"
20 5A B9   JSR ; print line number
A5 0F      LDA ; load max line length
85 0E      STA ; next print on new line
```

Check line number high, in case:

```
A5 88      LDA ; with line number high
C5 E9      CMP ; any change in high
D0 E5      BNE ; yes, back to store new
               high, etc.
60 RTN         ; and return
```

Writing a Basic program to input this trace is an interesting little problem, because of the required modification to the GETCHR routine while Basic is running. There are, however, ways to accomplish it. Would anyone care to supply a solution?

Variable input

THIS SHORT program is written on a Superboard, though it will probably run on a Compukit as well, writes Jonathan Turpin of Stanford-Le-Hope, Essex. The program is designed to be used when you are in Basic and want to input a variable without the problem of hitting Return and jumping out of the program.

The routine also operates on the Basic input routine and does not allow a carriage return unless the input buffer is partly full.

Here is the disassembled listing:

0222 20 BA FF	JSR $FFBA	Call keyboard/ cassette input routine
0225 C9 0D0 CMP £$0D		Is the character a carriage return?
0227 F0 01	BEQ $022A	If so, see if anything in buffer
0229 60	RTS	If not, return with character
022A E0 00	CPX £$00	Is the input buffer empty?
022C F0 F4	BEQ $0222	If it is, recall the input routine
022E 60	RTS	If not, return with the character

The basic listing is:

```
10 FOR I = 546TO558
20 READA:POKEI,A
30 NEXTI
40 REM Alter Input Vector (HEX 218)
50 POKE536,34:POKE537,2
60 END
70 DATA32,186,255,201,13,240,01
80 DATA96,224,0,240,244,96
```

Square puzzle

THIS PROGRAM emulates the simple puzzle which has 15 sliding squares mounted in a frame which is so designed to allow only one square at a time to be moved writes PJ Cooper of Southminster, Essex. Each of the 15 squares has a different letter — from A to 0 — printed on its face and the object of the puzzle is to place the squares in alphabetical order.

Although it all sounds simple, I can assure you it is not and if you have a day to spare — one hour to enter the program and the rest to solve the puzzle — then this is the one for you.

(continued on next page)

(continued from previous page)

It has been written for the standard Superboard II and contains many peeks and pokes which owners of other machines may find difficult to disentangle. Those enterprising UK101 users UK 101 should not find it too difficult. As a guide the screen display for the Superboard II more or less starts at 53285, top left, and finishes at 54140, bottom right, with 32 locations per line.

Incidentally, the program presents a different puzzle each time it is run.

Line numbers

THERE ARE thousands of tips and ideas begging to be explored writes Peter Jones of Standish, Lancashire.

For instance, it is not difficult to write a file-search program whereby after inserting the required List Line Number, the computer will search through the incoming tape listing, until the required List Line Number appears.

On receiving this List Line Number the computer will either: carry-out the instructions in the List Line or print out the whole List Line.

Can anyone suggest a program for the Superboard in which the computer will do all the searching, etc., at the same time leaving the screen blank?

List route

STEVE PURDY'S solution to the List problem on the Superboard in the February 1981 6502 Special may have left readers wondering why I wanted the program to continue execution after LIST.

With a routine using the facility, RUN 63000 will save your Basic program up to line 62998 on tape, so that on reloading, the program runs automatically:

```
62999 END
63000 SAVE : POKE 4,194 : POKE 5,165
63100 LIST — 62998 : POKE 4,195 : POKE
      5,168
63200 PRINT : PRINT "0 POKE 515,0":
      PRINT "RUN
63300 POKE 517,0
```

To save the routine with the program, remove the — 62998 after LIST. The Superboard is very reliable on saving and loading but occasionally you obtain a spurious single-digit line number, i.e., from 0 to 9, from the rubbish on the tape before the load starts. This problem can be overcome by changing line 63200 to

```
63200 PRINT : PRINT " 0 POKE 515,0 :
      GOTO first line number " : PRINT"
      RUN
```

```
5 FORZ=0TO25:PRINT:NEXTZ
10 GOSUB455
15 Y=169
20 FORX=53295TO53308
25 POKEX,Y:POKEX+32,Y:POKEX+704,Y:POKEX+736,Y
30 NEXTX
35 FORX=53359TO53967STEP32
40 POKEX,Y:POKEX+13,Y
45 NEXTX
50 A=53425
55 FORA=ATOA+9STEP3
57 IFA>53911THEN85
60 GOSUB100
65 NEXTA
70 A=A+148
80 GOTO55
85 POKE53914,96
90 A=53425
95 GOTO130
100 POKEA-65,189:POKEA-64,135:POKEA-63,190
105 POKEA-33,136:POKEA-31,143:POKEA-1,136
110 POKEA+1,143:POKEA+31,136:POKEA+33,143
115 POKEA+63,190:POKEA+64,128:POKEA+65,189
120 POKEA,96
125 RETURN
130 REM*RANDOM LETTERS*
135 X=1:Y=1
140 A$="ABCDEFGHIJKLMNO"
145 B=INT((1-14)*RND(1)+14)
150 B$=RIGHT$(A$,14-B)+MID$(A$,2,B)+LEFT$(A$,1)
155 X=X+1:A$=B$:IFX<25THEN145
160 REM*PUT IN SQUARES*
165 FORA=ATOA+9STEP3
170 X$=MID$(A$,Y,1)
175 Y=Y+1:IFY>16THEN200
180 Z=ASC(X$)
185 POKEA,Z
190 NEXTA
195 A=A+148:GOTO165
200 REM*KEYBOARD*
205 POKE11,34:POKE12,2
210 DATA32,0,253,141,128,2,96
215 FORX=546TO552:READC:POKEX,C:NEXTX
220 GOSUB500
225 X=USR(X)
230 D=PEEK(640):REM*SQUARE*
235 IFD>64ANDD<80THEN245
240 GOTO225
245 REM*SEARCH FOR SQUARE*
250 A=53425
255 FORA=ATOA+9STEP3
260 IFPEEK(A)=DTHENPOKEA-32,58:GOTO285
265 NEXTA
270 A=A+148
275 IFA>53914THEN250
280 GOTO255
285 GOSUB560
290 X=USR(X)
295 D=PEEK(640):REM*DIRECTION*
300 IFD>48ANDD<53THEN310
305 GOTO290
310 REM*VALIDATE MOVE*
315 IFD=49ANDPEEK(A-160)=96THEN355
325 IFD=50ANDPEEK(A+160)=96THEN380
335 IFD=51ANDPEEK(A-3)=96THEN405
345 IFD=52ANDPEEK(A+3)=96THEN430
350 GOSUB595:POKEA-32,32:GOTO220
K
355 REM*MOVE UP*
360 E=A:F=PEEK(A)
365 IFA=E-160THENPOKEE,96:GOTO220
370 GOSUB635:A=A-32:GOSUB100
375 POKEA,F:FORT=0TO500:NEXTT:GOTO365
380 REM*MOVE DOWN*
385 E=A:F=PEEK(A)
390 IFA=E+160THENPOKEE,96:GOTO220
395 GOSUB635:A=A+32:GOSUB100
400 POKEA,F:FORT=0TO500:NEXTT:GOTO390
405 REM*MOVE LEFT*
410 E=A:F=PEEK(A)
415 IFA=E-3THENPOKEE,96:GOTO220
420 GOSUB635:A=A-1:GOSUB100
425 POKEA,F:FORT=0TO500:NEXTT:GOTO415
430 REM*MOVE RIGHT*
435 E=A:F=PEEK(A)
440 IFA=E+3THENPOKEE,96:GOTO220
445 GOSUB635:A=A+1:GOSUB100
450 POKEA,F:FORT=0TO500:NEXTT:GOTO440
455 PRINT" SQUARES"
460 PRINT" -------"
465 PRINT:PRINT:PRINT
470 PRINT" KEY 1=";CHR$(16):PRINT
475 PRINT" KEY 2=";CHR$(20):PRINT
480 PRINT" KEY 3=";CHR$(22):PRINT
485 PRINT" KEY 4=";CHR$(18):PRINT
490 FORX=0TO10:PRINT:NEXTX
495 RETURN
500 REM*INSTRUCTION*
505 D$="INPUT SQUARE TO MOVE"
510 Y=1
515 FORX=54119TO54138
520 X$=MID$(D$,Y,1)
525 POKEX,ASC(X$):Y=Y+1:NEXTX
530 RETURN
560 REM*INSTRUCTION*
565 D$="NOW INPUT DIRECTION "
570 Y=1
575 FORX=54119TO54138
580 X$=MID$(D$,Y,1)
585 POKEX,ASC(X$):Y=Y+1:NEXTX
590 RETURN
595 REM*ERROR*
600 D$="THIS IS NOT POSSIBLE"
605 Y=1
610 FORX=54119TO54138
615 X$=MID$(D$,Y,1)
620 POKEX,ASC(X$):Y=Y+1:NEXTX
625 FORT=0TO2000:NEXTT
630 RETURN
635 REM*SQUARE DELETE*
640 POKEA-65,32:POKEA-64,32:POKEA-63,32
645 POKEA-33,32:POKEA-31,32:POKEA-1,32
650 POKEA+1,32:POKEA+31,32:POKEA+33,32
655 POKEA+63,32:POKEA+64,32:POKEA+65,32:POKEA,32
660 RETURN
K
```

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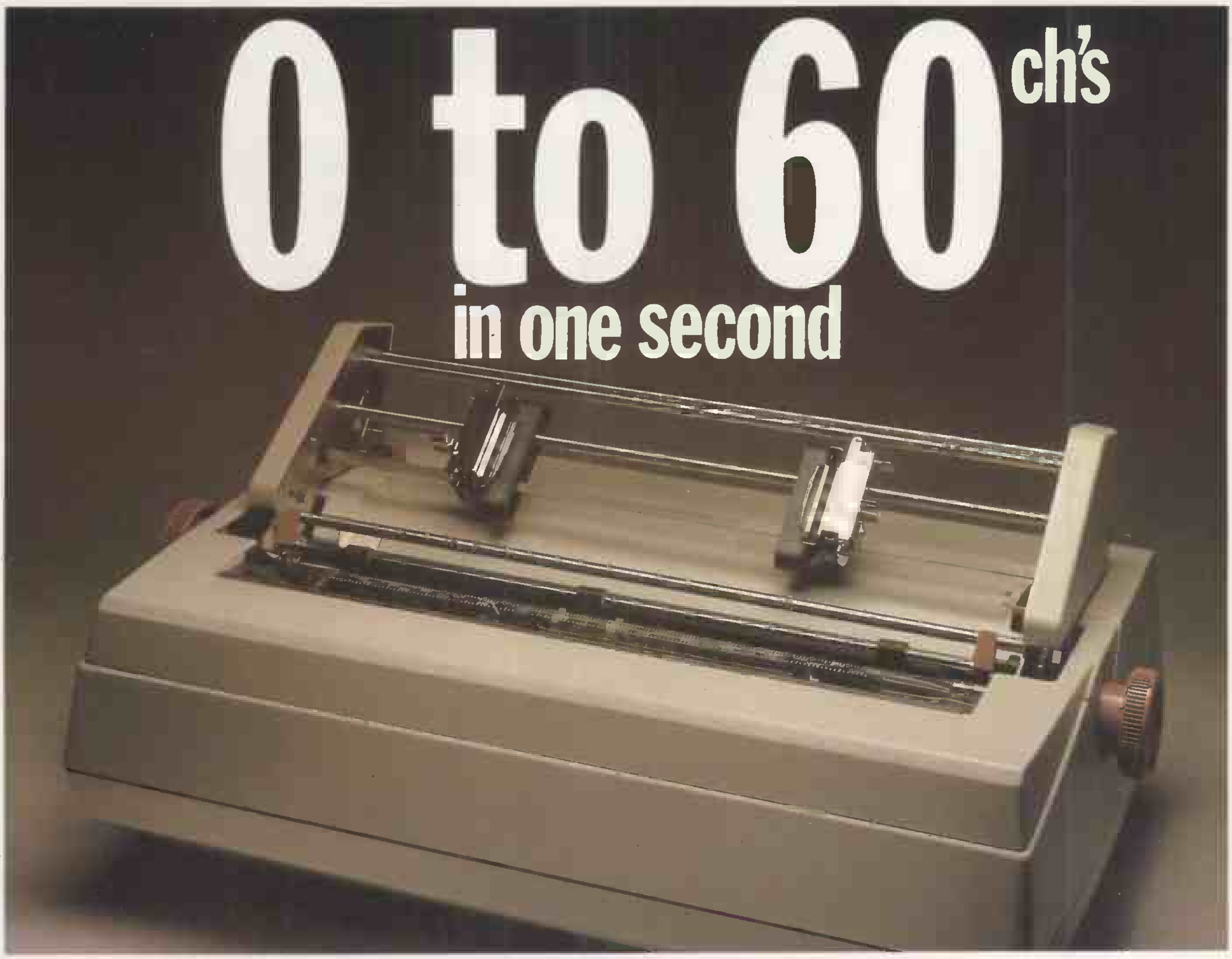

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Video Genie ideas

A FEW months ago I bought a Video Genie computer, writes Simon Goodwin of Hereford. As many will know, this machine is based on the Tandy TRS-80 level 2 computer, with a few enhancements — a second cassette port is standard, as is a built-in tape recorder on port 1.

The dreaded TRS-80 keyboard bounce has been largely eliminated. A Video Genie does not return to a cold-start when the re-set key on the back of the box is pressed; it returns to Basic with variables and program intact. This feature makes a program crash less likely than on a Tandy machine. It can, however, be inconvenient if the user wants to change the area of protected memory on the computer. The reason for the potential inconvenience is that, according to the manual, the machine must be turned-off and turned-on — after a 10-second wait to allow the power supply to discharge — to return to the prompt requesting reserved memory size.

In fact, it is easy to branch to this prompt — clearing the current program — from Basic without having to turn the machine on and off. Enter System new-line followed by slash zero new-line to return to the system start-up prompt. You can now enter the starting address for reserved memory as if you had just turned the machine on.

The instruction slash zero tells the Video Genie monitor to execute the program at location zero. This is where the Basic ROM starts, and where the Z-80 looks for the first instructions when it is turned-on. Obviously, it is much better for the system if you can re-start it without having to turn it on and off — chips are at their most vulnerable at these times.

There are a few characters which apparently cannot be obtained directly from the Video Genie keyboard. Underline, backslash, up arrow, close square bracket, tabulator and clear screen can be obtained, according to the manual, only by using the CHR$() function. In fact, a look at the TRS-80 technical manual shows that it should be possible to generate all these codes by pressing combinations of keys.

Try holding down the "Z" and "2" keys with your left hand. With those keys still down, type two backspaces to remove the last two characters from the display — now tap "3" gently, with "Z" and "2" still depressed. If you were gentle, an open square bracket character "[" will have appeared. If you were too fierce the "[" will still have been produced, but it will be followed by a "3". You can delete the "3" with another backspace, still holding "Z" and "2" down.

So far, that may not seem very useful — you could have produced a "[" just by typing the ESC key. Still, hold down "Z" and "2" again, type two backspaces, followed by a light press on "4". This should produce a backslash " \ " symbol, which used to be unobtainable from your keyboard. Keep the first two keys down and tap "5" — you produce the ubiquitous close square bracket "]". Try "6" — it produces another untypable character, an up-arrow or '^'. Finally, still with "Z" and "2" down, press "7" briefly to produce an underline "—" symbol. This procedure may sound complex, but with practice it is really very simple — "Z" and "2" are used as a kind of extra "shift" key.

Those functions can be very useful when entering programs — particularly ones that use graphics generated from text symbols. When using the line editor, a different set of shift keys must be used to have the same effect — in fact, other combinations of keys can be used to provide the shift — "Z" and "2" were chosen for their proximity on the keyboard.

Control codes can also be produced by a similar technique. Hold down "shift" and "CTRL" together — they should not produce any characters on their own. Now press "I". This combination produces a TAB function and prints a variable number of spaces to take the cursor up to the start of the next eight-character wide tabulator field. This is very useful when tidying listings or using the editor assembler, as it allows you to spread information easily into neat columns. If you try to enter a TAB while in insert mode in the Basic editor, you will produce a rather less useful reverse line-feed.

Obviously, it is possible to type the entire range of characters available on a Video Genie by pressing groups of keys. TRS-80 users may also find this useful, though as their keyboard has more keys on it, the advantage will be correspondingly less. I am mystified by the way a shifted zero on the Video Genie produces a space, CHR$(32). It must be the most useless extra way yet invented to type a character.

Finally, I would like to recommend from personal experience the TRS-80 manuals to owners of Video Genies. The Video Genie manuals are clear, but the Basic manual is definitely too short to cover all the details. I have found the TRS-80 level 2 Basic manual excellent as a supplement to this — it is comprehensive, properly indexed in its second edition and contains many useful routines and programs illustrating functions in Basic and simple machine code.

Faster conversion

IT GRIEVED me to see the Decimal-to-Hex conversion program by N Brickell published in your January 1981 Tandy Forum, writes John Leach of Deal, Kent. Apart from writing a very clumsy program, Brickell never asked himself: What if? What if a negative number is entered? What if the number is > 65535?

A little thought and ingenuity will soon give a far more flexible subroutine, including the vital error flags, which can be tested for in the main program on return from the subroutine, in a mere eight lines of code.

Practical Computing obviously tries to encourage good programming style, for which many thanks. The Hex program falls down badly; lines 30 to 64 should be in a simple loop — see lines 1110 to 1130 in my program — while lines 100 to 150 are quite absurd. All that is needed is
100 B$ = CHR$ (VAL (A$) + 55): RETURN

I dare say the program works as listed, but no wonder it is so slow. Suppose you wanted to convert 1,000 decimal numbers. Far too many published programs contain long lists of If Then statements, which can nearly always be changed to a short loop, utilising a simple arithmetic conversion as in my example, or by using a look-up table in DATA. Apart from saving memory, the program can normally be made to run much faster.

```
1000 REM Convert a decimal number to a Hexadecimal string with error flags
1010 REM AZ$ = Output string
1020 REM LZ  = Length of output string (defined in main program)
1030 REM EZ  = Error flag (EZ = 0 if conversion satisfactory)
1040 REM FZ  = Negative number flag (FZ = 1 if negative, otherwise = 0)
1050 REM NZ  = Decimal number to be converted (not changed by the subroutine)
1060 AZ$="": EZ=0: IF LZ < 1 THEN EZ=1: RETURN: REM Length not defined
1070 QZ=NZ: FZ=0: KZ=16↑(LZ-1): IF QZ >=0 GOTO 1100: REM Check sign
1080 FZ=1: IF ABS(QZ) > KZ*8 THEN EZ=2: RETURN: REM Negative number out of range
1090 QZ=KZ*16 + QZ: REM Adjust QZ when negative
1100 QZ=INT(QZ): DZ=48: REM Get ready for conversion loop
1110 FOR IZ=1 TO LZ: TZ=INT(QZ/KZ): IF TZ>15 THEN EZ=2: RETURN: REM Out of range
1120 AZ$=AZ$+CHR$(DZ+TZ-7*(TZ>9)): REM Convert Hex value to ASCII
1130 QZ=QZ-KZ*TZ: KZ=KZ/16: NEXT IZ: RETURN
1140 REM For TRS 80 substitute FIX for INT
1150 REM IZ, KZ, TZ and QZ are temporary variables within the subroutine
1160 REM Line 1120 uses Microsoft BASIC logical operator   (TZ>9)
1170 REM If this is not allowed in other versions, change to

1120 JZ=TZ: IF JZ>9 THEN JZ=JZ+7
1125 AZ$=AZ$+CHR$(DZ+JZ)

1190 REM All variables end in Z to avoid confusion with main program variables
1200 REM Sample program

10 INPUT "LENGTH, NUMBER ";LZ,NZ
20 GOSUB 1000
30 IF EZ = 0 THEN PRINT AZ$: GOTO 10
40 PRINT "ERROR TYPE ";EZ: GOTO 10
```

Pet sort by selection

THIS PROGRAM uses a sort by selection procedure, writes Simon Letts of Runcorn, Cheshire. That is, it searches the unsorted array for the lowest item — the data is ASCII coded. When this is found it is swapped with the item at the bottom of the array. The base address of the unsorted array is then incremented.

In this way, a sorted array is built-up at the bottom of the unsorted one — which decreases in size as each item is removed from it. The method was chosen for its simplicity rather than its efficiency and could be improved in that respect. For example,

Unsorted array	1st pass	2nd pass	3rd pass
1 Peter	Andrew	Andrew	Andrew
2 John	1 John	Charles	Charles
3 Andrew	2 Peter	1 Peter	John
4 Charles	3 Charles	2 John	1 Peter

In fact, the program does not move the data itself, which could be very lengthy, but when sorting the data, it moves the addresses of that data. Each one is only three bytes long and the Pet holds them all together above the Basic program and variables.

Null strings

The program is designed to leave null strings in position in the array and to place a longer string after a shorter one that is the same for the length of the shorter. For example,

Unsorted array	1st pass	2nd pass	3rd pass
Smith A B	Jones P	Jones P	Jones P
null	null	null	null
Jones P	Smith A B	Smith A B	Smith A
Smith A	Smith A	Smith A	Smith A B

The program is stored in the second cassette buffer but is completely re-locatable as it uses only relative addressing. The program uses some of the zero-page memory normally retained for cassette handling work space. Due to considerations of size, speed and simplicity in use, this version of the sort can only handle arrays of up to 256 — 0 - 255 — elements.

Call from Basic

The routine must be called by the following line of Basic:

POKE 18 0,C: NM$(0) = NM$(0) : SYS(826)

where C is the length of the array and NM$ is the name of the array which can be anything.

The POKE puts the length of the array into the zero-page work space and setting the zero array element equal to itself puts the address of the array into zero page address 68-69 — Hex 0044-0045 — which is the current variable address where it can then be found by the machine-code routine. SYS(826) calls this routine.

Program notes

Further notes may be found in the listing.

Workspace use — hex addresses, all in zero page

00B4	Array length, decimal address 180
00B5-B6	Base address of unsorted array
00B7-B8	Address of lowest element so far in this pass
00B9-BA	Address of next element to be checked
00BB-BD	Address of data in lowest element
00BE-C0	Address of data in next element to be checked
00B1-B3	Temporary storage for address swap

Notes:

Addresses 033A - 033F saves the 6502 registers on the stack.

0340 - 0356 loads the address of the array into the zero page workspace.

0357 - 0363 increment the address of the present array element to form that of the element next to be compared.

0364 - 0372 loads the addresses of the data to be compared — the actual strings.

0373 - 037A are either of the strings null? If so, do not compare.

037B - 0383 checks if every character in either string has been compared.

0384 - 0393 compare the next character of each string. Try next characters if these two are the same. Try next string if lowest value is still the lowest. Otherwise, (038C), store address of present element in space for lowest element.

0394 - 0396 decrement length of array left to be searched. Try next string if end of array not reached.

0397 - 03A9 swap addresses of lowest element and element at bottom of unsorted array. This builds up the sorted array.

03AA - 03B6 increment base address of unsorted array by three — this shortens the unsorted array and lengthens the sorted one.

03B7 - 03BA decrement unsorted array length register, continue with sort if end of array not yet reached.

03BB - 03C1 restore 6502 registers from the stack and return to Basic.

```
READY.

B*
     PC  IRQ  SR AC XR YR SP
.;  0401 E62E 32 04 5E 00 F8

.:  033A 08 48 8A 48 98 48 D8 A5
.:  0342 44 85 B5 A5 45 85 B6 A6
.:  034A B4 A5 B5 85 B7 85 B9 A5
.:  0352 B6 85 B8 85 BA 18 A5 B9
.:  035A 69 03 85 B9 A5 BA 69 00
.:  0362 85 BA A0 02 B1 B7 99 BB
.:  036A 00 B1 B9 99 BE 00 88 10
.:  0372 F3 A5 BE F0 1D A5 BB F0
.:  037A 19 C8 C4 BE F0 0C C4 BB
.:  0382 F0 10 B1 BC D1 BF F0 F1
.:  038A 90 08 A5 B9 85 B7 A5 BA
.:  0392 85 B8 CA D0 C0 A0 02 B1
.:  039A B7 99 B1 00 B1 B5 91 B7
.:  03A2 B9 B1 00 91 B5 88 10 EF
.:  03AA 18 A5 B5 69 03 85 B5 A5
.:  03B2 B6 69 00 85 B6 C6 B4 D0
.:  03BA 8E 68 A8 68 AA 68 28 60
.?

READY.
033A 08           PHP
033B 48           PHA
033C 8A           TXA
033D 48           PHA
033E 98           TYA
033F 48           PHA
0340 D8           CLD
0341 A544           LDA 44
0343 85B5           STA B5
0345 A545           LDA 45
0347 85B6           STA B6
0349 A6B4           LDX B4
034B A5B5           LDA B5
034D 85B7           STA B7
034F 85B9           STA B9
0351 A5B6           LDA B6
0353 85B8           STA B8
0355 85BA           STA BA
0357 18           CLC
0358 A5B9           LDA B9
035A 6903           ADC #03
035C 85B9           STA B9
035E A5BA           LDA BA
0360 6900           ADC #00
0362 85BA           STA BA
0364 A002           LDY #02
0366 B1B7           LDA (B7),Y
0368 99BB00           STA 00BB,Y
036B B1B9           LDA (B9),Y
036D 99BE00           STA 00BE,Y
0370 88           DEY
0371 10F3           BPL 0366
0373 A5BE           LDA BE
0375 F01D           BEQ 0394
0377 A5BB           LDA BB
0379 F019           BEQ 0394
037B C8           INY
037C C4BE           CPY BE
037E F00C           BEQ 038C
0380 C4BB           CPY BB
0382 F010           BEQ 0394
0384 B1BC           LDA (BC),Y
0386 D1BF           CMP (BF),Y
0388 F0F1           BEQ 037B
038A 9008           BCC 0394
038C A5B9           LDA B9
038E 85B7           STA B7
0390 A5BA           LDA BA
0392 85B8           STA B8
0394 CA           DEX
0395 D0C0           BNE 0357
0397 A002           LDY #02
0399 B1B7           LDA (B7),Y
039B 99B100           STA 00B1,Y
039E B1B5           LDA (B5),Y
03A0 91B7           STA (B7),Y
03A2 B9B100           LDA 00B1,Y
03A5 91B5           STA (B5),Y
03A7 88           DEY
03A8 10EF           BPL 0399
03AA 18           CLC
03AB A5B5           LDA B5
03AD 6903           ADC #03
03AF 85B5           STA B5
03B1 A5B6           LDA B6
03B3 6900           ADC #00
03B5 85B6           STA B6
03B7 C6B4           DEC B4
03B9 D08E           BNE 0349
03BB 68           PLA
03BC A8           TAY
03BD 68           PLA
03BE AA           TAX
03BF 68           PLA
03C0 28           PLP
03C1 60           RTS
```

Miniassembler facility

I WAS very disappointed to discover that the 48K Europlus lacked the mini-assembler facility writes David Kyte of Bristol. When flicking through back copies of *Practical Computing,* I noticed letters concerning re-locating the program.

My first problem was finding a copy of the listing, there was no copy in the latest manuals which accompany the system. I found it in the old manual, a copy of which I obtained from my local dealer. I believe there is also a listing in the 2020 manual.

A point not mentioned in the letters in *Practical Computing* is the influence of DOS. At first I tried to re-locate it at $b000 as the program is only $166 bytes long. The effect of trying to save the program on disc and watching the system crash, coupled with DOS overwriting the code in memory is crippling. After several fruitless attempts I offer the following advice.

DOS alters high memory thus:

System	High memory	DOS high memory
48K	$bfff	$9600
36K	$8fff	$6600
32K	$7fff	$5600
24K	$5fff	$3600
20K	$4fff	$2600
16K	$3fff	$1600

The problem is solved if the program is located from address $0800 to $0966. This involves changing the following segments of code

Address	Old code	New code
$f535:	4c 95 f5	— 4c 95 08
$f559:	4c 95 f5	— 4c 95 08
$f5bd:	20 34 f6	— 20 34 09
$f5d5:	20 34 f6	— 20 34 09
$f5e5:	20 34 f6	— 20 34 09
$f631:	4c 5c f5	— 4c 5c 08
$f666:	4c 92 f5	— 4c 92 08

The rest of the code is identical. The miniassembler is run by typing $0966g.

Cross-referencing

A QUICK glance at E McGeough's Cross-Reference program, Apple Pie, January 1981, showed that it did not handle names more than 4 characters very well and was limited to 999 references writes Neil Lomas of Crewe. It seemed rather slow, however, even for Basic — a program containing 878 references took 37 minutes 15 seconds.

The most obvious cause of its slow speed was that it sat on top of the program being analysed. Every Goto caused the whole program to be scanned — and there are very many Gotos during a sort. Removing of the program once the references had been assembled seemed to provide the answer.

Although it may appear a disadvantage to have to preserve the string array on disc while the program is changed, this produced a significant reduction in the overall time and also opened the way to removing the 999 limit. Instead of assembling all the strings and writing them to one file, a new file is written whenever a certain number of references, 512, have been assembled. The files are sorted independently and then merged.

Further savings resulted from clearing string array elements to null as soon as they were no longer required — reducing the frequency of garbage collection — and by sorting an array of pointers instead of the strings themselves. I was a little surprised at this, as I had some vague notion that two strings with the same value were merely two pointers to the same string. If there are circumstances where this is true, it does not happen here — otherwise sorting a string array would only amount to swapping pointers.

Finally, the printer had a habit of stopping for long periods while garbage collection took place. Assembling each print line in memory is a high-speed garbage generator — unloading the assembly job on to the printer cleared the problem completely.

Since this process now destroys the program being analysed, it is first saved in a file called In case of accidents. After the cross-reference has been produced, In case of accidents may be loaded if necessary, lines 63955 onwards deleted, and the program saved under its proper name.

If the program to be analysed has been run, Clear the data areas before running the cross-reference. If any program has reduced high memory, re-boot DOS and re-load the program. Failure to do this will greatly slow the process, if it does not stop it altogether. Note that the last character of a long name is now saved, to distinguished $ and %.

The program as listed analysed McGeough's program in 23 minutes 36 seconds, a saving of more than 36 percent. Although the original listed the program as well, the times quoted compare like with like. To accelerate the initial assembly phase, try removing the progress print and assembling the arrays directly to disc. This would involve replacing the individual file sizes and continuation markers with a separate index.

A note about the printing: the protocol used is for a parallel printer which adds its own line feed, actions received LFs, and has a reverse LF facility. It can be adapted for any parallel printer except one which adds LFs and cannot reverse. In that case, the program must be changed to begin a new print line for each disc file — even where that results in repeating a variable name — or to revert to the original method of assembling print lines in memory. If you have a serial printer, this may not apply.

```
10  REM   XREF
20  REM   RUNNING THIS PROGRAM WILL SAVE
30  REM   THE LINES 1000-63999 IN AN
40  REM  EXEC FILE 'CROSS-REF' WHICH MAY
50  REM  BE EXECUTED DIRECTLY ON A PROGRAM
60  REM  IN MEMORY TO GIVE A CROSS-REF
70  REM  LIST OF THE PROGRAM'S VARIABLES
80  REM   EXTENDED BY N.LOMAS FROM PROGRAM BY E.MCGEOUGH, P.
     C. JAN 81
90  REM   LINES 63955-63999 ARE LOADED ON TOP
100  REM   OF THE PROGRAM AND RUN TO EXTRACT
110  REM   ALL THE REFERENCES AND WRITE THEM
120  REM   TO ONE OR MORE DISC FILES.
130  REM   THE PROGRAM IS DELETED AND
140  REM   REPLACED WITH LINES 1000 - 1720
150  REM   (WITH REMS STRIPPED) WHICH SORT
160  REM   AND MERGE THE DISC FILES AND
170  REM   PRINT THE CROSS-REFERENCE LIST.
180  REM   EACH DISC FILE CONTAINS UP TO 512
190  REM   REFERENCES PRECEDED BY TWO NUMBERS.
200  REM   THE FIRST NUMBER IS THE NUMBER OF
210  REM   REFERENCES ON THE FILE.
220  REM   THE SECOND NUMBER IS NON-ZERO IF
230  REM   THERE IS ANOTHER FILE TO FOLLOW.
240 NF$ = "CROSS-REF"
```

```
250 D$ =  CHR$ (4)
260  PRINT D$;"OPEN ";NF$
270  PRINT D$;"DELETE ";NF$
280  PRINT D$;"OPEN ";NF$
290  PRINT D$;"WRITE ";NF$
300  LIST 63955.
310  PRINT "RUN63955"
320  PRINT "NEW"
330  LIST 1000,1020
340  LIST 1060,1070
350  LIST 1100,1170
360  LIST 1210,1240
370  LIST 1270
390  LIST 1310,1450
400  LIST 1470,1480
410  LIST 1510
420  LIST 1530,1550
440  LIST 1590
450  LIST 1640,1660
460  LIST 1710,1720
470  PRINT "RUN"
480  PRINT D$;"CLOSE ";NF$
490  END
1000 D$ =  CHR$ (4):I$ =  CHR$ (9):YA = 1:PD$ = "     ":W = 7
     6: DIM T$(513),U$(513),PP(512)
1010 OP$ = "OPEN XREF LIST ":RD$ = "READ XREF LIST ":WR$ = "
     WRITE XREF LIST ":CL$ = "CLOSE XREF LIST "
1020  PRINT D$;OP$;YA;",D1"
1030  REM   INPUT THE STRING ARRAY AND
1040  REM   CONSTRUCT A MATCHING ARRAY
1050  REM   OF POINTERS
1060  PRINT D$;RD$;YA: INPUT X: INPUT YB: FOR C = 1 TO X: INPUT
     T$(C):PP(C) = C: NEXT
1070 T$(X + 1) =  CHR$ (255): PRINT D$;CL$;YA
1080  REM   PERFORM A SHELL SORT
1090  REM   OF THE ARRAY OF POINTERS
1100 Y = X:M6 = Y: PRINT "SORTING --- WAIT"
1110 M6 =  INT (M6 / 2): IF M6 = 0 THEN 1210
1120 K6 = Y - M6:J6 = 1
1130 I6 = J6
1140 L6 = I6 + M6: IF T$(PP(I6)) <  = T$(PP(L6)) THEN 1160
1150 PP = PP(L6):PP(L6) = PP(I6):PP(I6) = PP:I6 = I6 - M6: IF
     I6 >  = 1 THEN 1140
1160 J6 = J6 + 1: IF J6 > K6 THEN 1110
1170  GOTO 1130
1180  REM   END OF SORT
1190  REM   WRITE THE SORTED FILE BACK
1200  REM   TO THE DISC
1210  PRINT D$;OP$;YA: PRINT D$;WR$;YA
1220  PRINT X: PRINT YB: FOR C = 1 TO X: PRINT T$(PP(C)): NEXT

1230  FOR C = 1 TO X:T$(C) = "": NEXT
1240  PRINT D$;CL$;YA: IF YB <  > 0 THEN YA = YA + 1: GOTO 1
     020
1250  REM   IF THERE IS ONLY ONE FILE
1260  REM   GO DIRECTLY TO PRINT
1270  IF YA = 1 THEN 1470
1280  REM   READ THE FILES IN PAIRS
1290  REM   AND MERGE THEM BACK
1300  REM   ON TO THE DISC
1310  FOR YC = 1 TO YA - 1: FOR YD = YC + 1 TO YA: PRINT "ME
     RGING FILES ";YC;" AND ";YD:
1320  PRINT D$;OP$;YC: PRINT D$;RD$;YC
1330  INPUT XA: INPUT YB: FOR C = 1 TO XA: INPUT T$(C): NEXT
     :T$(XA + 1) =  CHR$ (255)
1340  PRINT D$;CL$;YC
1350  PRINT D$;OP$;YD: PRINT D$;RD$;YD
1360  INPUT XB: INPUT YE: FOR C = 1 TO XB: INPUT U$(C): NEXT
     :U$(XB + 1) =  CHR$ (255)
1370  PRINT D$;CL$;YD: PRINT D$;OP$;YC: PRINT D$;WR$;YC: PRINT
     XA: PRINT YB
1380 XT = 1:XU = 1: FOR XE = 1 TO XA
1390  IF T$(XT) > U$(XU) THEN  PRINT U$(XU):U$(XU) = "":XU =
     XU + 1: GOTO 1410
1400  PRINT T$(XT):T$(XT) = "":XT = XT + 1
1410  NEXT : PRINT D$;CL$;YC: PRINT D$;OP$;YD: PRINT D$;WR$;
     YD: PRINT XB: PRINT YE
1420  FOR C = 1 TO XB
1430  IF T$(XT) > U$(XU) THEN  PRINT U$(XU):U$(XU) = "":XU =
     XU + 1: GOTO 1450
1440  PRINT T$(XT):T$(XT) = "":XT = XT + 1
1450  NEXT : PRINT D$;CL$;YD: NEXT : NEXT
1460  REM   READ A FILE
1470 T$(0) = PD$: FOR YC = 1 TO YA: PRINT D$;OP$;YC: PRINT D
     $;RD$;YC
1480  INPUT X: INPUT YB: FOR C = 1 TO X: INPUT T$(C): NEXT
1490  REM   PRINT THE FILE AND RETURN
1500  REM   FOR THE NEXT
1510  GOSUB 1590: PRINT D$;CL$;YC: NEXT
1520  REM   DELETE ALL WORK FILES AND END
1530  FOR YC = 1 TO YA: PRINT D$;"DELETE XREF LIST ";YC: NEXT

1540  END
1550  PRINT D$;"PR#1": PRINT I$;"K";: PRINT I$;"80N";: RETURN

1560  REM   PRINT FILE
1570  REM   OPEN PRINTER AND SPACE ALONG
1580  REM   LINE IF NOT FIRST FILE
1590  GOSUB 1550: IF WW <  > 0 THEN  PRINT  SPC( WW);
1600  REM   IF THE NEXT VARIABLE DIFFERS FROM THE LAST
1610  REM   START A NEW LINE.
1620  REM   IF NOT APPEND LINE NUMBER
1630  REM   UNLESS PRINT LINE IS FULL.
1640  FOR C = 1 TO X: IF  LEFT$ (T$(C - 1),4) <  >  LEFT$ (T
     $(C),4) THEN  PRINT "": PRINT T$(C);:WW = 10: GOTO 1710

1650  IF WW >  = W THEN  PRINT "": PRINT PD$;:WW = 4
1660  PRINT  RIGHT$ (T$(C),6);:WW = WW + 6
1670  REM   AT END OF FILE SET T$(0) TO
1680  REM   THE LAST REFERENCE PRINTED
1690  REM   TO COMPARE WITH 1ST REF ON NEXT FILE.
1700  REM   EXECUTE REVERSE LF AND TERMINATE LINE
1710  NEXT :T$(0) = T$(X): PRINT  CHR$ (27) +  CHR$ (10)
1720  PRINT D$;"PR#0": RETURN
63955  TEXT : HOME
63956  PRINT "VARIABLE LISTER"
63957 D$ =  CHR$ (4)
63958  PRINT D$;"SAVE IN.CASE OF ACCIDENTS,D1"
63959 X = 0:Y = 1:LL = 63953: REM   HIGHEST LINE
63960 PD$ = "     "
63961  DIM T$(512)
63962  REM  FIND FIRST LINE
63963 NL = 2049
63964 P = 2049
63965  REM  RETURN HERE FOR NEXT LINE
63966 NL =  PEEK (P) +  PEEK (P + 1) * 256
63967  IF NL = 0 THEN 63997
63968 P = P + 2
63969 LN =  PEEK (P) +  PEEK (P + 1) * 256:P = P + 1
63970  IF LN > LL THEN 63997
63971 LAB$ = ""
63972  GOSUB 63980: REM  GET NEXT ALPHA
63973 LAB$ = LAB$ +  CHR$ (CH)
63974  GOSUB 63988: REM  GET NEXT CHAR
63975  IF CH > 64 AND CH < 91 THEN 63973
63976  IF CH > 47 AND CH < 58 THEN 63973
63977  IF CH = 36 OR CH = 37 THEN 63973
63978  GOSUB 63993
63979  GOTO 63971
63980  GOSUB 63988
63981  IF CH = 34 THEN  GOSUB 63984: GOTO 63980
63982  IF CH < 65 OR CH > 90 THEN 63980
63983  RETURN
63984  GOSUB 63988
63985  IF CH <  > 34 THEN 63984
63986  RETURN
63987  REM  GET NEXT CHAR
63988 P = P + 1
63989  IF P = NL THEN  POP : POP : GOTO 63965
63990 CH =  PEEK (P): IF CH = 178 THEN P = NL: POP : POP : GOTO
     63965
63991  RETURN
63992  REM  STORE LABEL
63993  PRINT LN;" ";LAB$
63994  IF X = 512 THEN YA = 1: GOSUB 63998
63995  IF  LEN (LAB$) > 4 THEN LAB$ =  LEFT$ (LAB$,3) +  RIGHT$
     (LAB$,1)
63996 X = X + 1:LN$ =  STR$ (LN):T$(X) =  LEFT$ (LAB$ + PD$,
     5) +  RIGHT$ (PD$ + LN$,5): RETURN
63997 YA = 0: GOSUB 63998: END
63998  PRINT D$;"OPEN XREF LIST ";Y;",D1": PRINT D$;"WRITE X
     REF LIST ";Y
63999  PRINT X: PRINT YA: FOR C = 1 TO X: PRINT T$(C):T$(C) =
     "": NEXT : PRINT D$;"CLOSE XREF LIST ";Y:Y = Y + 1:X =
     0: RETURN
```

Dynamics laws create control 'nightmare'

IF YOU have followed my advice from the previous micromouse pages and now have a movable chassis, you are about to discover the two basic laws of dynamics:

- When a moving object meets an immovable object, the immovable object is knocked out of the way.
- Every static object exerts an equal but not opposite attraction to any nearby moving object.

The underlying principle of the first law is that a robot must detect an object sufficiently far away from it to be able to stop. One mouse, based on ordinary motors, had the problem that — although it could detect objects at a distance — when the wheels were stopped the mouse kept on sliding until it hit a wall. On one memorable occasion it burst out of the side of the maze and leapt into space — it was caught just in time.

Remember, the base of the maze is chipboard painted in a smooth, matt-black paint. I believe slightly spongy wheels — such as the model aircraft wheels I used — are essential.

It is also worth noting that the walls of the maze are designed only to withstand a force of one Newton — the weight of a medium-sized apple, I am told. Another mouse, based on stepper motors, had trouble with deceleration. Stepper motors

by Nick Smith

need to be accelerated if high speed is to be achieved but this means, of course, they need to be decelerated to stop. It can mean that sensors need to be able to detect a wall in front from a considerable distance.

The mouse from Finland took about a metre to stop from its top speed. Its sensors could detect a wall at a distance of about 4in. Before you fall out of your chair in hysterical laughter, I would like to point out just how clever their software was. Like all good mice it built-up a bit map of the maze. Unlike any other mouse, however, it had three possible states for each wall: wall present, wall not present, not known.

When running in a straight line, the software checked ahead to find the nearest known wall or unknown position. It then continuously calculated its speed on the basis that it must be able to stop if there was a wall at that point. The first time it went along a passage it went relatively slowly, accelerating and decelerating in little bursts from square to square.

The second time along a passage, it accelerated smoothly to a much higher speed until, half way along, and then it decelerated smoothly to the end. When it became confused, however, it managed to demolish several walls before it stopped.

The underlying principle of the second law is that however hard you try, your mouse will not travel in a straight line. It is much better to accept this and start planning on what your mouse is going to do as it is magically attracted towards a side wall, rather than to try harder and harder to build a mouse that will go straight. A mouse could travel several 100ft. not to mention going round many 90° corners during its 15 minutes in the maze.

After the July trial last year, the competition organiser John Billingsley was so concerned about peoples lack of understanding of control theory that he sent the following advice to all competitors:

The most important thing to bear in mind is that what the controller does not know about, it cannot control. When guiding a mouse along a straight run, everybody thinks about the mouse's displacement from the centre line, but at least as important is the angle at which the mouse is pointing. For a vehicle with a steering wheel, running at constant speed, the behaviour can be described by two state equations:

1. Rate of change of displacement is proportional to angle — roughly.
2. Rate of change of angle is proportional to steering.

For stability, the feedback signal which controls the steering must contain information of both displacement and angle. The simplest way to achieve this is by mounting the wall-sensor forward of the unsteered axle — the further forward, the more the signal will depend on the angle. Since, in most systems, this signal will be on-off, its use to control steering angle would result in the front wheel(s) snapping to-and-fro. If instead it is used to control the rate-of-turn of the steering wheel, there is a third state equation:

3. Rate of change of steering is proportional to input.

Thus the feedback signal must also reflect the steering angle. This can be achieved by mounting the sensor on a forward boom which rotates with the steering — not an easy thing to fit within the confines of a maze, however.

The mice which entered the Portsmouth heat were not based on a car, but on a wheelchair. The two main wheels, one each side, are driven independently. To prevent toppling, other wheels are fitted but these merely act as castors. For steering, one wheel is driven forwards while the other is driven backwards — or less strongly, or not at all. This scheme is mechanically much simpler, but it can become a controller's nightmare. The state equations now become:

1. Rate of change of displacement is proportional to angle — rather more roughly.
2. Rate of change of angle is proportional to left-motor-speed minus right-motor-speed.
3. Rate of change of left-motor-speed is proportional to applied left drive minus motor damping effect times left speed.
4. Rate of change of right motor speed is proportional to applied right drive minus motor damping times right speed.

Having built what John Billingsley describes as a controller's nightmare, I was not entranced by the idea of writing the software to solve four simultaneous differential equations. How I eventually solved the steering problem will be the subject of a future article.

It does not matter how good your logic and software are if your sensors are not gathering the necessary information and transmitting it correctly to the controller. My own mouse was based entirely on mechanical sensors because I did not have the electronic knowledge to do anything else. For the benefit of the more advanced constructor, I have obtained information and suggested circuits for using Ultra Sonics which should be ideal for long-range sensing.

I have, however, failed to glean any information about using infra-red devices for sensors. The Plessey team — whose mouse used infra-red rays — are not talking. Anyway, I understand their circuit included purpose-built chips not available to the general public. If anyone can supply me with details of using infra-red devices, especially for measuring distance, please write.

The code to generate the sequence of bit patterns for my stepper motors was incorrect. The third and fourth lines were interchanged. If, when you do a shift, a 1 drops off one end, you add a 1 to the other end to maintain the bit pattern. So, if a zero is shifted out, you skip the addition.

Summer heats

FOR THOSE trying to plan your summer holidays you could go to:

Paris	May 4-9 for Micro-Expo 81, heat
Holland	June, heat
London	July 29-31 for the Online Exhibition, heat
Paris	September 7-10 for the Euromicro Symposium, finals

The Paris heat and finals are at the Palais De La Découverte. There will also be a number of weekend trials held there during the summer.

Entry forms

FOR DETAILED information about the competition and entry forms please contact Dr John Billingsley, Portsmouth Polytechnic, Department of Electrical and Electronic Engineering, Anglesea Building, Anglesea Road, Portsmouth, PO1 3DJ.

John Billingsley is about to reduce his regular mailing list to those people who have sent in completed entry forms. So, if you have obtained details and have not yet sent in your entry form, do it now.

There have been enquiries from just about every European country you can think of and an entry from Japan. There have even been two enquiries from Russia. I would guess the most common language between the contestants is likely to be Z-80 machine code despite the fact that the RCA 1802 is a much more useful micro chip.

User Groups is a region-by-region list of micro clubs in Britain. If a new club has been formed, send us the details and we will include them in the next available issue.

AVON
BAUD, Bristol Apple Users and Dabblers
Geoff Smythe
Datalink Microcomputer Systems Ltd
10 Waring House
Redcliffe Hill
Bristol BS1 6TB.
Tel: 0272 213427.
Bristol Computing Club
Leo Wallis
6 Kilbernie Road
Bridge Farm Estate
Bristol BS14 0HY.
Tel: 0272 832453.
Brunel Computer Club
S W Rabone
18 Castle Road
Worle
Weston-Super-Mare
Avon BS22 GJW
Tel: 0934 513068

BEDFORDSHIRE
U.K. Intel MDS Users' Group
Lewis Hand
29 Chaucer Road
Bedford.
Tel: 0234 41685.
6502 Users' Club
Joe Manifold
16 Bun Yam Close
Pirton, near Hitchin
Hertfordshire.
Tel: 0462 18522.

BERKSHIRE
Commodore Pet User Club
M Gulliford
818 Leigh Road
Slough Industrial Estate
Slough
Berkshire.
Tel: 0753 74111.

BUCKINGHAMSHIRE
Apple Users' Group
S F Proffitt
The Granary
Hill Farm Road
Marlow Bottom
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Tel: Marlow 73074
01-750 7298, day.
National TRS-80 Users' Group
Brian Pain
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International Nascom Microcomputer Club
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CAMBRIDGESHIRE
Peterborough Computer Club
Trevor Marchant.
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Machine-code programming for the Nascom 1 and 2

By G R Wilson. Published by Interface Components Limited, Oakfield Corner, Sycamore Road, Amersham, Buckinghamshire, HP6 6SU. Telephone 02403 22307. 125 A4 pages paperback, available from the publisher. Price £4.50 plus 50p postage.

THIS BOOK is intended for the Nascom programmer with little or no previous experience of machine-code programming. It covers the necessary ground to start the reader programming confidently, but lacks the extra features which would make it especially useful.

Following an introduction to number systems and to computer concepts, the text describes the detailed function of the most important Z-80 instructions. They include the register-register and memory-register-memory move instructions, conditional and unconditional branches, arithmetic and logical operations and shifts, and simple input-output. The instructions are extensively illustrated by example program sections, with associated descriptive text, flowcharts and diagrams.

Appendices

There are five appendices which describe the CPU register sets and memory maps for Nascom 1 and Nascom 2, give a routine for displaying CPU registers, explain the attachment of simple I/O devices; describe the method of entering and executing a program under Nas-Sys; and, finally, provide a list of Nasbug routines equivalent to the Nas-Sys routines used in the text.

The contents are perfectly adequate for an introduction to Nascom machine-code programming, but the provision of a few extras could have easily lifted the text into a higher class altogether. A full list of Z-80 operation codes, mnemonics, timings, and a symbolic description of each instruction would only take a few extra pages but would make this a useful reference text once the reader has gained proficiency. A simple index would help.

Most valuably, the inclusion of 12 or so useful subroutines would save a great deal of wasted programming effort as many readers reinvent standard algorithms. Candidates for inclusion might be integer multiplication and division — for eight- and 16-bit values — simple floating-point, one or two sorts, a hashing routine, a search, a random number generator, a simple storage manager, and routines to convert printable characters to binary numbers and *vice versa*, for integers, decimals and floating-point. Such subroutines would serve the additional functions of providing substantial examples of good programming techniques.

With the additions mentioned, this would be an exceptionally good text for readers who want to teach themselves machine-code programming with a Nascom. It should be stressed, however, that there are some disadvantages to learning programming by starting at the machine-code level.

Real danger

There is a danger that the detail of registers, bits and instruction codes will obscure the real nature of the problem being solved, and that the newcomer to programming will develop a preoccupation with implementation details and efficiency which will make it harder to solve the larger-scale, complex, interesting problems of computing.

There is an increasingly widespread view among professional programmers that assembly or machine-code programming should be reserved for the few small sections of programs where the access to machine instructions is essential, and that high-level languages should be used elsewhere.

The pressures on amateurs are, of course, different and they have different interests, but anyone who plans a career as a programmer might do well to remember the professionals' increasing preference for higher-level languages.

Conclusions

- **A valuable book, providing a clear and accurate introduction to Z-80 machine-code programming and the Nascom.**
- **With a few additions this book could be exceptional; with its present contents it is still a thoroughly satisfactory book and good value for money.**

Martyn Thomas

Business information processing with Basic

George Struble. Published by Addison Wesley Publishing Company. 354 pages hardback. ISBN 0 201 07640 3.

FIVE TO 10 years ago it seemed as if everyone able to program was writing books on IBM 360/370 assembler. One text stood out as a standard against which all the others were judged and found wanting; one text had clearly been written by someone who had considerable experience of teaching the subject successfully.

That book was written by George Struble, and if any reader is looking for a textbook to serve as a tutorial text and reference book on IBM assembly language, BAL, Struble's book can be thoroughly recommended.

Nowadays, it seems as if everyone who can both program and spell is rushing to publish a book on programming in Basic, and once again George Struble has rushed to the rescue with a thoroughly-professional book — one surely destined to become a classic and a standard for judging future texts.

Struble's book is intended for students who wish to learn how to use a computer to solve business data-processing problems. It is equally suitable for use in a taught course and as a self-study text. No previous knowledge of computers, data processing or mathematics is required.

The book starts with an introduction to computer applications in businesses, and to the structure, organisation and use of a computer. Programming is introduced as a logical activity which should lead to a clear and correct statement of the actions which have to be performed.

The ideas of structured programming are introduced from the very beginning and are carried through the text, so the unstructured nature of the Basic language is not allowed to lead the novice programmer into bad habits which will have to be lost when a more powerful language such as Pascal is learned.

Struble explains in his preface that he prefers Basic to Cobol or RPG for an introductory business data processing course because it lends itself to this well-structured, procedural approach to programming.

He certainly carries conviction — the example programs are very good examples of clear, efficient, correct programs. The examples are noteworthy for other reasons, too. The use of REM is exemplary and the listings seem to have been reproduced from clear computer output, removing the dangers of errors introduced in the typesetting process.

Each of the chapters of the book ends with a summary of the main ideas and with a number of "questions for imagination and review". The questions are well-chosen and, best of all, the odd-numbered questions have answers given at the end of the book. There is a glossary and a good index.

Since it is a book for the real world of business applications, the whole text has a very practical air. Much emphasis is laid on file processing and a chapter is devoted to testing and debugging. There is also a chapter on systems analysis — the process of studying the way something is done in a business and deciding how it can best be implemented as a computer system.

The particular dialect of Basic used in all the examples is DEC-10 Basic, but not all the features of this are used, and, in any case, the use of pseudocode as a design tool makes it easy to translate into the local dialect of Basic the reader has available.

According to the preface to the book, there are a number of workbooks available giving the example programs in various other dialects, but none of these were provided for review.

Conclusions

- **An excellent book, thoroughly recommended to anyone who is serious about learning to program in Basic, particularly for business applications.**
- **It is destined to become a yardstick for measuring the comparative success of other authors' work.** *Martyn Thomas*

How to translate 6502 to Z-80 assembly language

TO KEEP things to a manageable size, the program is intended to take a general 6502 listing, and translate it to a general Z-80 listing. Thus, machine-specific sections are only translated as assembly code — they are not altered to suit the architecture of the target computer. For example, a Pet program may write directly to that computer's memory-mapped display — the translation would not automatically

by David Peckett

write to, say, the TRS-80 display area. Similarly, you will have to make your own decision about where to put the stack.

In this first article, I shall describe some of the theory behind the program; in part 2, I shall give its listing. The second part will also go into some of the practical aspects of using the translation program. I have to assume all the way through that you are familiar, to some extent, with the two micros' assembly languages — if you need more details, may I refer you to my recent series on the subject?

First of all, though, what is the use of such a program? If you only use a high-level language such as Basic, it is of no value at all. However, if you work in machine code, you will often meet apparently useful listings you cannot use because you have the wrong micro.

For instance, you might want to take a program for the 6502 in an Apple, and run it on your Video Genie Z-80. To do it, you would have to understand fully the original listing, and effectively work out its flowchart. You could then re-write it in Z-80 code. A translation program would do all this work for you — feed it 6502 code and it gives you Z-80 code.

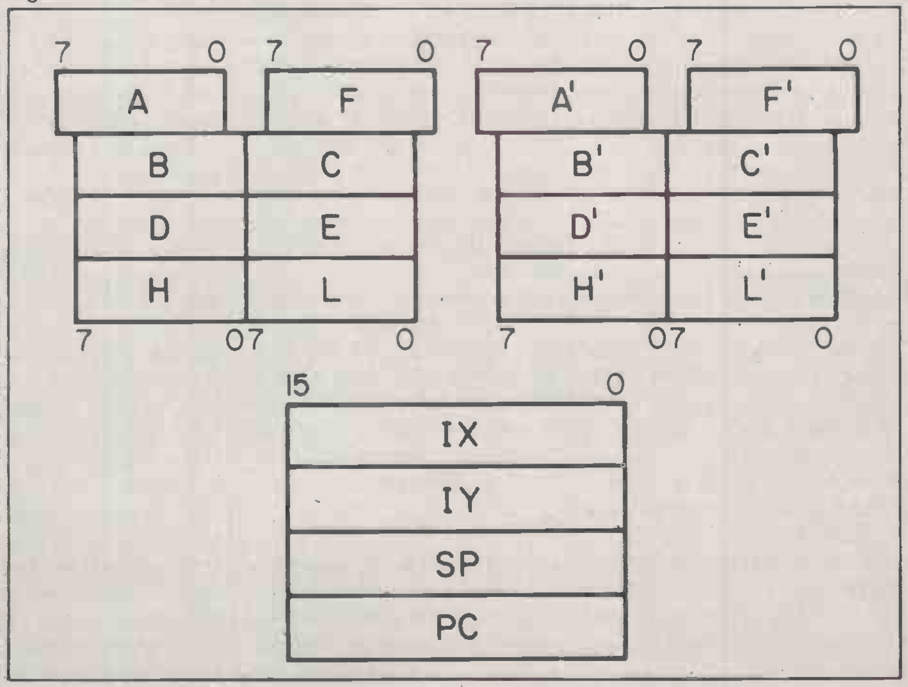
Why 6502 to Z-80 translation? There are two main reasons. In the first place, it is easier than the other way, and in the second place, I own a Z-80-based computer.

At this point, it is worth seeing just why it is easier to go from 6502 to Z-80. For those of you who did not see my earlier series, let us have a quick look at the architecture of the two micros.

6502 architecture. Figure 1 shows the basic 6502 configuration. The micro has a single eight-bit accumulator, in which all the arithmetic is done, and a status register, containing flags which show the results, e.g., carry generated, accumulator zeroed, etc., of the majority of the operations performed.

There are two eight-bit index registers, X and Y, which are, in many ways, interchangeable and can be used for temporary data storage, as loop counters, and as indices for the micro's numerous addressing modes. I shall return to the subject of

Figure 2. Basic Z-80 architecture.



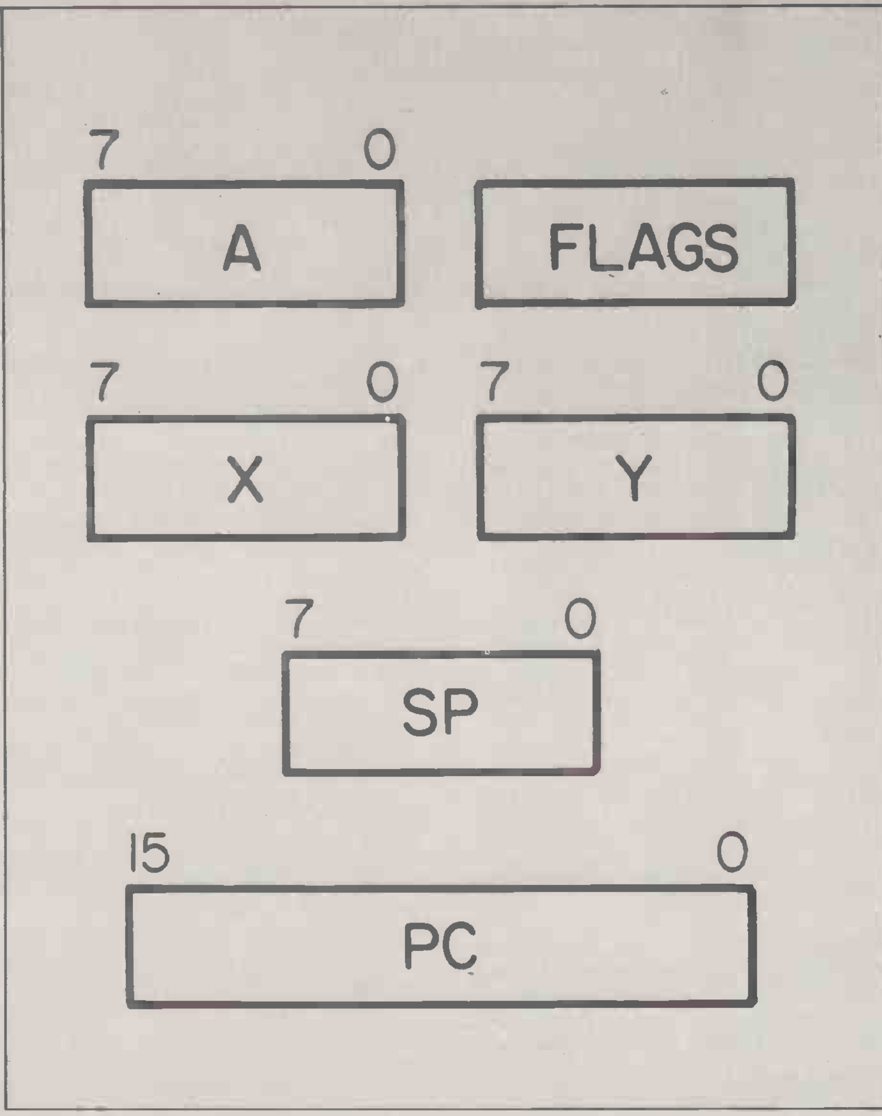


Figure 1. 6502 architecture.

6502 addressing modes in more detail later.

The 6502 also has an eight-bit stack pointer, SP, which is used to point to a stack permanently located on page 1 of memory, and a conventional 16-bit program counter, PC.

Z-80 architecture. The architecture of the Z-80 is shown in figure 2. The micro is obviously much more complex than the 6502, and its structure centres around two sets of working registers. It can use either set at any given time, but not the two together.

Each set has an eight-bit accumulator, A, with its associated flag register, F, and six general-purpose eight-bit registers, B-E, H,L. These six registers may be concatenated into three 16-bit registers, BC, DE and HL, in order to perform either limited 16-bit arithmetic, or to give pointers to anywhere in the micro's memory space. HL is more useful than either BC or DE.

The Z-80 also has a 16-bit SP, which means that the stack can be anywhere in memory, and a 16-bit PC. It also has two 16-bit index registers, IX and IY. The action of these two is very different from that of the 6502 X and Y, and I shall not be using them. So you can forget about them again.

Similarities between the micros. Both micros have an eight-bit accumulator, in which virtually all arithmetic is performed, and both offer substantially the same operations — the Z-80 actually does a few more than the 6502. The results of the operations are reflected in the flags, and both chips have almost equivalent carry, zero and sign flags. The PC operation is effectively identical in the two micros, and the 6502 eight-bit SP is a subset of the Z-80 16-bit one.

Major differences. The most important difference between the two micros lies in their addressing modes. The 6502 has a very rich choice of indexed, indirect and compound modes, as well as the more obvious immediate and absolute modes.

The Z-80, on the other hand, effectively has only immediate and indirect operations; the latter use HL as a pointer. It is possible to load and store A via absolute addressing, but you cannot, say, add directly to A in this mode. The micro has a form of indexing, but as I mentioned, it

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is totally dissimilar to that of the 6502.

The other major area of difference is in the way that the two micros use their flags. For a start, the 6502 sets its flags whenever it loads or manipulates A, X or Y; the Z-80 alters flags only after an arithmetic or logical operation. In subtraction and comparison operations, the 6502 sets its carry flag to show no borrow, while the Z-80 clears it to show the same state. During addition, both micros work in the same way.

The Z-80 lacks the 6502 break and decimal flags, and its overflow flag is only roughly equivalent to that in the 6502. The Z-80 does not have an interrupt flag either, but it can obtain the same effect another way. On the other hand, the Z-80 has two flags which the 6502 lacks.

That sounds like a depressing list of differences, but when you examine them. it is possible to fool the Z-80 into behaving much like a 6502. There are some grey areas, like the overflow flag, but in practical terms they are not

```
         ...      ABS,X
gives:
         LD       HL,ABS
         CALL     IXIX
IXIX     EX       AF,AF'    ;SAVE FLAGS
         ADD      HL,BC     ;INDEX
         EX       AF,AF'    ;RESTORE
         RET
```

Figure 3. ABS,X mode.

important. In fact, there are only four 6502 instructions which cannot be translated to a Z-80 format. They are SED, SEt Decimal, CLD, CLear Decimal, BRK, BReaK, and BIT, BIt Test. Otherwise, translation is possible.

The basic translation approach is to use the registers of the Z-80 to emulate those of the 6502. The two accumulators, flag registers, SPs and PCs are equivalent and so present no problems. C is used to represent X, and E models the Y register. By keeping B and D at zero, we can then, as you will see, work through HL to obtain the same effects as the 6502 addressing modes.

You will probably have gathered by now that the translation program will handle one 6502 instruction at a time — not an ideal approach. It was constrained, however, by a need to fit the program into 16K. With more RAM, it would not be too difficult to generate a rather more intelligent program, able to translate the sense of small blocks of 6502 code into equivalent Z-80 instructions.

Inevitably, this translation approach causes a growth in code size. A translated program will take up about three times as much RAM as the original, and run at about one-third of the speed. In real terms, I do not consider either of these penalties would be significant in the vast majority of cases. The need to watch every last byte and microsecond is often a hangover from the very early days of computing.

So, we will translate programs by taking

```
A. Untranslatable:
       BIT, BRK, CLD, SED
B. Single-line, no operand:
       CLI, DEX, DEY, INX, INY, NOP,
       PHA, PHP, RTS, SEC, SEI
C. Single-line with operand:
       BCC, BCS, BEQ, BMI, BNE, BPL,
       BVE, BVS, JSR
D. Standard format:
       ADC, AND, ASL, CMP, DEC, EOR,
       INC, JMP, LSR, ORA, ROL, ROR,
       STA, STX, STY
E. Irregular — short:
       CLC, PLA, PLP, RTI, TAX, TAY,
       TXA, TYA
F. Irregular — long:
       CLV, CPX, CPY, LDA, LDX, LDY,
       SBC, TSX, TXS
```

Table 1. 6502 instruction categories.

a single line of 6502 code, and replacing it with functionally equivalent Z-80 code. With an operation like ADD, or LDA, this is quite straightforward. Some operations, for example CLV, are much more complex.

If you like, the translation program is a specialised macro-assembler for the Z-80. On the other hand, it is also an off-line 6502 emulator; on-line emulators slow execution time by a factor of 50 or so.

The first problem, then, is how to translate the 6502 operations. I have not space to list all the details — if you really want to know, you can winkle them from the program listing next month. I will say, however, that the 6502 instructions fall into six general categories — table 1.

Untranslatable instructions are self-explanatory. The single-line commands are ones in which, as you might guess, a single line of Z-80 code can replace a single 6502 operation. Some of those operations use implied addressing, while

```
         ...      ABS,Y
gives:
         LD       HL,ABS
         CALL     IXIY
IXIY     EX       AF,AF'
         ADD      HL,DE
         EX       AF,AF'
         RET
```

Figure 4. ABS,Y mode.

the second group, all branches and jumps, use a relative or absolute address. To give examples, the 6502 instructions:

```
DEY
```

and:

```
BNE LOOP
```

can be translated exactly by:

```
DEC    E
```

and:

```
JR     NZ,LOOP
```

The standard multi-line translations define a group of commands in which the basic operation can be translated by a single line, which must then be topped and tailed by other lines to control flags and the addressing mode.

All the instructions in the standard group need identical topping and tailing. For example:

```
ADC       STORE1
```

can be translated as:

```
LD        HL,STORE1
ADC       A,(HL)
```

and:

```
        EOR        TEST
becomes:
        LD         HL,TEST
        XOR        (HL)
```

In general, all these translations involve setting HL to the operand address, and then performing the equivalent Z-80 operation using HL as a pointer.

The first three groups of translatable instructions obviously lend themselves to translation by a methodical technique. We have only to identify the operation, provide the single equivalent Z-80 opcode, and add the operand, which has a regular format.

The last two categories, however, do not fall into a regular pattern. The only reason that I think of two categories at all

```
        ...        (IND,X)
gives:
        LD         HL,IND
        CALL       IXIND
IXIND   EX         AF,AF'
        ADD        HL,BC      ;NEW POINTER
                              ADDRESS
        LD         A,(HL)     ;LOW BYTE...
        INC        HL
        LD         H,(HL)     ;HIGH BYTE...
        LD         L,A        ;...OF POINTER
        EX         AF,AF'
        RET
```

Figure 5. Indexed indirect.

is because of the way in which the translator works. Each 6502 instruction in these groups must be handled as an individual. For instance:

```
        TAX
becomes as:
LD   C,A
INC  C          ;THESE 2 LINES
DEC  C          ;SET THE FLAGS
while:
          CPY ≠ $ABCD
has to become:
LD   D,A        ;SAVE A
LD   A,E        ;A = Y
CMP  0ABCDH
CCF             ;ADJUST CARRY FLAG
LD   A,D        ;RESTORE A
LD   D,B        ;D = 0 AGAIN
```

We have to adjust the carry flag because the two micros affect it in different ways. In the translated program, the flag is held at its 6502 status. It has, therefore, to be complemented before and after subtraction, and after compares, to keep things in order.

In fact, the flags cause a problem all the way through, as the 6502 changes them far more often than the Z-80. I found that the easiest way to set the flags after, say, loading A from memory was to use:

```
      INC       A
      DEC       A
```

The shorter alternative, 'OR A', would zero the carry flag, which we do not want.

It is no use being able to translate operations of a 6502 if we cannot also translate all its addressing modes. The absolute and immediate modes are not too difficult, and neither is the pure indirect mode — but only JMP (x) uses that. It makes no difference to the translation whether or not Page zero addressing is in use — the Z-80 always uses 16-bit addresses.

Somehow, though, we have a deal with the 6502 indexed, indirect-indexed and indexed-indirect modes. Fortunately, the rules for each of these modes are precisely defined, and, at the expense of a few lines of code, it is possible to emulate them all with a Z-80.

The basic technique I chose was always to load HL with the central label of the operand, e.g., 'TOTAL' from 'LDA (TOTAL,X)'. It is followed by a call to one of four possible subroutines, which modify HL to point to the actual address intended. When the whole program is translated, any of the four subroutines actually called by the translation is added to the output. Figures 3-6 show the four subroutines.

Why subroutines? Mainly to minimise the size of the translated program. Inline code would run a little faster and would avoid the slight risk of the subroutine's corrupting the stack. On the other hand, it would make the translation much longer. Using macros would, at least, control the size of the output listing, but would still give plenty of object code. Furthermore, not all Z-80 assemblers have a macro facility. I decided, therefore, that the subroutine approach was the least undesirable one.

As an example of this technique in action:

```
      EOR        (STORE2),Y
translates as:
      LD         HL,STORE2
      CALL       INDIX
      XOR        (HL)
```

The heart of the translator is its handling of the 6502 operations and addressing modes. Once that is resolved, the rest of the program reduces to little more than

```
        ...        (IND),Y
gives:
        LD         HL,IND
        CALL       INDIX
INDIX   EX         AF,AF'
        LD         A,(HL)     ;LOW BYTE...
        INC        HL
        LD         H,(HL)     ;HIGH BYTE...
        LD         L,A        ;...HL =
                              POINTER
        ADD        HL,DE      ;OFFSET
        EX         AF,AF'
        RET
```

Figure 6. Indirect indexed.

control structures and facilities for reading the source code and outputting the translation.

I do not intend to go into the details of the actual implementation — I shall cover that in part 2. It is, however, worth looking at just what the program has to do, and how it should go about doing it.

A program of this complexity is difficult to describe with flowcharts. A more flexible technique is to use a Program Definition Language, PDL, and listing 1 is a specification for the translator, written in a simple PDL.

If you have not seen a PDL before, it describes a program in a format independent of any specific programming language — actually, it looks vaguely like

(continued on next page)

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Pascal. The PDL itself has very few reserved words — BEGIN, END, IF, END IF, THEN, ELSE, DO WHILE, etc. They define the program's flow, and are always written in capitals. The other words in capitals are the names of functional elements of the program — roughly, they represent subroutines. The lower-case text shows what each part of the program has to do.

With this approach, you can define a program in as much, or as little, depth as you want before you start coding. Also, as you can see, it forces you to use a structured approach. It is, therefore, a good way not only of describing a program, but it is also a good way of planning one.

I hope that the listing is reasonably easy to follow, and shows the logic of the program clearly. You have probably noticed that it is rather short on description in some areas, and that it is for one of two reasons.

The segment 'TRANSLATE LINE' is also very brief, and I have only given one example of the routines it calls. I have not shown the details of translating specific 6502 operations. If you want to know how each opcode is tackled, you can work it out from next month's listing.

The translation has to do a reasonable amount of syntax checking. However, do not expect it to do a full check of the source code. It only has to look for errors which might confuse it. Examples are:

- Comments not starting with ';'.
- Operation field not having three characters.
- More than six characters in a label.
- Labels not starting with a letter.
- Non-label, or non-immediate, operand fields.

Some errors could, therefore, slip through, but should be caught by the Z-80 assembler after the translation.

In next month's article, I shall detail how to use the translator. It is worth noting, however, a few of its limitations. I do not think that any are too serious. The operand field can only be a label, or an immediate quantity, in the latter case, it must start with '#'. In other words, you cannot use: LDS $12B7 or similar expressions.

The 6502 has a very useful ability to handle BCD quantities directly. With more space, that could have been translated, but I could not fit it into 16K. Because the Z-80 PUSHes and POPs move two bytes at a time, compared to the 6502's one, you can only have a maximum of 128 items on the stack at any one time. That is because the translated program's stack must be confined to a single page. Also, manipulating data in the stack may occasionally cause corruption.

On the other hand, the translator will handle a more complete and rational set of addressing modes than the 6502 provides. As far as the program is concerned, every instruction which addresses memory can use any addressing mode other than implied. As you know, the 6502 imposes an apparently arbitrary set of restrictions on what modes you can use when.

This bonus feature of the translator arose because it was easier to leave in, rather than to try to trap all the exceptions — now you can use 'STX (IND,X)' with impunity.

Listing 1.

```
BEGIN TRANSLATION
    INITIALIZE SYSTEM
    DO WHILE there is a program to be translated
        INPUT DATA
        IF data overflow
        THEN
            warn operator
        ENDIF
        DO WHILE there is data to be translated
            PARSE DATA LINE
            TRANSLATE LINE
            SAVE TRANSLATION
        ENDO
        WRAPUP TRANSLATION
    ENDO
END TRANSLATION

BEGIN PARSE DATA LINE
    IF comment line
    THEN
        indicate comment line
    ELSE
        read label, operation, operand, comment fields
    ENDIF
    CHECK FOR SYNTAX ERRORS
    IF no errors
    THEN
        BEGIN
            IDENTIFY OPCODE
            IF opcode OK
            THEN
                IDENTIFY ADDRESS MODE
            ELSE
                set error flag

        END
    ENDIF
END PARSE DATA LINE
BEGIN TRANSLATE LINE
    IF error
    THEN
        INDICATE ERROR
    ELSE
        CASENTRY operation type
            CASE untranslatable
                INDICATE UNTRANSLATABLE
            CASE single-line and no operand
                TRANSLATE ONE LINE
            CASE single-line and operand
                TRANSLATE ONE LINE AND OPERAND
            CASE 'standard' group of operations
                STANDARD TRANSLATION
            CASE irregular-short
                TRANSLATE IRREG-SHORT
            CASE irregular-long
                TRANSLATE IRREG-LONG
            ENDCASE
    ENDIF
END TRANSLATE LINE

BEGIN SAVE TRANSLATION
    write 'output' to VDU
    IF tape drive switched to 'record'
    THEN
        WRITE OUTPUT TO TAPE
    ENDIF
END SAVE TRANSLATION

BEGIN WRAPUP TRANSLATION
    IF 'IXIX' called
    THEN
        'output' = IXIX
        SAVE TRANSLATION
    ENDIF
    IF 'IXIY' called
    THEN
        'output' = IXIY
        SAVE TRANSLATION
    ENDIF
    IF 'IXIND' called
    THEN
        'output' = IXIND
        SAVE TRANSLATION
    ENDIF
    IF 'INDIX' called
    THEN
        'output' = INDIX
        SAVE TRANSLATION
    ENDIF
    'output' = 'END'
    SAVE TRANSLATION
END WRAPUP TRANSLATION

BEGIN CHECK FOR SYNTAX ERRORS
    IF bad label
    THEN
        set error flag
    ELSE
        IF operation format wrong
        THEN
            set error flag
        ELSE
            IF comment field format wrong
            THEN
                set error flag
            ENDIF
        ENDIF
    ENDIF
END CHECK FOR SYNTAX ERRORS

BEGIN IDENTIFY OPCODE
    check list of allowable opcodes
```

```
        IF opcode found
        THEN
            record opcode number
        ELSE
            set error flag
        ENDIF
    END IDENTIFY OPCODE

    BEGIN IDENTIFY ADDRESS MODE
        IF no operand
        THEN
            implied
        ELSE
            IF operand = 'A'
            THEN
                accumulator
            ELSE
                IF first character a letter
                THEN
                    IF penultimate character a ','
                    THEN
                        IF last character 'X' or 'Y'
                        THEN
                            INDEXED
                        ELSE
                            set error flag
                        ENDIF
                    ELSE
                        IF last character alphanumeric
                        THEN
                            absolute
                        ELSE
                            set error flag
                        ENDIF
                    ENDIF
                ELSE
                    IF opening bracket
                    THEN
                        IF ',X)' end
                        THEN
                            indexed indirect
                        ELSE
                            IF '),Y' end
                                THEN
                                    indirect indexed
                                    IF ')' end
                                    THEN
                                        indirect
                                    ELS
                                        set error flag
                                    END IF
                                ENDIF
                            ENDIF
                        ELSE
                            IF opening '#'
                            THEN
                                immediate
                            ELSE
                                set error flag
                            ENDIF
                        ENDIF
                    ENDIF
                ENDIF
            ENDIF
        END IDENTIFY ADDRESS MODE

        BEGIN INDICATE ERROR
            'output' = error message + faulty line of source code
        END INDICATE ERROR

        BEGIN STANDARD TRANSLATION
            IF addressing mode unsuited to operation
            THEN
                INDICATE ERROR
            ELSE
                extract translated operation
                IF immediate or accum. mode
                THEN
                    'output' = label + operation + operand + comment
                ELSE
                    IF indexed
                    THEN
                        select appropriate CALL
                    ELSE
                        'output' = label + 'LD    HL,' + operand + comment
                    ENDIF
                    'output' = 'output' + operation + '(HL)'
                ENDIF
            ENDIF
        END STANDARD TRANSLATION
```

Tracking down the cause of Pet's disc-drive problems

THE PET dual drive floppy disc unit with its 15 memory chips and two microprocessors is a much more intriguing device than many conventional disc systems. My interest in the operation of the 2040 disc unit was aroused when people started to bring their machines to us, I am technical services manager at Intelligent Artefacts Ltd, complaining of being unable to load programs which had been previously saved using the same machine.

After eliminating a variety of problems

by P Krueger

caused by discs being wedged tightly in their envelopes, or so loose that they did not settle down on to the conical mandrel correctly, and a case of burnt-out integrated circuits on the memory board, we were left with problems which could not be traced to hardware at all.

The only remaining possibility was that the discs were being corrupted in some mysterious way. So a program was written which would enable a disc to be accessed sector by sector and analysed. Even to begin to do this, we had to know exactly how the disc system operated and how data was held on disc.

Data is passed between the physical disc and the disc unit memory when user commands 1 or 2 are executed. One block of data is transferred between a specified sector of a track and a buffer in the disc unit memory.

Data is transferred between the disc unit memory and the Pet memory when memory read, M-R, or memory write commands, M-W, are executed. A buffer pointer command, B-P, is used to indicate where in the buffer reading or writing is to start — see figures 1 and 2.

Track 18 is of special interest when looking for any corruption which may be causing loading problems as that is the track reserved for disc administration. The first sector on track 18 is the block availabilty map indicating how full the disc is, and also the disc ID — the information put in by the user when Newing the disc.

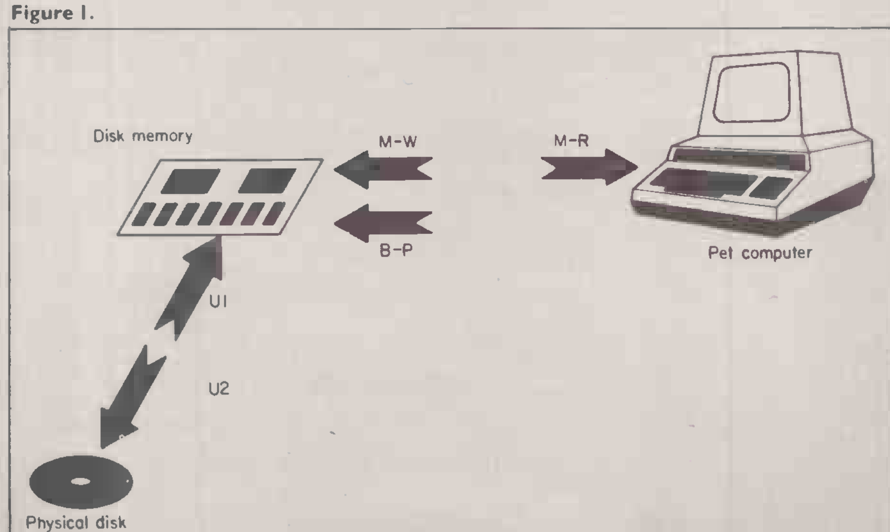
The rest of the sectors on track 18 are used as a directory of the files stored on the disc. Each sector of the directory is split into eight file entries which hold the following information.

1. A code to differentiate programs from data files.
2. An address, track and sector, at which the file starts.
3. The name of the file.
4. The number of blocks used by the file.

The program was built up to perform the following tasks:

- Read a block of, or contents of, a sector from the disc and display it on the Pet screen in both Hexadecimal notation and Asci. Hex was used to ease screen formatting.
- Each disc sector is displayed on the screen in two passes; one for bytes 1-127 and then after clearing the screen, bytes 128-255 are displayed.
- We decided not to scroll the screen output as the information would need to be translated and studied.
- There was also another reason why the output should be held static on the screen: the user should be given a

Figure 1.



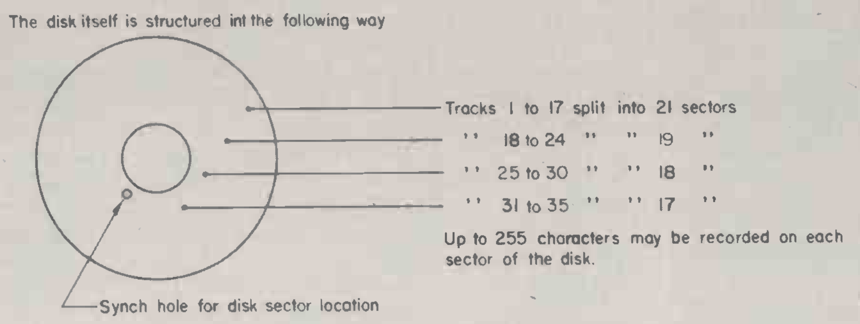


Figure 2.

chance to remove any corruptions found on the disc. The edit mode to do this works by the line to be changed being input by the user, i.e., 1 to 16. The cursor then moves up and deletes the line requested and waits until the user types the correct data in decimal notation. The edited sector is then written into the disc memory and then read out again in Hex to be checked. Once checked, it can then be written on to the physical disc itself from the disc memory.

The program was first used on a disc which would not respond to LOAD "*", 8 which should load the first file in the disc directory, but was instead causing read errors. By running the disc debug program, we found the following on track 18 sector in the second section of bytes, 127-255 — see example 1.

The corruption was deleted by re-writing lines 7, 8, 9 and 10 using Disc Debug. The corruption had been caused by the power to the machine being turned-off while the disc was still in the drive.

That has been the most common cause of the disc corruption found so far and illustrates the need to ensure discs are removed from the drive — even if they have write protects — when powering-down. The corruption itself was an error message written from channel 15 when the power was cut. It demonstrates the problem with two-state systems of predicting the result of unexpected power loss.

Once we had found this method of editing discs directly, it was tempting to examine the way programs were structured on the disc. A program was assembled which joined two routines

(continued on next page)

Example 1.

```
00   00 00 00 00 00 00 00 00   @@@@@@@@
00   00 00 00 00 0D F5 D7 01   @@@@MOA
00   43 4F 4D 57 4F 52 44 50   COMWORDP
00   52 4F 20 49 49 49 A0 A0   RO III
00   A0 A0 4D 41 20 20 A0 A0     MA
00   A0 A0 A0 00 00 00 00 00      @@@@@
00   00 00 00 00 33 31 2C 53   @@@@31,S  ┐
00   59 4E 54 41 58 20 45 52   YNTAX ER  │ contents of
00   52 4F 52 2C 30 30 2C 30   ROR,00,0  │ channel 15
00   30 0D 30 30 0D 20 20 00   0M00M  @  ┘ written on to the disc.
00   00 00 00 00 00 00 00 00   @@@@@@@@
00   00 00 00 00 00 00 00 00   @@@@@@@@
00   00 00 00 00 00 00 00 00   @@@@@@@@
00   00 00 00 00 00 00 00 00   @@@@@@@@
00   00 00 00 00 00 00 00 00   @@@@@@@@
00   00 00 00 00 00 00 00 00   @@@@@@@@
```

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which were originally stored as separate programs on the disc. The purpose of the program was to have one subroutine on the disc which, although it could not be loaded on its own, was loaded at the end of several other programs.

The program works in the following way: the user gives the name of the main routine, the directory is then read from the disc and searched until the program is found. The program then goes to the routine of address which is given in the directory. The first two bytes found will either be a 0 followed by a number giving the number of bytes of program in that sector or there may be a track and sector number indicating that there is more of the routine on another sector.

The search continues until the last sector containing the routine is found. The end of the routine is marked by three bytes, @ @ @ . They are removed and the rest of the sector is also cleared of any garbage left from previous programs — see example 2.

The user is then asked for the subroutine name. It is found in the same way as the routine and its header changed from a direct loading routine to a continuation sector. The track and sector of the subroutine are taken and written into the last track and sector of the main routine. That will cause the subroutine to be pointed to during the loading of the main routine. The routine can be pointed to by more than one main routine thus saving disc space. The disc can be edited back to having separated programs if required using the Disc Debug program.

Although it is not possible to load the subroutine, edit it, re-save it and still ensure it is appended to the main routines, it is possible using the disc debug program to edit it directly on the disc. Just as errors can be overwritten, so minor edits may be performed using Disc Debug to input the special codes used by the Pet disc to represent Basic commands on the disc.

Disc Debug and Concat are available on a disc, price £14.95. Documentation only is £1.98 from the Technical Services Department of Intelligent Artefacts Limited.

Example 2.

The following program is shown in its Pet disc form:

```
10 FOR I = 1 TO 10
20 PRINT "EXAMPLE"
30 NEXT
40 END
```

Number of bytes in routine

Start of Basic line

```
00    00 2D 01 04 0E 04 0A 00    @-ADNDJ@
0F    81 20 49 B2 31 A4 31 30    ↑ I┬1_10
1E    00 1D 04 14 00 99 22 45    @]DT@ I"■"E
2D    58 41 4D 50 4C 45 22 00    XAMPLE"■"@
3C    23 04 1E 00 82 00 29 04    #D^@|@)D
4B    28 00 80 00 00 00 2A 2A    (@■@@@**
5A    2A 2A 2A 2A 2A 2A 2A 2A    ********
69    2A 2A 2A 2A 00 4F 0E 7A    ****@ONz
78    03 8B 20 C6 28 43 24 29    C′ –(C$)
87    B3 33 32 20 A7 20 43 24    ┤32  | C$
96    B2 CA 28 46 53 24 2C 33    ┬\(FS$,3
A5    AC C6 28 43 24 29 AA 31    ■–(C$) ▌1
B4    2C 33 29 3A 8E 00 7D 0E    ,3):/@)N
C3    84 03 8B 20 C6 28 43 24    ┐C′ –(C$
D2    29 B2 33 34 20 B0 20 C6    )┬34 ┌ –
E1    28 43 24 29 B2 39 38 20    (C$)┬98
```

HEX — ASCI

/10__
FOR I = 1 TO 10/
____120__PRINT"E
XAMPLE"__
30__NEXT
40__END

Denotes end of routine

Garbage from previous programs

BUYERS' GUIDE

Software

Software packages are listed by application, in alphabetical order, with the systems on which each package will run also listed alphabetically. The guide is not exclusively for business applications : if your company is the source or dealer for a package with a more unusual application, send us the details and we will create a new category.

The usual criteria have been applied. The minimum configuration is 32K of RAM, a disc and a printer; the price of the package must lie between £50 and £1,000; the companies listed are the source of the software or the main dealers in the U.K., and the capacity quoted is per disc or drive.

Machine type by application

Combined-Ledger/Stock/Invoicing

Machine Type	Supplier Name	Price	Capacity
Apple II	Vlasak Electronics Ltd	£855	
Apple II/ITT 2020	Informex London Ltd	£298	500 A/Cs
Commodore 3032	Compfer Ltd	£400	varies
Commodore 3032	Bristol Software Factory	£300	1,000 A/Cs 6,000 trans
Commodore 3032	G W Computers Ltd	£275--£575	1,000

Commodore 3032	Analog Electronics	£550	
Commodore 3032	Stage One Computers	£600	varies
Commodore 3032	Logma Systems Design	£600	1-6 shops
Commodore 3032	Commodore B M (U.K.) Ltd	£650	650 A/Cs/ledger
Commodore 3032	Compfer Ltd	£600	500 A/Cs 1,000 items
CP/M	Minicomputer CS Ltd	£650	varies
CP/M	Computastore Ltd	£1,000	
CP/M	Minicomputer CS Ltd	£850	varies
CP/M North Star	Benchmark CS Ltd	£950	200 A/Cs 500 trans 300 items
CP/M North Star	Profcomp Ltd	P.O.A.	
CP/M North Star	Intelligent Artefacts	£510	1,500 A/Cs 5,000 trans
CP/M North Star	Instar Business Systems	£999	600-2,900
Metrotech System	Metrotech	£500--£1,000	
Ohio Scientific	Microcomputer B M	£656	
Tandy TRS-80	Microcomputer Applications	£90 each	
Tandy TRS-80	T & V Johnson Ltd	£110	750 trans/disc
Tandy TRS-80	Microcomputers Applications	£350	
TECS	Jar Software Systems	£650	500 A/Cs 300 nom A/Cs
Z-80/8080	Graffcom Systems Ltd	£995	
Z-80/8080	Great Northern C S Ltd	£995	varies

General Ledger

Machine Type	Supplier Name	Price	Capacity
Apple II	Vlasak Electronics Ltd	£225	200 A/Cs 1,000 trans
Apple II	Computech Systems	£295	500 A/Cs 1,700 trans
Apple II/ITT 2020	Systematics International Ltd	P.O.A.	
Commodore 3032	Analog Electronics	£450	
Commodore 3032	HB Computers Ltd	£200	Linked to S/L & P/L
Commodore 3032	Bristol Software Factory	£300	1,000 A/Cs 6,000 trans
CP/M	Haywood Associates Ltd	£500	
CP/M	Median-Tec Ltd	£500	500 A/Cs 600 trans
CP/M	Computastore Ltd	£500	999 A/Cs 99 centres nine companies
CP/M	Ludhouse Ltd	£500	200 A/Cs 5,000 trans
CP/M	Comput-A-Crop	£400	
CP/M	Benchmark CS Ltd	£250	500 A/Cs 5,700 trans
SD100/200	Barcellos Ltd	£250	
Tandy TRS-80	Tridata Micros Ltd	£225--£375	500 A/Cs 1,000 trans
Z-80/8080	Great Northern C S Ltd	£275	varies
Z-80/8080	Graffcom Systems Ltd	£390	

Incomplete Records

Machine Type	Supplier Name	Price	Capacity
Apple II	Personal Computers Ltd	£250	1,000 trans 2,600 A/Cs
Apple II/ITT 2020	Padmede Computer Services	£450	900 A/Cs 2,000 trans/disc
Commodore 3032	Stage One Computers	£750	500 centres 2,300 A/Cs
Commodore 3032	Micro Computation	£555	120 A/Cs 5,000 trans
CP/M	Profcomp Ltd	P.O.A.	2,000 entries
Durango F85	Kesho Systems	£1,000	
Exidy Sorcerer	Basic Computing	£350 incl.	see also Micropute

Job Costing/Billing

Machine Type	Supplier Name	Price	Capacity
Apple II/ITT 2020	Padmede Computer Services	£300	1,000 A/Cs 99 centres
Apple II/ITT 2020	Padmede Computer Services	£300	150 A/Cs
Commodore 3032	Stage One Computers	£100	300 appointments
Commodore 3032	CSM Ltd	£600	1,000 jobs 100 people
CP/M	Graffcom Systems Ltd.	P.O.A.	100 activity codes
Z-80/8080	Great Northern C S Ltd	£300	varies

Mailing Systems

Machine Type	Supplier Name	Price	Capacity
Apple II	Keen Computers Ltd	£300	500 addresses
Apple II/ITT 2020	Systematics International Ltd	£300	500 addresses
Apple II/ITT 2020	Guestel Ltd	£190	400 addresses
Apple II/ITT 2020	The Software House	£57	750 names & adds
Commodore 3032	Stage One Computers	£100	350 records
Commodore 3032	MMS Computer Systems	£250	3,000 records
CP/M	Graffcom Systems Ltd	£250	varies
CP/M	Median-Tec Ltd	£500	
CP/M	Structured Systems Group	£50	varies
CP/M Horizon	Microtek Computer Services	£500	varies
CP/M North Star	Micromedia Systems	£195	
Tandy TRS-80	Comput-A-Crop	£78	varies
Tandy TRS-80	Cleartone ADP	£50	660 entries
Tandy TRS-80	T & V Johnson Ltd	P.O.A.	3,000 names/addresses
Z-80/8080	Micro Focus	£90	varies
Z-80/8080	Intereurope S D Ltd	£500	3,000 entries

Payroll

Machine Type	Supplier Name	Price	Capacity
Apple II/ITT 2020	T W Computers Ltd	£145	
Apple II/ITT 2020	Informex London Ltd	£50	
Apple II/ITT 2020	Informex London Ltd	£198	200 employees
Apple II/ITT 2020	Algobel Computers Ltd	£295	500 employees
Apple II/ITT 2020	Vlasak Electronics Ltd	£360	
Apple II/ITT 2020	Minster Micro System	£199	100 month 50 weekly
Apple II/ITT 2020	Computech Systems	£379	300 employees
Commodore	Petsoft Ltd	£50	200 employees
Commodore 3032	Landsler Software	£95 incl.	200 employees
Commodore 3032	Commodore B M (U.K.) Ltd	£150	200 employees
Commodore 3032	Analog Electronics	£90	
Commodore 3032	ACT (Petsoft) Ltd	£195	600 employees
Commodore 3032	L & J Computers	£220	
Commodore 3032	Intex Datalog Ltd	£195	200 employees
Commodore 3032	Computastore Ltd	£200 & £350	275 & 500 employees
CP/M	Haywood Associates Ltd	£350	
CP/M	Median-Tec Ltd	£500	
CP/M	Selven Ltd	P.O.A.	
CP/M	Graffcom Systems Ltd	£500	250 employees
CP/M	PCL Software Ltd	£600	800 employees/MBYTE
CP/M	Ludhouse Ltd	£450	300 employees
CP/M	Comput-A-Crop	£450	
CP/M Horizon	Microtek Computer Services	Lease	varies
CP/M North Star	Micromedia Systems	£495	350 employees
Durango F-85	Kesho Systems	£500	
Sharp MZ-80K	Tridata Micros Ltd	£250	400 employees
Tandy TRS-80	A J Harding (Molimerx)	£95-£200	
Tandy TRS-80	Tridata Micros Ltd	£218--£375	400 employees
Tandy TRS-80	3-Line Computing	£140	
TECS	Jar Software Systems	£250	300 employees

Z-80/8080	Graffcom Systems Ltd	£490	250 employees
Z-80/8080	Liveport Data Products	£250	500 employees

Property Management

Machine Type	Supplier Name	Price	Capacity
Apple II/ITT 2020	Cyderpress Ltd	£650	500 properties; 420 applicants
Apple II/ITT 2020	Informex London Ltd	£298	300 entries
Apple II/ITT 2020	Algobel Computers Ltd	£650	400 buildings 250 Own 2,000 trans
CP/M	Algobel Computers Ltd	£650	2,000 trans
Z-80/8080	Graham Dorian Software	£325	varies

Purchase Ledger

Machine Type	Supplier Name	Price	Capacity
Apple II	Vlasak Electronics Ltd	£315	200 A/Cs 1,000 trans
Apple II	Computech Systems	£295	500 A/Cs 1,600 trans
Apple II/III 2020	Padmede Computer Services	£300	900 A/Cs 4,500 trans/disc
Apple II/III 2020	Systematics International Ltd	P.O.A.	
Commodore 3032	Microact Ltd	£350	2,000 A/Cs 7,000 trans
Commodore 3032	HB Computers Ltd	£350	800 A/Cs, 4,000 trans
Commodore 3032	Compfer Ltd	£300	1,000 A/Cs 7,000 entries
Commodore 3032	ACT (Petsoft) Ltd	£120	200 A/Cs 700 trans
CP/M	Haywood Associates Ltd	£350	
CP/M	Median-Tec Ltd	£500	500 A/Cs 600 trans/ACs
CP/M	Structured Systems Group	£460	varies
CP/M	Ludhouse Ltd	£500	500 A/Cs 5,000 trans
CP/M	Comput-A-Crop	£400	500 A/Cs
CP/M	Computastore Ltd	£400	500 A/Cs 3,100 trans
CP/M North Star	Benchmark CS Ltd	£250	500 A/Cs 2,000 trans
Durango F-85	Kesho Systems	£500	
Exidy Sorcerer	Basic Computing	£125 incl	See also Micropute
SD-100/200	Barcellos Ltd	£250	
Tandy TRS-80	AJ Harding (Molimerx)	£225	1,100 entries
Tandy TRS-80	Tridata Micros Ltd	£225-£375	125 A/Cs 1,000 trans
Z-80/8080	Great Northern CS Ltd	£275	varies
Z-80/8080	Graffcom Systems Ltd	£440	

Records Management

Machine Type	Supplier Name	Price	Capacity
Apple II	Courtman Micro Systems	£106	100K Characters
Apple II/ITT 2020	Diskdean Ltd	£120	varies
Apple II/ITT 2020	Systematics International Ltd	£125	1,000 references
Apple II/ITT 2020	Informex London Ltd	£198	500-1,200 records
Apple II/ITT 2020	T & V Johnson Ltd	£95	112K per drive
Apple II/ITT 2020	Systematics Intl Ltd	£72 & £175	
Apple/ITT 2020	The Software House	£140	900 records
Commodore 3032	CPS (Data Systems) Ltd	£200	varies
Commodore 3032	Amplicon MS Ltd	£140	1,500 records
Commodore 3032	Compsoft Ltd	£95-£170	600-5,000 records
Commodore 3032	Microact Ltd	P.O.A.	400K-800K
Commodore 3032	Commodore BM (U.K.) Ltd	£150	650
Commodore Pet	Stage One Computers	£130-£250	165K

CP/M	Clenlo Computing Services	£90-£325	varies
CP/M	Median-Tec Ltd	£500	
CP/M SWTPC	Verwood Systems		
Metrotech System	Metrotech	£200-£1,000	
Ohio Challenger	U-Microcomputers Ltd	£175+	
Ohio Scientific	Microcomputer BM	£175	
SD-100/200	Barcellos Ltd	£500-£1,000	
Tandy TRS-80	T & V Johnson Ltd	£200	
Z-80/8080	Structured Systems Group	£135	varies
Z-80/Cromenco	Xitan Systems Ltd	£850	4,000 records/disc

Sales Ledger

Machine Type	Supplier Name	Price	Capacity
Apple II	Vlasak Electronics Ltd	£315	200 A/Cs 1,000 trans
Apple II	Computech Systems	£295	500 A/Cs 1,600 trans
Apple II/ITT 2020	Padmede Computer Services	£300	900 A/Cs 4,500 trans/disc
Apple II/ITT 2020	Systematics International Ltd	P.O.A.	
Commodore 3032	Microact Ltd	£350	2,000 A/Cs 7,000 trans
Commodore 3032	Anagram Systems	£320	500 A/Cs
Commodore 3032	ACT (Petsoft) Ltd	£120	200 A/Cs 700 trans
Commodore 3032	HB Computers Ltd	£350	800 A/Cs 600 trans/ACs
CP/M	Median-Tec Ltd	£500	500 A/Cs 600 trans/ACs
CP/M	PCL Software Ltd	£500	1,000 A/Cs/MByte
CP/M	Ludhouse Ltd	£500	1,000 A/Cs 5,000 trans
CP/M	Ludhouse Ltd	£1,000	
CP/M	Computastore Ltd	£400	500 A/Cs 3,500 trans
CP/M	Haywood Associates Ltd	£350	
CP/M North Star	Benchmark CS Ltd	£250	500 A/Cs 2,000 trans
Durango F-85	Kesho Systems	£500	
Exidy Sorcerer	Basic Computing	£125 incl.	See also Micropute
SD-100/200	Barcellos Ltd	£250	
Tandy TRS-80	Tridata Micros Ltd	£225-£325	175 A/Cs 1,350 trans
Tandy TRS-80	AJ Harding (Molimerx)	£225	1,350 entries
TECS	Jar Software Systems Ltd	£550	500 A/Cs
Z-80/8080	Graffcom Systems Ltd	£440	
Z-80/8080	Great Northern CS Ltd	£275	varies

Stock Systems

Machine Type	Supplier Name	Price	Capacity
Apple II/ITT 2020	Microdigital Ltd	£225	625 items
Apple II/ITT 2020	Systematics Intl Ltd	£500	200-2,500 items
Apple II/ITT 2020	Vlasak Electronics Ltd	£285	
Apple/ITT 2020	The Software House	£80	800 items
Commodore 3032	SMG Microcomputers	£395-£495	2,450-7,000 items
Commodore 3032	Logma Systems Design	£600	1-6 shops
Commodore 3032	L & J Computers	£230	
Commodore 3032	ACT (Petsoft) Ltd	£75	2,400 items 1,000 A/Cs
Commodore 3032	Compfer Ltd	£350	200 lines 20 bars
Commodore 3032	Microact Ltd	£350	2,500 items, 1,000 A/Cs
Commodore 3032	Bristol Software Factory	£300-£360	2,300

Commodore 3032	Commodore B M (U.K.) Ltd	£150	650
Commodore 3032	Anagram Systems	£395	500-600 items 255 A/Cs
Commodore 3032	SA Systems	£650	300 records/disc
Commodore 3032	Petsoft Ltd	£50	2,500 items
Commodore 3032	L & J Computers	£60	500 items
Commodore 3032	Rockliff Brothers Ltd	£120	3,900 items
Commodore 3032	Stage One Computers	£100	650 items
CP/M	Haywood Associates Ltd	£350	
CP/M	Median-Tec Ltd	£500-£800	
CP/M	Graffcom Systems Ltd	£350	520-6,000 items
CP/M Cromemco	Micromedia Systems	£1,000	
CPM/Horizon	Microtek Computer Services	£1,000	varies
CP/M North Star	Benchmark CS Ltd	£450	1,000 items 750 trans
Exidy Sorcerer	Basic Computing	£125 Incl	See also Micropute
Tandy TRS-80	Microgems Software	£150	1,000-2,000 items
Tandy TRS-80	A J Harding (Molimerx)	£225	630 items
Tandy TRS-80	Cleartone ADP	P.O.A.	
Tandy TRS-80	S A Systems	£650	300 stock records
Tandy TRS-80	T & V Johnson Ltd	£115	1,000 items
Tandy TRS-80	T & V Johnson Ltd	£145	1,000 items/invoices
Tandy TRS-80	Tridata Micros Ltd	£200-£375	630 items/disc
TECS	Jar Software Systems	£800	10,000 items 5,000 orders
TECS	Jar Software Systems	£850	1,000 items 300 A/Cs
Z-80/8080	Graham Dorian Software	£325	varies
Z-80/8080	Rogis Systems Ltd	£500	900-3,500 items
Z-80/8080	Great Northern C.S. Ltd	£275	varies
Z-80/8080	Graffcom Systems Ltd	£340	
Z-80/8080	Graffcom Systems Ltd	£580	
Z-80/MCZ	Software Architects Ltd	£600	varies

Word Processing

Machine Type	Supplier Name	Price	Capacity
Apple II	Personal Computers Ltd	£150	17 A4 pages
Apple II/ITT 2020	Vlasak Electronics Ltd	£120	
Apple II/ITT 2020	Systematics International Ltd	£75	
Apple II/ITT 2020	Guestel Ltd	£190	100K characters
Apple II/ITT 2020	Algobel Computers Ltd	£75	800 lines
Commodore 3032	Act (Petsoft) Ltd	£325	12,000 bytes
Commodore 3032	Act (Petsoft) Ltd	£325	12K bytes
Commodore 3032	Dataview Ltd	£159	
Commodore 3032	HB Computers Ltd	£70	39 A4 pages
Commodore 3032	Commodore BM (U.K.) Ltd	£75 & £150	170 pages
Commodore 3032	Stage One Computers	£100	130 pages
CP/M	Median-Tec Ltd	£300	
CP/M	Computastore Ltd	£400	
CP/M	Southdata Ltd	£350	160,000 words
CP/M North Star	Micromedia Systems	£495	
Ohio Scientific	Microcomputer B M	£116	
Tandy TRS-80	T & V Johnson Ltd	£109	10,000 words
Z-80/8080	Structured Systems Group	£120	varies
Z-80/8080	Intereurope S D Ltd	£500	varies

There is an increasing number of packages which do not fit into any of the standard categories we have created and so we have consequently listed them under the title Miscellaneous. They appear in alphabetical order by machine type. The names of

similar packages can be very different so users of the guide should check every entry under their machine type. The full address of the supplier can be found at the end of the guide.

Miscellaneous applications for all machine types

Machine Type	Application and Supplier Name	Price	Capacity
Apple II/ITT 2020	Auction system Cyderpress Ltd	£650	400 entries
Apple II	Cashflow/Bank forecast Vlasak Electronics Ltd	£80	
Apple II	Credit control Microdigital Ltd	£130	
Apple II/ITT 2020	Employment Agents' system Informex London Ltd	£298	600 entries
Apple II/ITT 2020	Estate Agents' system Cyderpress Ltd	£650	280 properties 360 applicants
Apple II/ITT 2020	Estate Agents' system Systematics International Ltd	£850	
Apple II	Estate Agents' register Vlasak Electronics Ltd	£120	
Apple II/ITT 2020	Financial planning Systematics International Ltd	£295	
Apple II	3D graphics package Fylde Microcomputer Services	£150	
Apple II/ITT 2020	Hospital administration Informex London Ltd	£198	300-600 records
Apple II/ITT 2020	Insurance records Informex London Ltd	£198	600 records
Apple II	Letter writer Vlasak Electronics Ltd	£80	
Apple II/ITT 2020	Medical records Informex London Ltd	£198	300-600 records
Apple II/ITT 2020	Modelling, VisiCalc Microsense Computers Ltd	£95	Variable
Apple II/ITT 2020	Pipeline engineering Aerco-Gemsoft	£175	
Apple II/ITT 2020	Property/Estate system Cyderpress Ltd	£650	500 properties 420 applicants
Apple II/ITT 2020	Property/Estate Agents' Informex London Ltd	£298	300 entries
Apple II/ITT 2020	Property valuation Cyderpress Ltd	£650	
Apple II	Sales analysis Microdigital Ltd	£200	500 A/Cs
Apple II	Structural engineering design James C Steadman	£200	
Apple II/ITT 2020	Time recording—solicitors' Informex London Ltd	£198	300 clients
Apple II/ITT 2020	TV rental management system Diskwise Ltd	£395	
Commodore 3032	Appointments planner Commodore BM (U.K.) Ltd	£50	200 entries
Commodore 3032	Bank account reconciliation Stage One Computers	£100	
Commodore 3032	Building conversion Micro Computation	£300- £400	320 clauses
Commodore 3032	Cash book L & J Computers	£90	
Commodore 3032	Estate Agents' package Stage One Computers	£250	325 properties

Commodore 3032	Financial planning ACT (Petsoft) Ltd	£150	Varies
Commodore 3032	Hotel room system Landsler Software	£430	200 rooms
Commodore 3032	Hotel system and billing Landsler Software	£295	280 rooms
Commodore 3032	Insurance Brokers' system Stage One Computers	£100	
Commodore 3032	Invoicing/Costing—jewellers' CPS (Data Systems) Ltd	£575	
Commodore 3032	Job/Appointments planner Stage One Computers	£100	300 appointments
Commodore 3032	Machine hire L & J Computers	£420	
Commodore 3032	Order control MMS Computer Systems	£250	3,600 orders
Commodore 3032	Printers' job control Stage One Computers	£450	130 jobs/disc
Commodore 3032	Printers' quote system Microland	£175	
Commodore 3032	Sales analysis Logma Systems Design	£600	1-6 shops
Commodore 3032	Service company package Stage One Computers	£1,000	
Commodore 3032	Stock/farming livestock S.A. Systems	£650	300 records/disc
Commodore 3032	Window replacement CSM Ltd	£500	
Commodore 3032	Work measurement The Alphabet Company	£150	
CP/M	Cashflow forecasting Ludhouse Ltd	£250	
CP/M	Financial analysis Median-Tec Ltd	£500	
CP/M	Hire purchase system Graffcom Systems Ltd	P.O.A.	Depends on system
CP/M	Invoice discount/factoring Micromedia Systems	£1,000	
CP/M	Order entry & invoicing Graffcom Systems Ltd	£350	500-5,000 orders
CP/M various	P & L budgeting system Micromedia Systems	£495	
CP/M North Star	Personnel records Micromedia Systems	£595	
CP/M	Purchasing system Graffcom Systems Ltd	£450	540-7,000 invoices
CP/M	Statistical analysis Research Resources Ltd	£240 pa	
CP/M	Time recording Haywood Associates Ltd	£500	
CP/M North Star	Vehicle maintenance Micromedia Systems	£195	
Tandy TRS-80	Financial analysis A J Harding (Molimerx)	£55	
Tandy TRS-80	Invoicing Tridata Micros Ltd	£75-150	Linked to stock and sales
Tecs	Production analysis Jar Software Systems	£600	1,000 products 2,500 items
Durango F-85	Time recording/ledger Kesho Systems	£1,000	
Z-80/8080	Appointments system Great Northern CS Ltd	£220-275	Depends on system
Z-80/8080	Civil/structural engineering design Equinox Computer Systems	£500	varies
Z-80/8080	Conference organiser Intereurope SD Ltd	£500	30,000 entries
Z-80/8080	Financial modelling Intereurope SD Ltd	£500	1,000 items 100 reports
Z-80/8080	Personnel records Intereurope S D Ltd	£500	200-300 items

Z-80/8080	Sales analysis retail Graham Dorian Software	£325	Depends on system

Alphabetical list of suppliers

Supplier	Address	Sales contact
3-Line Computing 0482-445496	36 Clough Road Hull HU5 1QL	Tim Hill
Minster Micro Systems 04254-4751	88 Christchurch Road Ringwood, Hampshire, BH24 1DR	R Kilpatrick
ACT (Petsoft) Ltd 021-454-5341	Radclyffe House 66-68 Hagley Road, Edgbaston Birmingham	M Wauchope
Aerco-Gemsoft 04862-22881	27 Chobham Road Woking, Surrey GU21 1JD	Nigel Tylor
A J Harding (Molimerx) 0424-22039	28 Collington Avenue Bexhill-on-Sea, East Sussex	John Harding
Algobel Computers Ltd 021-233-2407	33 Cornwall Buildings Newhall Street, Birmingham B3 3QR	Steven Linden
Amplicon M S Ltd 0273-562163	143A Ditchling Road Brighton, Sussex BN1 6JA	Jim Hicks
Anagram Systems 0403-68601	9 Michell Close Horsham, West Sussex RH12 1JT	Jon Quigly
Analog Electronics 0203-417761	47 Ridgeway Avenue Coventry	
Barcellos Ltd Leicester 26584/5	Kimberley House Vaughan Way, Leicester	K Tapp
Basic Computing 0535-65094	Oakworth Road Keighley, West Yorkshire BD22 7LA	Mike Collier
Benchmark CS Ltd 0726-61000	Tremena Manor Tremena Road, St Austell Cornwall PL25 5QG	S Willmott
Bristol Software Factory 0272-314278	Micro House St. Michael's Hill, Bristol BS2 8BS	W J Kyle-Price
Cleartone ADP 0495-244555	Prince of Wales Industrial Estate, Abercarn, Gwent NP1 5RJ	E Balding
Clenlo Computing Services 01-653-6028	15 South View Court The Woodlands, Beulah Hill, London SE19	T Froud
Commodore B M (U.K.) Ltd 0753-74111	818 Leigh Road Trading Estate, Slough, Berkshire	Nick Green
Compfer Ltd 0772-57684	Preston Computer Centre 6 Victoria Buildings, Fishergate, Preston, Lancashire	D Steele
Compsoft Ltd 0483-39665	Old Manor Lane Chilworth, Guildford, Surrey	Nick Horgan
Comput-A-Crop 01-771-0867	32 Whitworth Road London SE25 6XH	Jenny Wilson
Computastore Ltd 061-832 4761	16 John Dalton Street Manchester	David Nicholson
Computech Systems 01-794-0202	168 Finchley Road London NW3	Laurence Payne
Courtman Micro Systems 0222-495257	48 Melrose Avenue Penylan, Cardiff	G Stuckey
CPS (Data Systems) Ltd 021-707-3866	Arden House 1102 Warwick Road, Acocks Green, Birmingham B276BH	N Ashbourne
CSM Ltd 021-382-4171	Refuge Assurance House Sutton New Road, Erdington, Birmingham B23 6QX	Peter Mart
Cyderpress Ltd 0491-37769	2 Church Lane Wallingford, Oxfordshire	C Murphy

Diskdean Ltd 01-242-7394	23 Bedford Row London WC1R 4EB	
Diskwise Ltd 05793-3780	25 Fore Street Callington, Cornwall	R Cornforth
Equinox Computer Systems 01-739-2387/9	Kleeman House 16 Anning Street, New Inn Yard, London EC2	M Kusmirak
Fylde Microcomputer Services 0253 692954	48 Lomond Avenue, Blackpool, Lancashire	B Seedle
G W Computers Ltd 01-636-8210	89 Bedford Court Mansions Bedford Avenue London WC1	T Winter
Graffcom Systems Ltd 01-734-8862	52 Shaftesbury Avenue London W1V 7DE	Barbara Castledine
Graham Dorian Software 01-379-7931	c/o Lifeboat Associates 32 Neal Street, London WC2H 9PS	J Clifford
Great Northern C S Ltd 0532-589980	116 Low Lane, Horsforth, Leeds LS18 8PX	P Clark
Guestel Ltd 0225-65379	Refuge House 2-4 Henry Street, Bath BA1 1J	Allen Timpany
Haywood Associates Ltd 01-428-9831	11 Station Approach Northwood, Middlesex	I Clarke
HB Computers Ltd 0536-83922 & 520910	22 Newland Street Kettering, Northamptonshire	Stuart Whittaker
Informex London Ltd 01-318-4213/7	8-12 Lee High Road London SE13 5LQ	K Tayfoor
Instar Business Systems 01-680-5330	61 High Street Croydon,Surrey	S Kent
Intelligent Artefacts 022020-689	Cambridge Road Orwell, Hertfordshire	D Sands
Intereurope SD Ltd 0734-789183	19-21 Denmark Street Wokingham, Berkshire RG11 2QX	E Stoneham
Intex Datalog Ltd 0642-781193	Eaglescliffe Industrial Estate Eaglescliffe, Cleveland TS16 OPN	T Ingle
James C Steadman 0903-814923	18 Manor Road Upper Beeding, Steyning, Sussex BN4 3TJ	James Steadman
Jar Software Systems Bolton 26644	124 Newport Street Bolton, Lancashire	J Blackburn
Keen Computers Ltd 0602-583254	5B The Poultry Nottingham	Bob Ellis
Kesho Systems 041-226-4236	72 Waterloo Street Glasgow G2	Angus Nial
L & J Computers 01-204-7525	3 Crundale Avenue Kingsbury, London NW9 9PJ	Jack Goodman
Landsler Software 01-399-2476/7	29A Tolworth Park Road Surbiton, Surrey KT6 7RL	E Landsler
Liveport Data Products 0736-798157	The Ivory Works St Ives, Cornwall TR26 2HF	G Wilkinson
Logma Systems Design Bolton 389854	2-10 Bradshawgate Bolton, Lancashire	R Odell
Ludhouse Ltd 01-679-4321	2-6 Marian Road London SW16 5HR	M Ward
Median-Tec Ltd 0734-596842	120 Oxford Road Reading, Berkshire RG1 7NL	W Stevenson
Metrotech 0895-58111	Waterloo Road Uxbridge, Middlesex UB8 2YW	C Ogilvy
Micro Computation 01-882-5104	8 Station Parade Southgate, London N14	Graham Dicker
Micro Focus 01-379-7931	c/o Lifeboat Associates 32 Neal Street, London WC2H 9PS	C Barnes
Microact Ltd 021-455-8585	Radclyffe House 66-68 Hagley Road, Edgbaston, Birmingham B16 8PF	John Farthing
Microcomputer Applications 0734-470425	11 Riverside Court Caversham, Reading RG4 8AL	W Jupp
Microcomputer BM 01-981-3993	4 Morgan Street London E3 5AB	
Microdigital Ltd 051-227-2535	25 Brusnwick Street Liverpool L2 OBJ	Graham Jones
Microgems Software 0602-275559	32 Buckingham Avenue Hucknall, Nottinghamshire	Mrs J Wyatt

Buyers' Guide

Microland 0723-70715	17 Victoria Road Scarborough, North Yorks YO11 1SB	R Howard
Micromedia Systems Newport 59276/7	Seymour House 14-16 Chepstow Road, Newport, Gwent	H Harrison-Allen
Micropute 0625-612818	Communique Place 9 Prestbury Place, Macclesfield, Cheshire	Don Cooper
Microsense Computers Ltd 0442-41191/48151	Finway Road, Hemel Hempstead, Hertfordshire HP2 7PS	D Page
Microtek Computer Services 0689-26803	50 Chislehurst Road Orpington, Kent BR5 ODJ	J Rothwell
Minicomputer CS Ltd 0494-448686	Pilot Trading Estate 163 West Wycombe Road, High Wycombe, Buckinghamshire	B Conlon
MMS Computer Systems 0234-40601	26 Mill Street Bedford	D Nicholls
Padmede Computer Services 025-671-2434	112/116 High Street Odiham Basingstoke, Hampshire	John Packwood
PCL Software Ltd 021-544-5071	146-150 Birchfield Lane Oldbury Warley, West Midlands	P Hemmings
Personal Computers Ltd 01-626-8121/2/3	194-200 Bishopsgate London EC4M 4NR	Steve Derrick
Petsoft Ltd 021-455-8585	Radclyffe House 66-68 Hagley Road, Edgbaston Birmingham B16 8PF	
Profcomp Ltd 01-989-8177	107 George Lane South Woodford London E18 1AN	Mr Whitcombe
Research Resources Ltd 07073-26633	40 Stonehills Welwyn Garden City, Hertfordshire	
Rockliff Brothers Ltd 051-521-5830	2 Rumford Street Liverpool L2	M Taylor
Rogis Systems Ltd 0580-80310	Keeper's Lodge Frittenden, Cranbrook, Kent	W Everard
SA Systems Newbury 45813	Allington Lodge, Round End, Newbury, Berkshire RG14 6PL	
Selven Ltd 0376-42900	Newhaven-Ludham Hall Black Notley Braintree, Essex	R Crowther
SMG Microcomputers Gravesend 55813	39 Windmill Street Gravesend, Kent	Tom Wood
Software Architects Ltd 01-734-9402	34/35 Dean Street, London W1V 5AP	G Matheson
Southdata Ltd 01-602-4604	2/4 Avon Trading Estate London W14	Tony Macilwaine
Stage One Computers 0202-23570	6 Criterion Arcade Old Christchurch Road, Bournemouth	N Hewitt
Structured Systems Group 01-379-7931	c/o Lifeboat Associates 32 Neal Street, London WC2H 9PS	J Clifford
Systematics International Ltd 0268-284601	Essex House Cherrydown Basildon Essex	R Young
T & V Johnson Ltd 0276-62506	165 London Road Camberley, Surrey GU15 3JS	T Johnson
T W Computers Ltd 061-456-8187	293 London Road Hazel Grove, Stockport, Cheshire	G Thompson
The Alphabet Company 03046 7209	2 Whitefriars Way Sandwich Kent CT13 9AD	A L Minter
The Software House 01-637-2108/1587	146 Oxford Street London W1	Keith Jones
Tridata Micros Ltd 021-622-6085	Smithfield House Digbeth, Birmingham B5 6BS	A Plackowski
U-Microcomputers Ltd Warrington 54117	Winstanly Industrial Estate Long Lane, Warrington	Dr W Unsworth
Verwood Systems 0788-87629	Verwood House High Street, West Haddon, Northamptonshire	N Howard
Vlasak Electronics Ltd 06284-74789	Thames Building Dedmere Road, Marlow, Buckinghamshire SL7 1PB	Paul Vlasak
Xitan Systems Ltd 0703-38740	23 Cumberland Place Southampton	G Lynch

SHOPWINDOW

MICRO ADS
are accepted from private readers only, pre-paid and in writing, 20p per word, minimum charge £2.
Please make cheques payable to Practical Computing and send to Room L311, Quadrant House, The Quadrant, Sutton, Surrey SM2 5AS.

PET PROGRAMS: Games/Business Software/Utilities for Sale (changing system) Tel. 0427 788443.

UK101/SUPERBOARD INTERFACE Upto 32 Input/Output, 8 AtoD, 2 DtoA. P.C.B. assembled/tested with I.C. sockets. Add your own I.C.s and connectors. £29 or SAE for details. Mr. D. Butler, 82 Banks Lane, Riddlesden, Keighley, West Yorks.

PLAN AND IMPROVE YOUR LIFE with a Biorhythm and Compatability program for the Sharp MZ-80K. State memory size when ordering, minimum 18K. Cassette £4.95. J. Tylar, 2 Chester Ave., Cranham, Upminster, Essex.

TELETYPE 43 PRINTER (with keyboard) for sale. £550 or offer. Telephone Storrington 2663.

ZX80 SOFTWARE — Four listings for 1K. ZX80. Moonlander (graphics), Pontoon, Calendar, Mathstest. Send £2. to: P. Pickering, 56 Lennox Road, Todmorden, Lancs. OL14 8QD.

CBM 2001/32K PET, Large keyboard, cassette, toolkit, cover etc. £595. Phone Rossendale 26313 Evenings.

DARTS, game of skill and dexterity for Nascom 2 with 8K, send £3.50 to P.E. Firmin, 63 Lady Lane, Chelmsford, Essex, CM2 0TQ.

FOR SALE Teletype 33 KSR excellent mechanical condition, complete with stand. £170. Sorcerer Development Pac £50. 029 83 4426 (Darley Dale)

APPLE II PLUS 48K. Disk with and without controller (DOS 3.3). 12 inch monitor. Silentype graphics printer. Applewriter and database software. (Value £2500). Sell for £1950 o.n.o. Tel. 01-876 4613 Evenings.

UK101 PROGRAMMERS AID. Features Find, Trace, Delete Renumber, Variables List and more. Super Board compatable (2K machine code) 021-308-7012 (Richard).

16K SORCERER plus dev. Pak, blank EPROM paks, full range of manuals, software, seldom used, £595 o.n.o. 01-226 1612 (after 7pm).

FOR SALE: Tandy Quick Printer II for TRS80, no interface required. £100 o.n.o. Telephone 01-543 0360, evenings or week-end.

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LOWER CASE AND TEXT on Hi-Res Screen for Apple. Software, Demonstration Programs etc. All supplied on cassette. State size of machine. £5. V.J.M. Harris, 25 Thirlmere Ave, Nuneaton, Warks.

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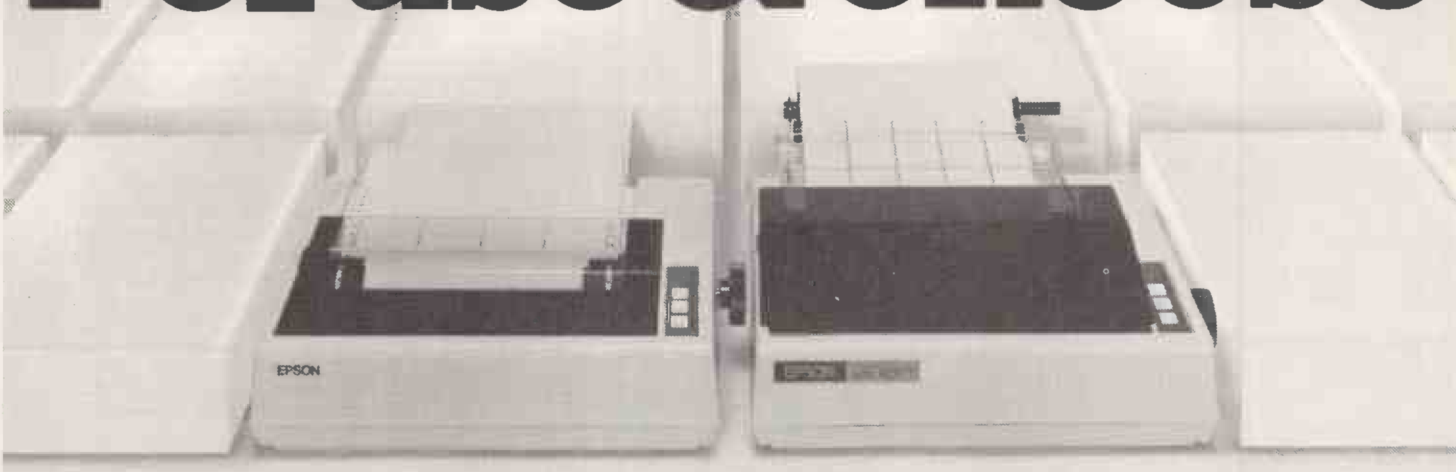

Son of Hexadecimal Kid

Samson Synapse has become a secret computer freak. He has also discovered that he can influence living things, causing plants to grow into computer peripherals. Yet when he takes a fancy to drinking his new-born sister's blood, things have clearly gone too far.

The cry of Samson's baby sister split the night. Cleo sat up in bed. "Samson, is that you? What are you doing"?

Samson ran upstairs to his room and bolted the door. He was shaking. Shame and revulsion at what he had done swept over him. Quickly he pulled on his shoes. Downstairs there was quite a commotion. The baby was still crying, and Cleo was trying to soothe it. He could hear McNull's raised voice and Cleo telling him to be quiet. Presently, there came the sound of footsteps on the stairs. There was a knock.

"Samson, come out". The door handle rattled. Samson backed towards the window.

The door would not budge. There was a pause. Then he heard his aunt's voice giving a command to Piltdown 2 in Esperanto. The wooden latch began to bend and crack.

Samson did not wait for it to break. Clutching his precious potted plant he leapt out of the window and plummeted into the sand beneath. He picked himself up, shook off the dust, and tore off into the hills. He ran until he could no longer hear the confusion of shouts behind him.

Next morning he took stock. He was too proud to go home, and would not be welcome there in any case. To visit a Nullard Village, even where he was not known, would be to court death. Yet he had no idea how to survive on his own in the wild. He was a dab hand with a soldering iron and a wizard at machine code but what he needed now was food and drink. He was already feeling thirsty.

The more he thought about it, the more depressing it seemed. There was only one thing to do. He switched-on the Moonshine Micro, sat down at its keyboard and slotted a pair of his home-grown floppies into the disc drives. The drives hummed and the screen filled up with a cloud of menacing crater-pitted asteroids rushing towards him at alarming speed, cleverly projected to give an illusion of depth. It was his favourite — Astro-Pinball.

Soon he was lost among the meteorites, oblivious to the cares of the world. The counter at the top corner of the screen clicked up and up as he manoeuvred his way through the meteor swarm. He was at the helm of a great spacecraft which leaped and turned in response to fingertip pressure, weaving past the onrushing planets and zapping any alien ships foolish enough to cross his path.

Higher and higher climbed the score. He was intoxicated. Now he was destroying everything in his path — comets, moons, planets even stars with the touch of a button as he raced to the ends of the galaxy. Suddenly a cracking twig brought him down to earth again. The sound, though quiet, stood out from the shrill electronic bleeps of his video game. He looked around. His eyes probed the chinks in the foliage. Was it just a rustle of leaves in the wind?

That moment of inattention had cost him the game. His starship had ploughed straight into a neutron start. Now the screen was a field of little dots of light, twinkling serenely. On the bottom line was an invitation for him to record his name for posterity. Desite his lapse of concentration he had beaten the previous top score by a substantial margin.

As he tapped in his initials he heard another twig snap. This time he was sure: he could feel someone's eyes on his back. He sprang up and pushed aside the overhanging branches. For an uncomfortable second he was eyeball-to-eyeball with a coarse face. The brow was furrowed in a leering frown and the eyes filled with distrust. Then it fled.

He watched the figure, clad in ragged furs, loping down away from him. It was one of the village lads from Happy Valley.

"But what the Hell was he doing up here"? Samson asked the heavens out loud. Perhaps the intruder had been out fur-trapping and had overheard the Astro-Pinball sound effects. Perhaps he had been minding sheep and one of them had strayed. The answer did not matter. What was certain was that he would head back to his folks and tell them what he had seen. A Nullard search party would be on its way before nightfall.

Meanwhile, far out in the frigid vacuum beyond the orbit of Pluto, the space freighter Green Tangerine drifted helplessly out of control. Her metal sides glinted dully in the faint light from the distant pinprick of fire that was our sun as she rolled ponderously end over end.

On the foredeck, Prestel, the ship's parrot and commanding officer, had called the two most senior of the mutant cybernoids who crewed the ship to him for an explanation. He directed his questioning at the first mate, an experienced veteran of the space lanes.

"Rom, what's the meaning of this"?

"Navigational computer sir. That cosmic ray storm put the refresh circuits out of action".

"Well, can't you fix them? What about the back-up modules"?

"Same problem, sir, we've tried. We'll have to take her to Arcturus under manual control".

Prestel gnashed his beak in frustration. He thought of the long haul to the repair depot at Arcturus, limping along under manual guidance. It would take an eternity.

"Do you realise what we're carrying on this trip"?

Rom had no idea. He had been surprised and annoyed by the obsessive precautions during loading on Zargon 7. A security guard had machine-handled him off his own ship when he came aboard early unannounced.

"Well I'll tell you. There's no point in secrecy any more. We have a cargo of half-baked ideas to replenish the dwindling supply at Omega Solaris. It is vital we get them through before they go stale".

Rom drew in a long breath. So that was it. Now he understood the reason for all the cloak-and-dagger stuff in port. If the supply of half-baked ideas to the Think Tank in Omega Solaris dried-up, it would throw the whole galaxy into chaos.

There was silence. Prestel shifted from claw to claw on his perch.

"Well"? asked Prestel.

"Permission to make a suggestion sir"? chimed in Ram, the other cybernoid, who had held his peace so far.

Prestel leaned forward. "Yes"?

"I was checking the instruments after the radiation storm to inspect for damage when I noticed something interesting".

"Go on".

"The sensors detected evidence of intelligent life on the third planet of the local stellar system."

"Intelligent life on Terra Firma? It must be an instrument failure".

"With the greatest respect sir, there's only one configuration of signals which indicates a score of more than 10 billion on Astro-Pinball. I'd know that pattern anywhere".

"Astro-Pinball", murmured Prestel as he chewed over this nugget of information. Even their shipboard computer had an Astro-Pinball rating of less than 5 billion. As for Rom, he wasn't in the same league. A pilot of that calibre, if one truly existed, could not merely get them to their destination on time but ahead of schedule. He, Prestel, would be showered in glory.

He spoke to Rom and Ram. "You two are going on a little recruiting drive".

"Understand sir", they replied in unison, and started heading towards the exit hatches at the stern of the ship.

"Oh, and Ram —".

"Yes sir", said Ram, pausing at the door.

"You'd better be right".

"I am sir".

"Good. Because if you're not back with your Pinball Wizard within four temporal units we'll blast off without you".

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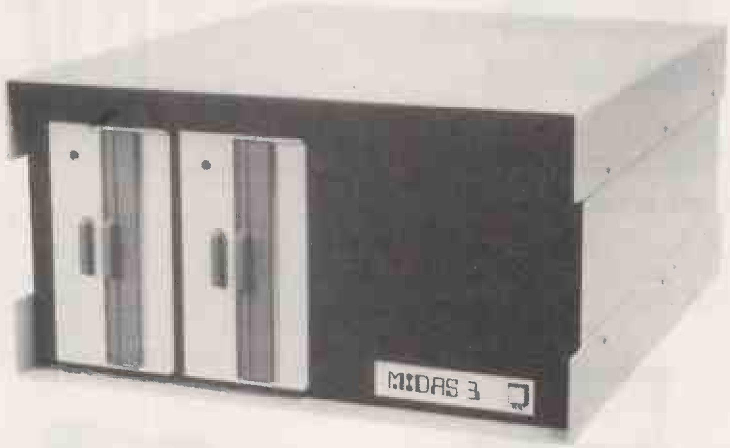

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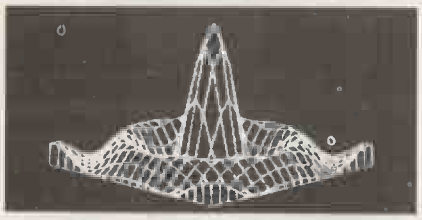

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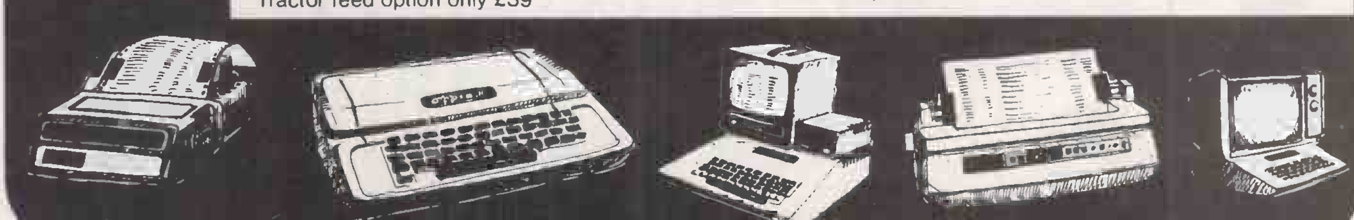

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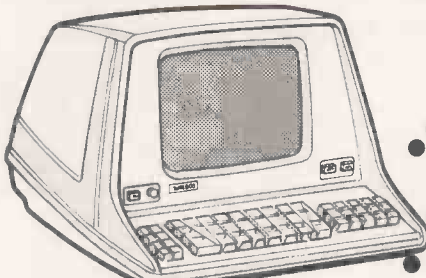

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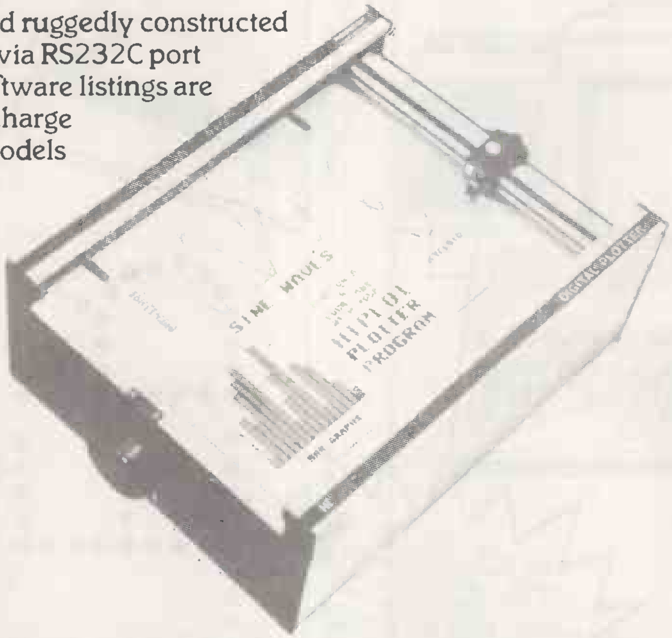

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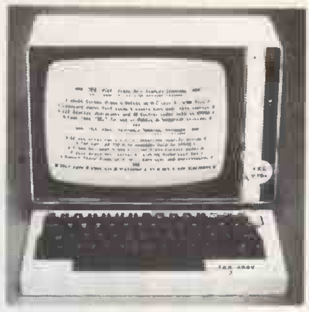

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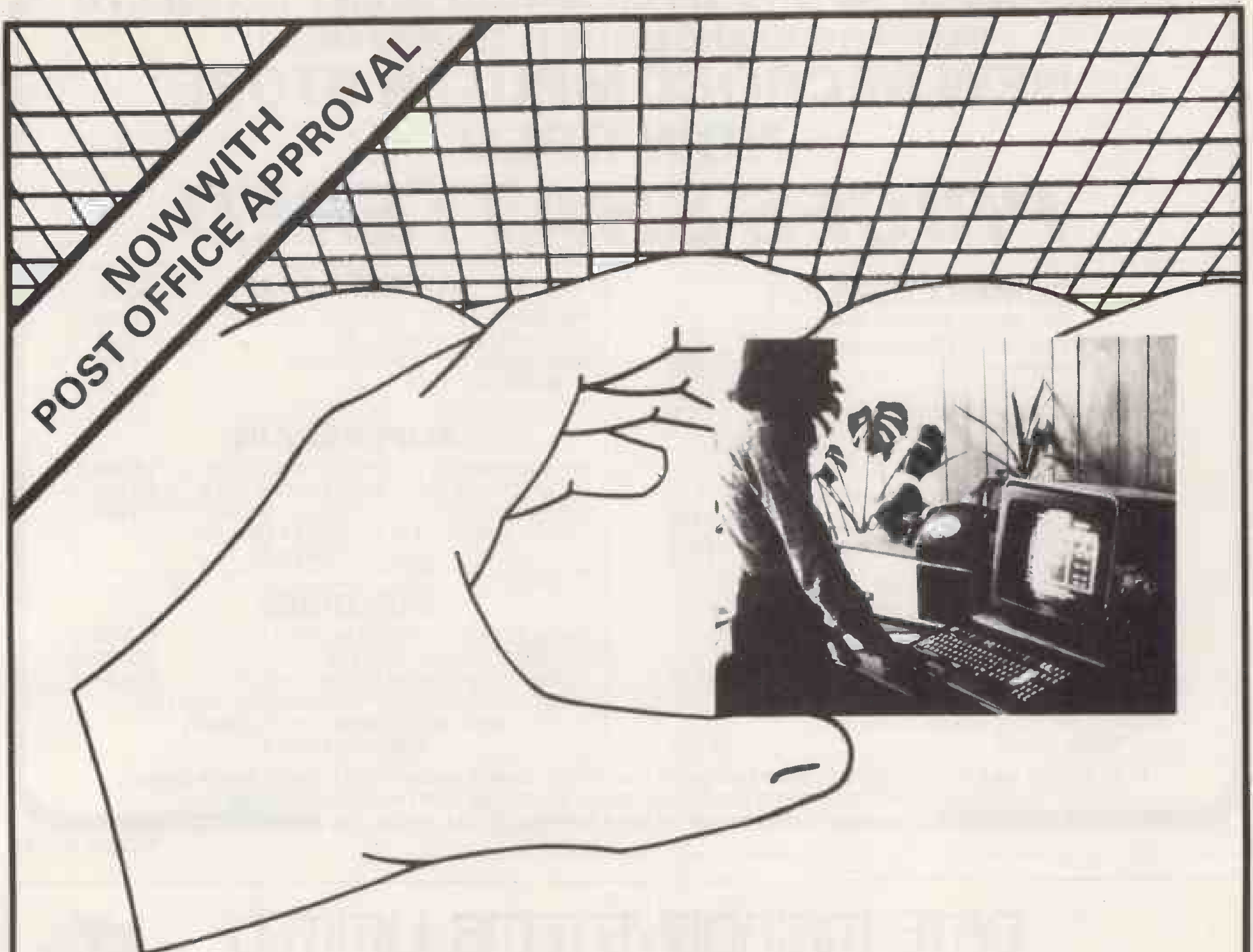

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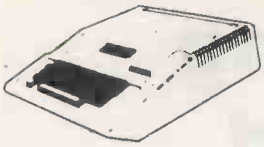

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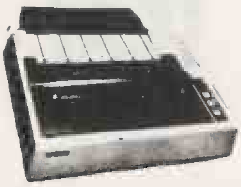

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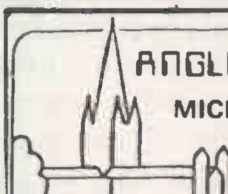

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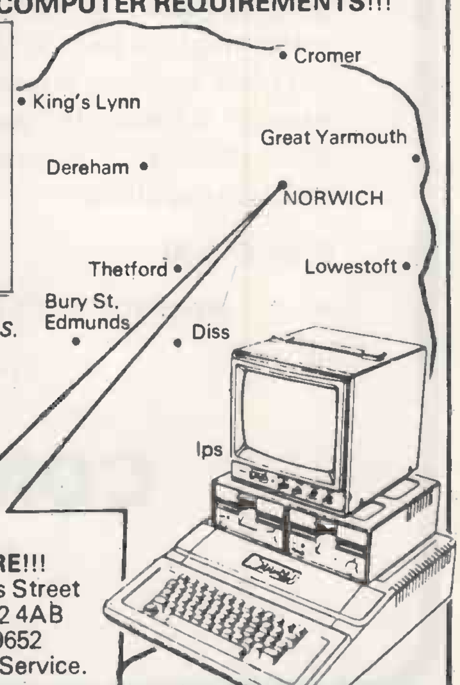

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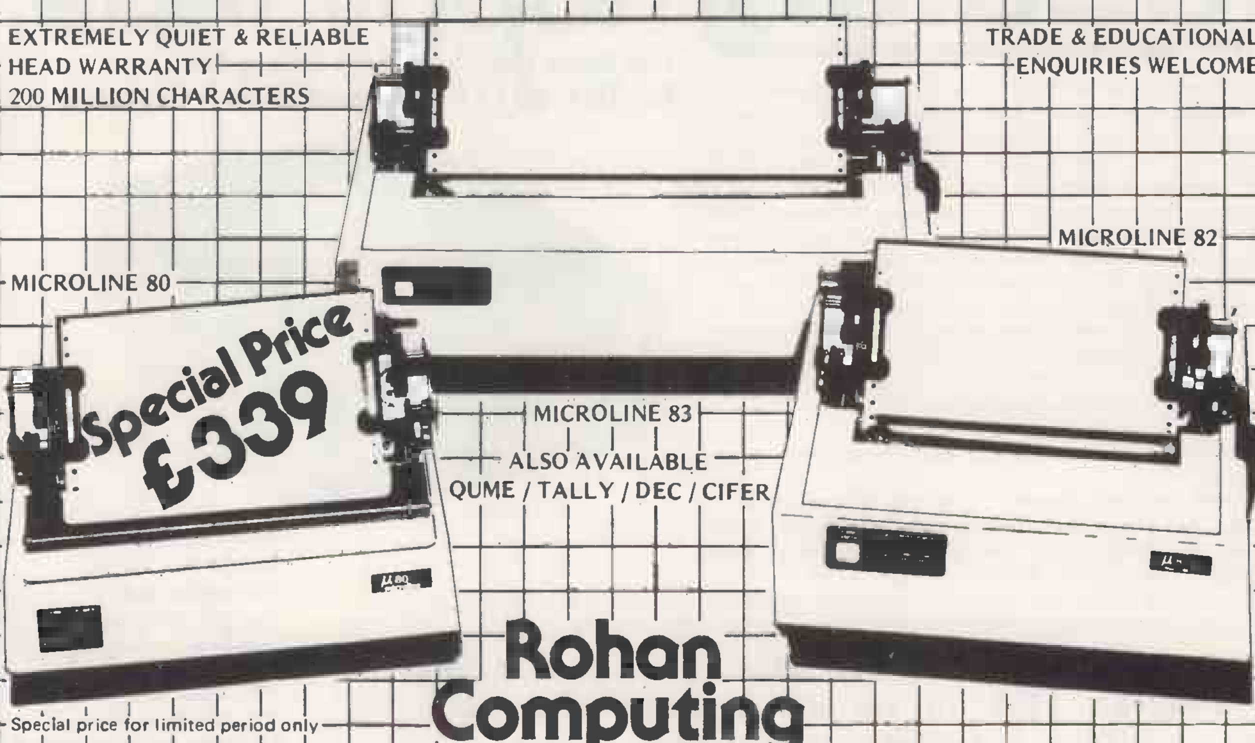

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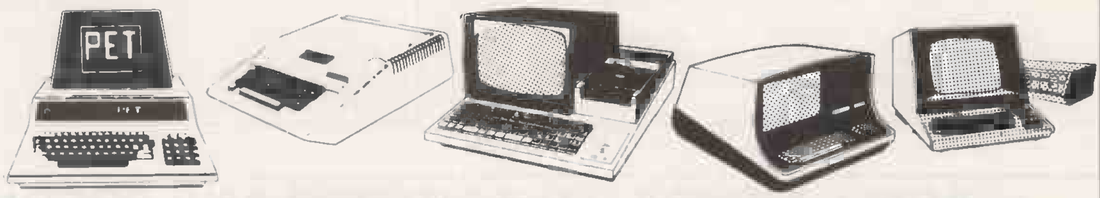

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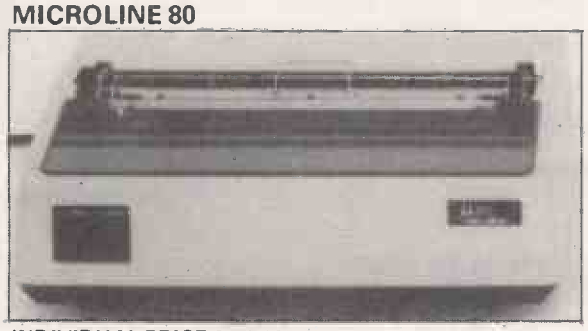

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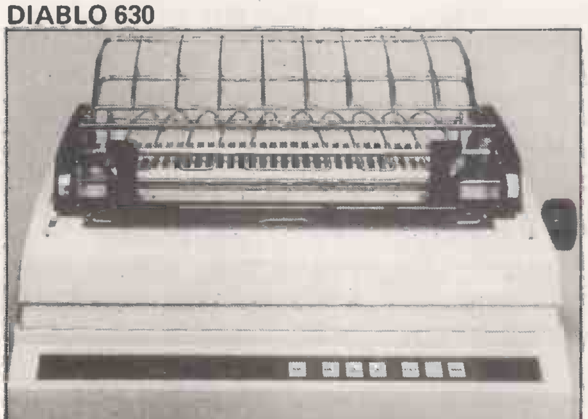

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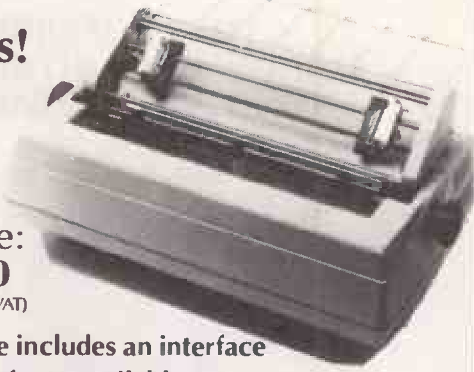

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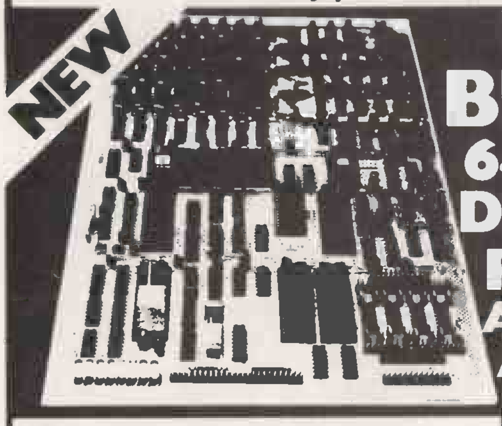

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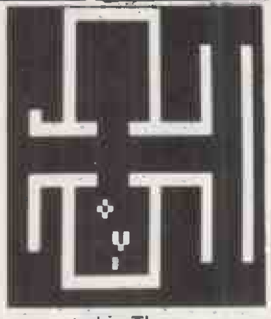

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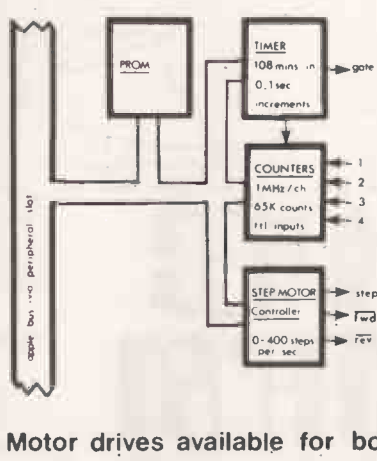

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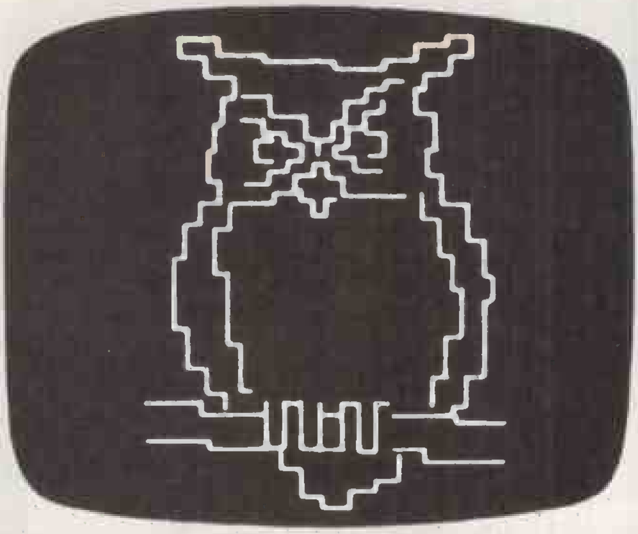

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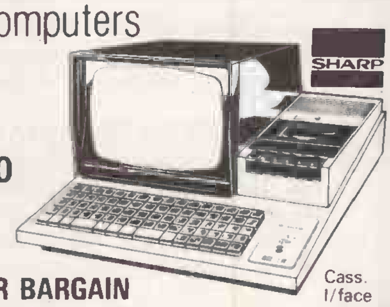

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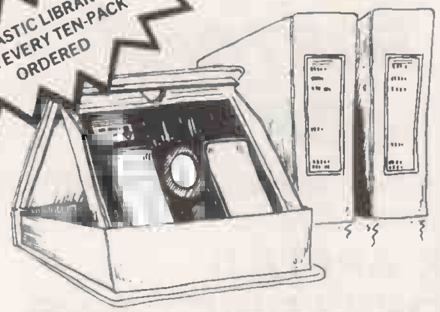

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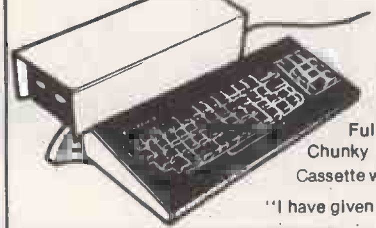

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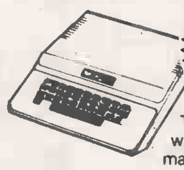

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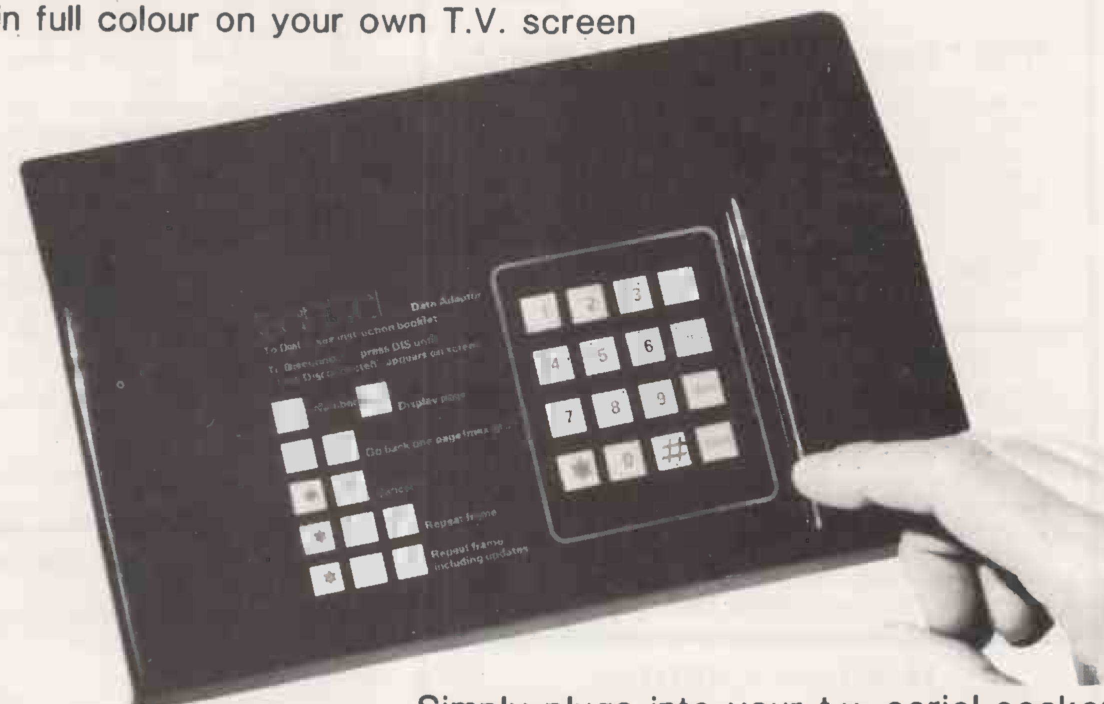

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PC5/81

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The VISUAL 100 is a new microprocessor based video display terminal that offers total compatibility with the DEC VT100* from both a software and operator point of view.

For the operator, the detached solid-stale keyboard has been customized so that all key positions and LED indicators are in identical location to that of the VT100.

For the software, all codes and features have been implemented in a manner identical to the VT100 assuring plug-to-plug compatibility.

The big difference between the VISUAL 100 and the DEC VT100 is that the VISUAL 100 offers features not available on the VT100, or available only as extra-cost options. These added features include:

- ETCHED NON-GLARE FACEPLATE
  Your operator will appreciate viewing characters through an etched non-glare faceplate. This feature assures crisp, sharp character resolution even in the brightest office environments. Further, the tilt screen feature allows an adjustable viewing angle, 10° to 15°, for optimal viewing comfort.
- ADVANCED VIDEO PACKAGE IS STANDARD
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- CURRENT LOOP INTERFACE IS STANDARD
  A 20mA current loop interface as well as an EIA RS232C interface.
- BUFFERED PRINTER INTERFACE OPTION
  This option allows independent print/communication baud rates and independent parity. The printer option also allows the VISUAL 100 to function as a controller between host and printer, using "XON XOFF" protocol. Printer busy can also be monitored using XON XOFF, or control line.

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The VISUAL 200 is a new, low cost, microprocessor based video display terminal which truly stands above competitive teletype compatible terminals in its price range.

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- Detachable Keyboard
- Smooth Scroll
- Tilt Screen (10° to 15° viewing angle)
- Large 7 × 9 Dot Matrix Characters

Perhaps the most distinctive feature of the VISUAL 200 is the Switchable Emulation capability. A switch on the rear panel programs the terminal for code-for-code emulation of a Hazeltine 1500, ADDS 520, Lear Siegler ADM-3A or DEC VT-52. To an O.E.M. customer it means no change in software to displace the older, less powerful terminals in his product line with the new, reliable and low cost VISUAL 200. To a Distributor it means offering a single modern terminal which is compatible with all the software his customers have written for the older terminals. And you're not limited to merely emulating these older terminals; you can outperform them at the same time by taking advantage of the additional features of the VISUAL 200.

Reliability designed into the VISUAL 200 is evidenced by its solid state keyboard, single P.C. Board and self test diagnostics on power up.

Seeing is believing, so see for yourself. For a demonstration and a pleasant surprise on quantity pricing of the powerful, easy to use and reliable VISUAL 200, call or write us today.

Standard Features

- 24 × 80 Screen Format
- 7 × 9 Dot Matrix
- Upper/Lower Case
- Numeric Pad
- Background/Foreground
- Blink Line
- Insert/Delete Line & Character
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- Set/Clear Tab
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- Clear Line
- Clear Screen
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- Composite Video
- Serial Copy Port
- Hold Screen
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- Tilt Screen
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DATASOUTH DS180

HIGH SPEED MATRIX PRINTER

£1490 + VAT

The Datasouth DS180 is a dot-matrix serial impact printer designed for high performance at an economical price. Application flexibility and a long list of standard features make the DS180 an ideal device for small business systems, distributed communications networks and intelligent terminals.

HIGH SPEED PRINTING

Utilizing 180 cps optimized bidirectional printing, the DS180 offers higher throughput than any printer in its class. Its 9-wire printhead produces highly legible 9x7 characters with decenders for lower case letters and true underlining. All 96 ASCII characters may be printed across a 132 column line at 10 characters per inch. Expanded characters (5 cpi) may be selected for highlighting portions of the text.

USER PROGRAMMABLE

The DS180 offers a large number of user programmable features, yet is easy to operate. A unique programming keypad with a non-volatile memory makes printer set-up quick and simple. Top of form, horizontal and vertical tabs, perforation skip-over and auto line feed are just a few of the features the user may select. Communications status may also be programmed and monitored using the indicator panel lights and LED display.

ATTRACTIVE DESIGN

Compact, desk-top packaging allows the DS180 to fit into almost any installation. Its noise dampening cover makes it suitable for use in a quiet office environment. The cartridge ribbon makes routine changes clean, fast and convenient.

MICROPROCESSOR ELECTRONICS

Through the use of state-of-the-art microprocessor electronics, reliability and maintainability have been greatly improved. The simple modular design of the DS180 provides easy access to all major components. A single printed circuit board contains both the power supply electronics and digital controller for the printer. A self-test feature and diagnostic display panel help the user verify proper operation of the unit and isolate problems should they occur.

COMMUNICATIONS

Interfaces on the DS180 include RS232 and 20mA current loop serial interfaces, and a Centronics compatible parallel interface. Baud rates from 110-9600 and parity selection may be keyed in by the user for his specific application.

FORMS HANDLING

Adjustable tractors accomodate forms from 3-15 inches wide. A head-to-platen gap adjustment ensures optimum print quality on up to 6-part forms. Fanfold paper may be fed from the front or bottom of the DS180. A paper out sensor may be programmed to send a stop transmission character and sound an audible alarm.

QUALITY MANUFACTURING

Reliable performance is ensured by a stringent quality control program. Datasouth uses pretested, high reliability parts from leading manufacturers. Multiple tests are performed on sub-assemblies during each stage of production, with each completed unit undergoing a final 24 hour print test and burn-in. The DS180 carries a 90 day warranty on materials and workmanship.

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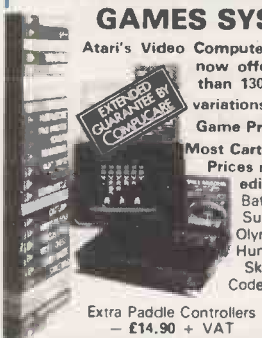

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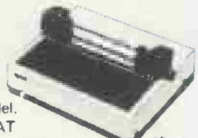

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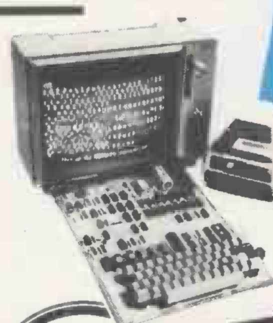

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