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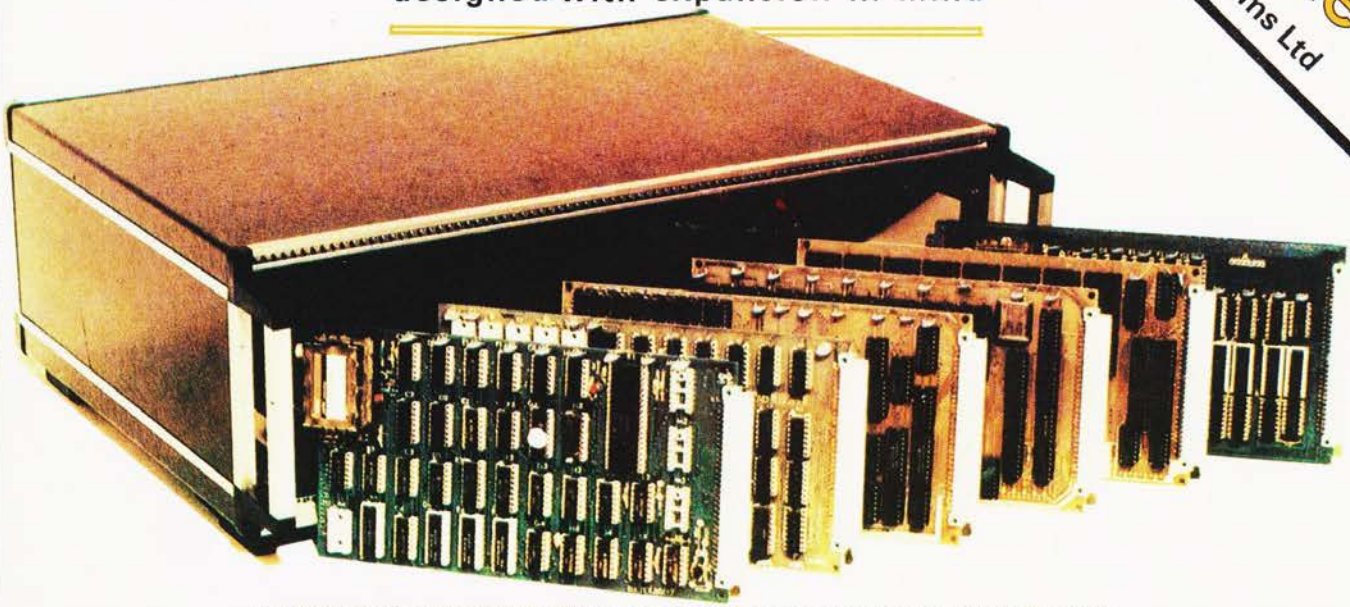

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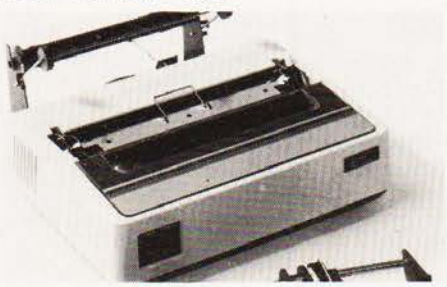

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6.144MHz	300p
7.0MHz	300p
7.168MHz	300p
8.00MHz	300p
8.867MHz	300p
10.00MHz	310p
10.7MHz	300p
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NEW YORK NUMBERS
From Cyndy Miles, our New York correspondent

New York has taken to gambling for raising money to pay for public services. The State government has done it in a big way by setting up a complex computerised system, with hundreds of terminals in the New York City area alone, where the punters can place their bets. It's not a game of skill. Luck — lots of it — is all that's needed, superstition is the ruling force.

All the numbers game player does is go to the nearest store or coffee bar where there is a computer terminal, pick three numbers, choose one of nine ways to bet, hand over anything from 50 cents to $5 for each wager, and then wait for the televised draw that night. He or she has a 500-1 chance of winning.

The terminals are simple keyboards operated by shopkeepers, who tap in the wager and hand the punter a computerised ticket recording the details.

The information is then fed to a central computer in Albany, the state capital, where details from more than 700 selling points are collated each day.

Of course, there have been teething problems. Not least that of maintaining good will among participating shopkeepers.

"At first it was a novelty," explained a newsagent in downtown Manhattan. "Now it's affecting our business. Every day there are long lines of people waiting to bet. The shop gets crowded. Pilfering has increased.

"I'm fed up with the whole thing, but if I get the machine taken away my rival will install it. That would be even worse for business.

"It's the same in other places. It's just not working for us."

Neither, it seems, does the equipment work for them. Breakdowns at the terminals are not uncommon. The punters get angry and the shopkeepers become increasingly upset and frustrated.

But despite the hassles, business has not been bad in the month or so since the legalised numbers game was launched and the New York State Lottery, which runs the business, seems to be well on the way to its projected 100 million dollars by March 31.

Of that cash more than half will go back to the players in winnings, 35% will go to State funds, and the rest will be eaten up by administration costs.

On the face of it New York's venture into the world of gambling has been successful.

But it has severe competition. While the State offers legality, the backstreet boys running a mutimillion dollar illegal game offer better odds and tax-free winnings.

Running them off the streets, as the State Lottery hopes to do, is not going to be easy, especially if computerisation proves to be more of a hinderance than a help.

And, so far, luck hasn't been really with the State.

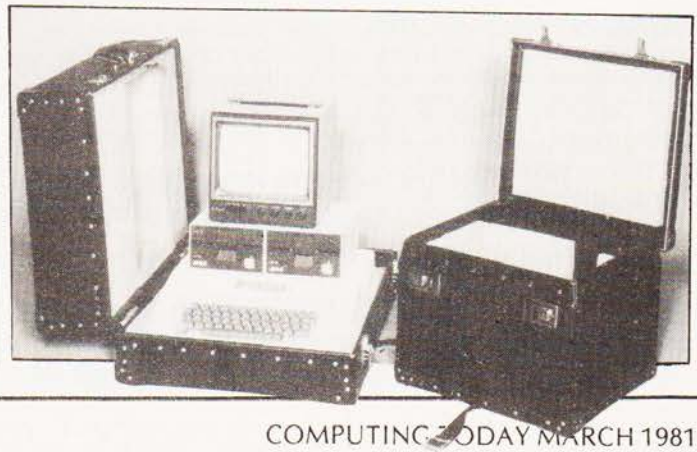
(Reprinted with the kind permission of Datalink.)

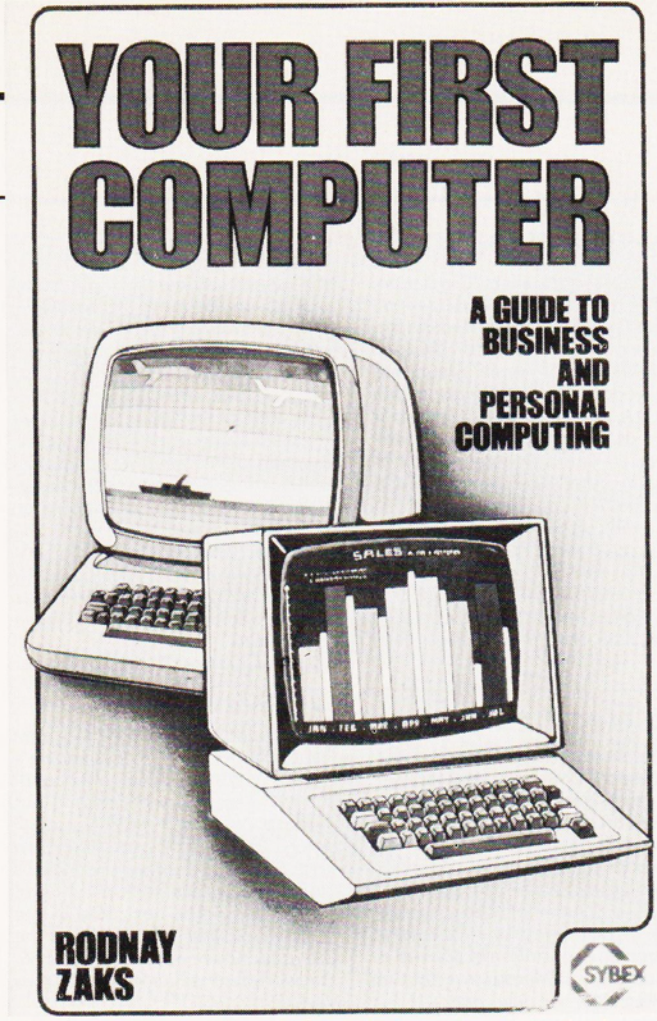
THE LANGUAGE OF TOMORROW?

If you've never been to school in Denmark the chances are the name COMAL doesn't mean a lot to you. The chances are equally high, however, that you will soon hear an awful lot about it. COMAL stands for COMmon Algorithmic Language and is, effectively, a structured form of BASIC. Anyone who can program in BASIC can, with a little thought, program in COMAL, it uses the same common 'core' of commands but borrows considerably from the 'structure' of languages like ALGOL 68 and Pascal to give commands like IF . . . THEN . . . ELSE and procedures rather than subroutines. COMAL will shortly be available from your local Commodore educational or user group and will be public domain software in that there will be no charge made for copying the software. It runs on 3032 and 8032 machines but is disc based (it takes 26K) although the possibility exists for Commodore to offer a subset on cassette or even in ROM. The language is the minimum educational requirement in Denmark and appears to be taking off in other European countries, it ws first thought of in 1974. Designed by Borge Christensen it certainly appears to offer all the benefits of structured languages without the rigid constraints that, for example, Pascal needs. With the growing demand for programmers who are prepared for the real world rather than the classroom it may well be that COMAL is the language to choose. We'll be taking a very close look at what it has to offer in the near future so keep your eyes tuned-in to our editorial. Information can be sought from the Commodore Educational people in Euston Road but it is unlikely that your local dealer will be able to help the individual user for a few months yet.

PACKED APPLES

If you tote your micro around a lot it probably needs a nice padded case for its protection. Apple owners can now buy two custom-made transit boxes, one takes an Apple and two floppy drives, the other takes a monitor. The Apple can be used whilst still in the bottom half of its box so the set-up should prove ideal for travelling demonstrations etc. The boxes will cost you £39.50 and £19.50 respectively, to which you have to add VAT and carriage. For details of these and all the other Apple products contact Microsense Computers at Finway Road, Hemel Hempstead, Herts HP2 7PS.





With a rapidly growing interest in the microcomputer both with the small business and home environments, together with the reduction in price of both hardware and software many people are becoming more interested in learning the 'how', 'what' and 'why' of computers. The title of this book together with a short glimpse at the preface which informs the reader that "neither a technical background nor a prior knowledge of computers is required", should set our budding computer operator rushing to the pay desk with his £5.95 to purchase it. The quotes from various American computer magazines, found just inside the front cover, seem to be ecstatic: "refreshingly clear", "clear, comprehensive, practical", "good clear prose" are but a few. Computing Today does not entirely agree. Rodney Zaks, without question a respected writer in the computing field, falls into the same traps that others have before him when faced with the difficult task of trying to explain the rudiments of the micro/mini computer to someone with no prior knowledge of the subject. Many people, whether they already have some knowledge or not, need books, magazine articles or a patient tutor to supply answers to a number of questions which themselves generate more questions. The difficulty in writing a book or magazine article is in determining for whom you are writing and how much information you should include. Rodney Zaks has defined for whom the book is written — those with "neither a technical background nor prior knowledge". Its purpose we are told "is to explain what a microcomputer is, how it works and what it can do". The impression I get is that he could not resist using computer terms that, although in common usage in professional circles, are not really of immediate importance to someone investigating the advantages of buying a small micro system. Having been fairly critical of the aims and achievements of 'Your First Computer', let us look more closely at what is contained between the covers. There are 14 chapters, starting in chapter 1 — 'The Microcomputer Era', with a witty scenario from a possible future, describing how the computer could so easily assist and compliment humanity throughout everyday life.

Chapter 2 — 'Using the System' presents a cogent appraisal of today's microcomputer.

Chapter 3 — The contents page tells us 'Microcomputer Applications', the actual chapter heading gives us 'Basic Definitions'. Both titles could be valid and it is at this point I begin to feel uncertain at whom the book is aimed. Yes, the basic definitions are fairly clear but I can see that the reader with some previous knowledge would gain at the expense of the initiate who could wonder whether all these new terms were essential to his initial understanding of what a computer can do for him.

Chapter 4 — 'How the System Works' gives me the same impression — clear and concise but does the newcomer want so much detail at this stage? Can he take in this information in such a concentrated form?

Chapter 5 — 'Programming the Computer', again a fairly concentrated dose that could very well have a reader with no background knowledge reeling in his seat. It does contain an interesting example of an algorithm: "simply a step by step specification of the solution to the problem". The example is a simplified traffic control algorithm for a typical intersection (traffic light sequence at a crossroads, to us English). If used, the example given would end up with red, green and amber showing in one direction and green in the other ... Well, Mr. Zaks does say elsewhere that every system will occasionally suffer from software bugs ...

Chapter 6 — 'From BASIC to COBOL' takes a fairly intensive look at BASIC followed by a briefer look at APL and Pascal. FORTRAN and COBOL are mentioned but not at any great length. The emphasis, quite rightly in a book such as this, is on BASIC.

Chapter 7 — 'Business Computing' clearly states the case for the Business Computer and some applications. It follows with a fairly in-depth appraisal of a specific Mailing List Program and a Word Processing Program, both of which would, I feel, be more applicable to your second computer book than your first!

Chapter 8 — 'Selecting a System' and Chapter 9 — 'The Peripherals' can be read, understood and prove useful to anyone. They list all those points one should be aware of when contemplating the purchase and use of a computer.

Chapter 10 — 'Selecting a Microcomputer, starts with a 'micro-history of computers' that is concise and informative. This is followed by a brief résume of the salient points of a number of microcomputers, albeit American and, as any list in this field must be, out of date on the day of publication. Nevertheless, it represents a comparative listing that will be useful for some time to come.

Chapter 11 — 'Economics of a Business System' offers a simplified formula to businessmen to assess the real cost of installation, maintenance and programming such a system.

Chapter 12 — 'How to Fail with a Business System' is a cautionary chapter on the sources of error that can occur without sufficient foresight.

Chapter 13 — 'Help' would be a useful source for the American, but other than suggestions for general sources of information, is less help in this country.

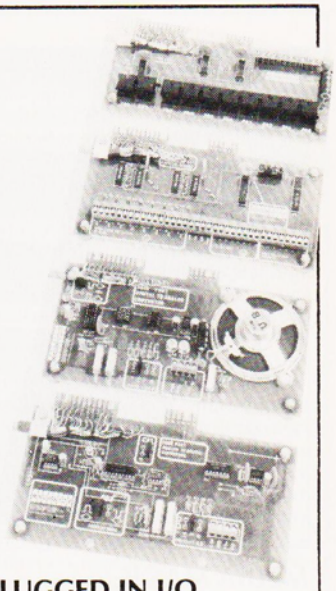
Chapter 14 — 'Tomorrow' is very brief, a total of 1½ pages and although summarising possible developments in the field, could very well have been included elsewhere.

Six appendices conclude the book, covering in a fairly concentrated form such topics as Computer Logic, Bits and Bytes, Files and Records and lists of American manufacturers.

In conclusion therefore, a book that does not fulfill its stated intention but still provides useful reading for someone who already has some knowledge of the subject.

Your first computer . . . A Guide for Business and Personal Computing by Rodney Zaks, published by Sybex at £5.95 ISSN 0-89588-045-8.

NEWS



PLUGGED IN I/O

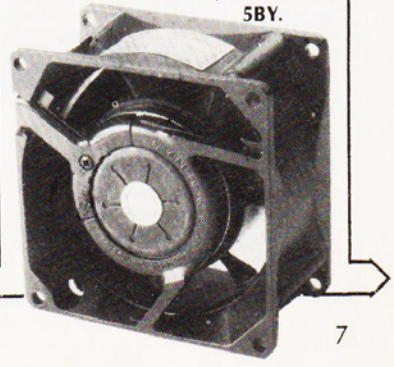
Machsize Ltd of York House, Clarendon Avenue, Leamington Spa, Warks., have added two more boards to their general purpose I/O range. Both are for the PET and offer analogue to digital and digital to analogue conversion. Each board is supplied complete with documentation and necessary software to drive it and will cost £69.95. The two devices are matched in terms of their input and output characteristics.

SPACED OUT

Owing to heavy demand we are no longer able to supply the complete Space Invasion program listing. Any orders that we have received will be dealt with, but we cannot guarantee to supply any further copies.

QUIET 'N COOL

Constructors of computer equipment for use in the home seldom seem to fit fans. Maybe they have implicit faith in their equipment, but it's often better not to trust to luck. Many of the existing fans for small computers are both bulky and noisy, but now there's an alternative, the Sprite. It's only 3.1" square and 1.6" thick so it should fit into the smallest computer box without too much trouble. The new models are denoted by the range suffix G and H, they will directly replace their older, noisier brothers. For prices and quantity discounts contact VSI Electronics (UK) Ltd Roydonbury Industrial Park, Horsecroft Road, Harlow, Essex CM19 5BY.



MEDIA MAGIC

INMAC, a fairly new addition to the legions of UK media suppliers, have sent word of two of their latest offerings. First out of the bag was a new cleaning kit for floppy discs consisting of three cleaning discs and two bottles of the necessary solution. All you have to do is soak the exposed portion of the cleaning disc with the solution, slap it in the drive for 30 seconds and, bingo, one set of clean heads. This should, they say, be done once a week. For 8½" drives a kit will cost you £30.00 and for 5¼" it's £28.00, each kit is sufficient for 60 or more cleanings. The second offering is extension cables for your VDUs. The idea being to get unnecessary people out of the computer room and back to their offices where, no doubt, they can play 'Invaders' or 'Adventure' in peace! For details of these and all the other INMAC offerings contact them direct at 18 Goddard Road, Astmoor Industrial Estate, Runcorn, Cheshire WA7 1QF.

RETAILERS BRANCH OUT

The Computer Retailers Association, or CRA for short, is expanding rapidly. They have just announced the formation of a committee to advise on the formation of Apple, Sharp and Commodore dealer groups within the CRA and have added Shannons Radio of Manchester and HB Computers of Luton to the fold. This brings the number of members up to 25 in the first year of operation. For full details of how the CRA can help you if you have a complaint against any of its members or how you can benefit fron the code of practice that it operates contact the Secretary, Owles Hall, Buntingford, Herts. SG9 9PL.

ARE BUREAUX BEST?

A seminar is to be held at the London Chamber of Commerce and Industry on March 24th at 2.00pm. The topic under discussion is the relative merits of bureaux computers against your own small or micro computer. For non-members the afternoon will cost £34.50, members can attend for £26.45. The address to write to is 66 Cannon Street, London EC4N 5AB or give Miss C A Measures a ring on 01-248 4444.

IN NAME ONLY

In our news last month we published an item on the move to Slough by Ohio Scientific. What we didn't tell you, because we didn't know, was that the name Ohio Scientific (UK) Ltd is, in fact, owned by American Data and not by the US company of the same name. American Data are the main agents for Ohio computers and it is they who have established the sales and service base at Langley in Slough. To add mayhem to the already existing confusion they supplied the wrong telephone number, it should be Slough (0753) 75915. Our apologies to anyone who may have been misled.

WORKSHOP

Roots and Williams of 63 Connaught Gardens, London N10 are running a regular monthly workshop for small businessmen who want to find out more about small business computers. They actually use their own system to demonstrate the various points, they've got an Alpha Micro. For details of the next date in the calendar contact John Roots at the above address or ring on 01-883 3656. The workshop will cost you £50 plus VAT.

TECHNICAL ENQUIRIES

Owing to increased pressures of work on our technical staff we are no longer able to offer a telephone technical enquiry service on Wednesday afternoons. If you do have a query about any published material in the magazine then it should be sent to our normal office address together with an SAE for our reply. In order to speed the service please ensure that you have remembered the SAE and that you have marked your envelope 'Technical Enquiry'.

PASCAL IN 16K

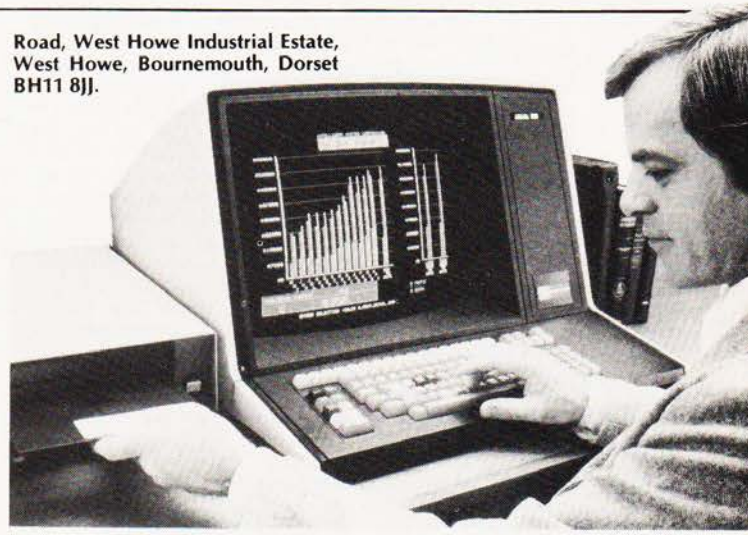
If you're a Pascal fancier and you own a NASCOM or an RML380Z then you might be interested in a new Interpreter and pseudo compiler from Enertech. The language requires a minimum of 16K of RAM and a memory mapped display and the package is supplied complete with a system bootstrap, floating-point package and a screen editor. Among the features offered by the implementation are the capability to handle real, integer and character variables, 32 bit floating point arithmetic with trig, exponential and log functions and compilation into re-locatable MAP code. The language is currently available on cassette tape for NASCOM 2s and RML380Zs at £35 and users will have the option to convert into EPROM at a later date if they wish. For full details contact Enertech direct at 32 Gildedge Road, Eastbourne, East Sussex.

FILTER IT OUT

If you are using a microcomputer in a domestic or other electrically hostile environment you can now have plug-in protection. Just announced by Lyons Instruments are IEC in-line filters that cost a mere £8 each and they come in current ratings; 1A, 3A and 6A. Designed to plug into existing IEC power inlets on the back of your computer and have the mains lead connected into the filter it probably represents the quickest and cheapest way to protect a single piece of equipment against RFI. For a full technical specification contact Lyons at Hoddesdon, Herts.

INTO COLOUR WITH CP/M

Fancy a desktop colour computer for your business? Techex, the UK suppliers of Intecolor, are now offering them with CP/M compatability. This gives access to all the software written in that format, such as ready-to-use sales and general ledgers, mailing lists and wordprocessors — all in glowing colour! The Intecolor range is available with 13 or 19" VDUs, 32K of RAM (expandable to 48K), 8K of ROM and up to 1182K of disc storage. Also supplied is a 'Soft Disc' which contains ISCs version of the Microsoft Business BASIC with added colour commands. Microsoft COBOL and FORTRAN IV are optional. For details of the range contact Techex at 5b Roundways, Elliott Road, West Howe Industrial Estate, West Howe, Bournemouth, Dorset BH11 8JJ.



BUSINESS NEWS

SPEAKING OUT

Communications are the up-and-coming section of the computer market and no part of that market gets more press coverage than speech recognition. In an attempt to transfer the accumulated expertise of some fifteen years research to British Industry the National Physical Laboratory has, under the guidance of the DOI, set up a 'Speech Recognition Club'. The idea is that companies within the UK who think that they might be able to benefit from the work done at NPL subscribe to the club and, in return, get the latest technical information. The idea works the other way too in that the NPL will benefit from industry giving it specific research targets to meet rather than working in a pure research environment. We covered the work done at the NPL in our September 1979 issue if you are interested in reading up about it. Several British companies have taken up the offer and they include Ferranti Computer Systems, Plessey, Systems Designers, Quest Automation Research and Nexos Office Systems. Applications from other interested companies will be considered, the fee payable depends on the amount of technology you want to access.

BUSINESS PRINT

Commodore have finally announced an up-market printer for the new 8000 (SuperPET) range of computers. Aimed directly at the small business market, the new device — the 8024, offers 160 cps printing on a 9 by 7 format. A wide variety of paper widths can be handled so the machine can be used for labelling as well as invoices and the like. The price tag is £1160 plus the ubiquitous VAT. Owners of the 3000 series can use the printer too, it's driven from the IEEE-488 bus, but at this price it is not really a viable alternative to some of the other devices coming onto the market. For product information contact their Information Centre at 360 Euston Road, London NW1.

TIMESHARE AND SAVE

If you want to access a computer to get the benefits of a bureau service in your own home, then the latest announcement by Computer Time Sharing Services is worth close scrutiny. They are announcing even cheaper rates for block usage which can provide up to 50% discount. In addition to these offerings for the business user they are continuing to provide their 99p per hour, off-peak service for the home user. For a detailed list of the services they can offer and the relative charges contact CTSS at Caldare House, 144/146 High Street, Chadwell Heath, Essex RM6 6NT.

MICRO MD

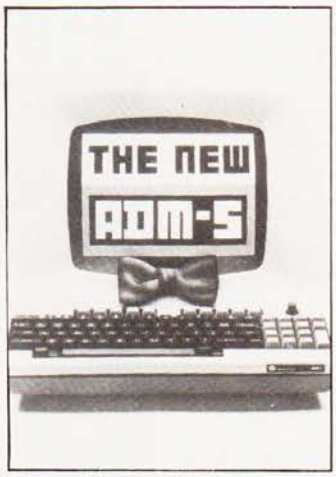
The Micro Computer Centre of 28 Sheen Lane, London SW14 has set up a 'Micro Clinic' for PET and Apple users within a 50 mile radius of London. For a basic annual fee of approximately 10-15% of the capital cost you will receive regular maintenance calls and be guaranteed that your machine will never be 'down' for more than 24 hours. If they can't fix it on the spot then they'll lend you a machine whilst the corpse is being resuscitated back at base. If you are interested in getting further information contact Malcolm North at the above address.

IMPORTANT NOTICE

Readers have recently confused Electronics Today Limited as being associated with the ownership of our magazine, Electronics Today International. Our magazine is owned by Modmags Limited, part of the Argus Press Holdings Limited Group of Companies. Electronics Today Limited advertises in our magazine, as "Metac", but so as to prevent any further confusion we wish to make it clear that Electronics Today Limited is not in any way owned or managed by any member of the Argus Press Holdings Limited Group of Companies.

NEW DUMB ONE

Lear Siegler, the American VDU people, have recently announced a new dumb terminal in their ADM range. Designated the ADM-5 it is a low-cost, limited facility unit. It comes with a 12" screen capable of displaying a total of 1920 characters, true lower case font, numeric pad and cursor controls and a programmable display memory. Data transmission is by a 10 baud rate RS232 interface and there is an extension port for hard copy. A fully detailed information sheet will be available from Lear Siegler at Brookwood, Surrey or from their normal UK distributors soon.



CUT PRICE COMPUTING

Now that LSI Computers have introduced their M-Two small business computer the price of the M-One model is to be reduced. The basic model will now cost you £4200, a reduction of some £1700. The model comprises an 8K micro with a 60 cps matrix printer and a VDU. Storage is provided by two double density floppy drives giving over 1Mb of available space. To add to the fun you also get a choice of basic applications software, accounting, payroll etc. The new pricing is intended to put the system within the reach of a first-time business user who might otherwise be tempted by a 'hobby' machine which may be incapable of the work. Anyone interested in taking advantage of the low prices should contact LSI Computers at Copse Road, St Johns, Woking, Surrey GU21 1SX.

MOBILE MICROS

That annual moving computer show is back again. Computermarket '81 will be making stops in Glasgow, at the Albany Hotel, from the 17th to the 19th of March and then moving down to the New Century Hall, Manchester from the 24th to the 26th of March. The remaining two stops on its lightning tour are the Albany Hotel, Birmingham from the 31st of March to the 2nd of April and the West Centre Hotel in London from the 7th to 9th of April. At all the venues the exhibition will be open from 10am to 5pm and, unless you are pre-registered, it will cost you £2.50 to get in. Pre-registered tickets are available from Couchmead Ltd at 42 Great Windmill Street, London W1V 7PA on receipt of an SAE.

HEALTHY HEATH

It's not often that a company reduces the price of its goods but the latest Heathkit catalogue reveals that the cost of both the H14 matrix printer and the H19 VDU have dropped. You can get your own copy of this kit-builders' fantasia by sending 25p in stamps to Heath Electronics (UK) Ltd, Bristol Road, Gloucester GL2 6EE.

BUSINESS BOX

Sintrom Ellinor, part of the Sintrom group, are offering a complete LSI 11 chassis with power supply and twin tape transports. There is no computer in the box so it can act as the basis of an OEM system or you could go it alone with the DEC equipment and build a complete system. Sintrom will, of course, be happy to supply the bits to fill the chassis with as well. The tape drives are the TU58 cartridge type and are complete with the necessary controllers, they can be omitted from the chassis if not required. For information and prices contact Sintrom Ellinor at 14 Arkwright Road, Reading RG2 0LS.

The PIC-CHIP.... a powerful easy-to-use graphics facility for all New Rom PETs.

The PicChip is a ROM module which simply plugs into your PET making available immediately over forty new BASIC commands. These commands use BASIC variables as parameters (no PEEKing or POKEing) and enable the graphic possibilities of the PET to be fully exploited - even by beginners! Using an X, Y coordinate system based on an origin specified by program, lines, graphs and drawings of all kinds can be generated on the screen by simple programming. Other commands enable defined areas, or the whole of the screen, to be rolled or shifted up, down, left and right. Images can be stored to and retrieved from any RAM address.

Originally designed for **scientific** and **technical** applications, the PicChip is also being used in **educational projects, games** and **design work** of all kinds. The combination of fast plotting and area manipulation makes the PicChip ideal for the continuous display of real-time data in graphical form.

Just see how easy it is to use PicChip commands: the following examples were all photographed directly from a PET screen.

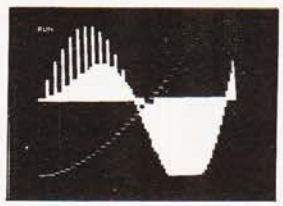
Picture 1 shows two curves, one drawn in fine-density and one in bar form, produced by two program lines:

```
10 FOR X=0 TO 39:Y = X↑1.5:!WF:
NEXT
20 Y0=25:FOR X=0TO79 STEP 3:
Y=SIN(X/12)✱24:!WY:NEXT
```

(1)

Picture 2 adds a third program line to plot a function as adjacent bars:

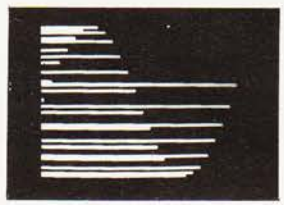
```
30 FOR X = 0 TO 79:Y=SIN(X/12)✱
X/2:!WY:NEXT
```



(2)

If we just take the second program line and change !WY to !WX, the bars are plotted horizontally:

```
20 FOR X = 0 TO 79:Y=SIN(X/12)✱24:
!WX:NEXT
```

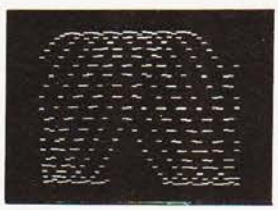


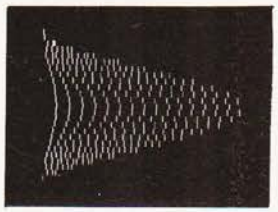
(3)

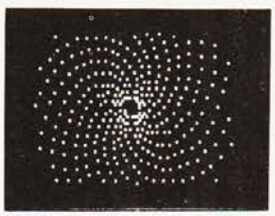
All the other pictures reproduced here were generated by the DEMONSTRATION PROGRAM included in the 20-page Handbook. What we can't show here are the amazing effects produced by shifting or rolling or otherwise manipulating different areas of the screen. There is even a repeat-key function, and commands for reading and setting the cursor position in X,Y co-ordinates.

PicChip Functions.

Command	Function
SYS 45056	PicChip On
!RE	Restore screen
!CO	PicChip off
!RP	Repeat-Key on
!RO	Repeat-Key off
!CW	Cursor-position Write
!CR	Cursor-position Read
!AF	Area Fill
!AR	Area Reverse
!AN	Area Normal
!AI	Area Invert
!AS	Area in Shift case
!AU	Area in Unshift case
!AC	Area Case invert
!AF	Screen Fill
!SR	Screen Reverse
!SN	Screen Normal
!SI	Screen Invert
!SS	Screen in Shift case
!SU	Screen in Unshift case
!SC	Screen Case invert
!US	Up Shift
!DS	Down Shift
!LS	Left Shift
!RS	Right Shift
!UR	Up Roll
!DR	Down Roll
!LR	Left Roll
!RR	Right Roll
!WP	Write Point
!EP	Erase Point
!WL	Write Line
!EL	Erase Line
!WC	Write Continuous line
!EC	Erase Continuous line
!WX	Write bar in X axis
!EX	Erase bar in X axis
!WY	Write bar in Y axis
!EY	Erase bar in Y axis
!WF	Write fine Y
!EF	Erase fine Y
!FW	Write fine X
!FE	Erase fine X
!CS	Copy Screen
!PC	Poke Character







The standard PicChip plugs into socket UD4 of the PET, but is also available to fit either of the other two sockets. PicChip is therefore **compatible with other PET ROM packages.** Installation and use are fully described in the handbook.

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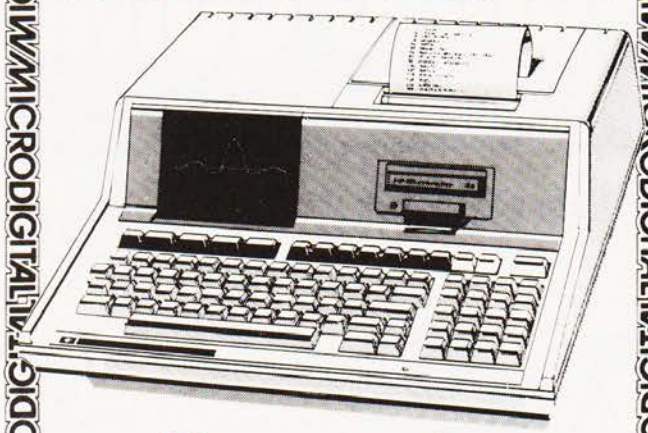

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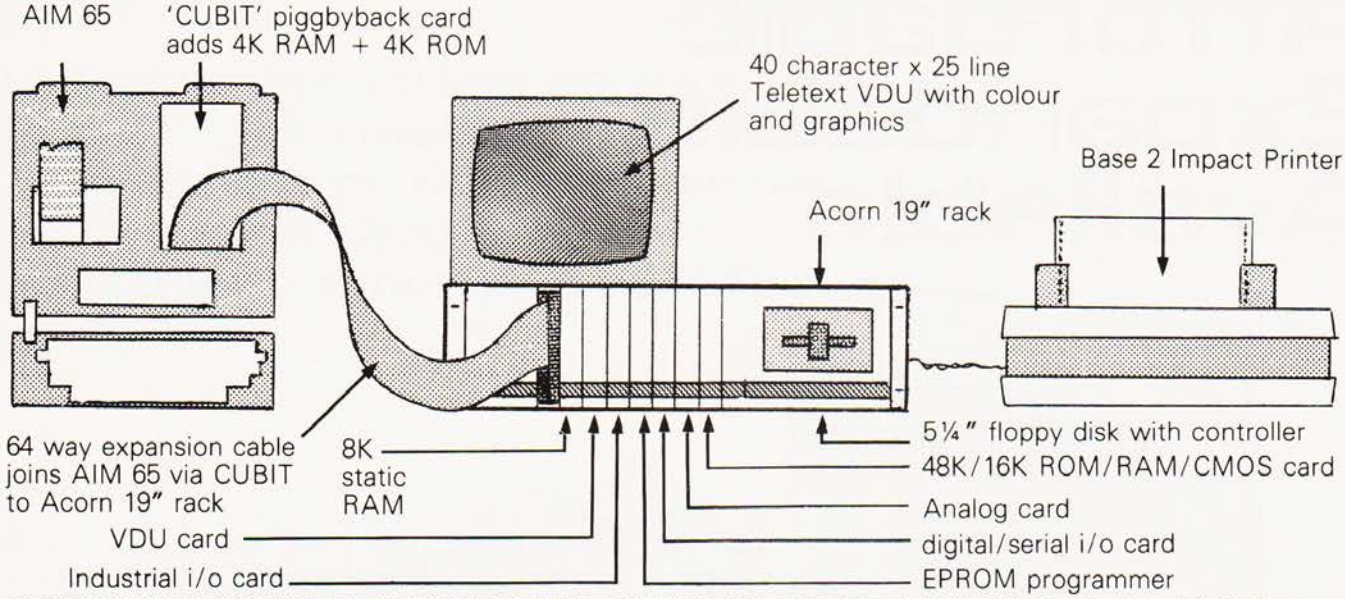

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LE

LIFE ON A 6800

Edwin J Peffer

An interesting variant on the popular LIFE emulation specifically for 6800 owners. Designed for the SWT range it should prove adaptable to other 6800 based machines.

The program LIFE is a set of rules to define the growth or death of a moss-like form. It was devised by J Conway and and depends entirely on the number of "neighbours" that each cell has, as follows.

A 'live cell' with only two or three neighbours will remain alive, but if there are more or less than this it will die. An empty cell with three neighbours will result in a birth at the empty location. Whether this really proves anything is very doubtful but it is both interesting and amusing. The end result can fall into one of the following categories, a) the whole system dies, b) a stable pattern results (a square of four is an example of this) or, c) a cyclic pattern which goes through one or more generations before repeating. The best example of these that I have found starts as three solid rows of cells across the centre of the matrix and this eventually produces a cyclic pattern that takes 15 generations to repeat.

My first program for LIFE was written in BASIC for Hewlett-Packard 2000F and even on this machine it took 10 seconds per generation. There was a 10 x 10 matrix and the technique was to count the neighbours for every cell in order to determine the next generation, ie eight subscripted variables for each of 100 locations. I eventually realised that rather than count for *every* cell it would be quicker to zero a matrix and then add one to each neighbour of a *live* cell (still eight subscripted variables for each cell examined but considerably fewer cells to worry about. After this the counting matrix has a record of the number of neighbours for each cell and the appropriate symbol can be loaded into the printing matrix. This cuts down the time to approximately one second per generation, which was acceptable.

Then the college at which I teach bought a SWTP 6800 system and I modified LIFE to suit the slightly different BASIC. Due to the BASICs slowness in handling subscripted variables it takes an incredible 50 seconds per generation. Hence my decision to write a machine code version of LIFE.

Method

I settled on a 16 x 16 matrix although this can be increased or decreased quite easily. To simplify the printing it treats the whole matrix as a single string and uses the Mikbug/SWTbug routine PSTRING (E07E). Thus the string consists x's or .'s with every 17th and 18th item as 'return', 'linefeed' respectively and the last item is an 'end of string' (code 04). So the string is effectively folded back on itself as shown.

```
. . . . XXXXX. . . . . ret,l/f. . . .
XXXXX. . . . . ret,l/f. . . . . XXXXX
. . . . . ret,l/f. . . . . XX.ret,l/f,eot
```

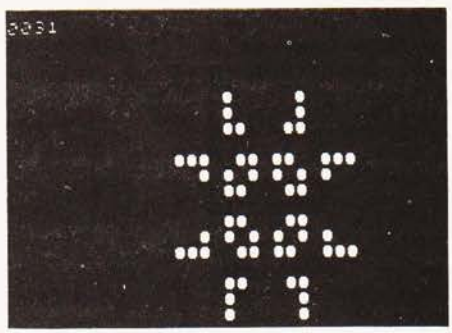
As you will see later the whole string gets modified by the calculation process and therefore before actually printing the string the 'return', 'linefeed', etc characters have to be added in again (program steps 017B to 01A6).

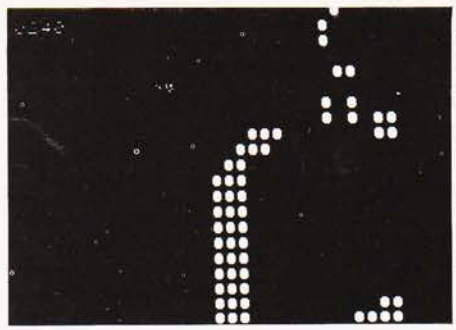
There have to be two matrices, Gen1 which is the present generation and Gen2 which is used to count the number of neighbours. The first stage in the calculation is to clear Gen2 (subroutine CLGEN2). Then it reads through Gen1 to find a live cell(X). When it does so it sets the index register to the corresponding cell in Gen2 (using subroutine XOFSET). It then has to add one to each of its eight neighbours as shown.

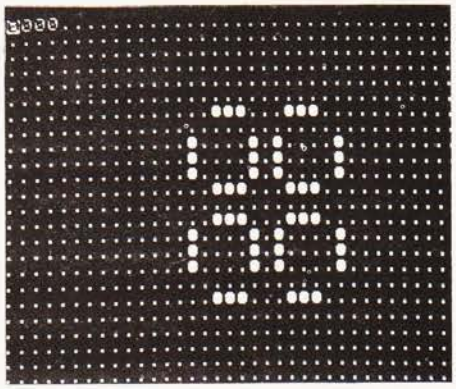
```
A   B   C
D   X   E
F   G   H
```

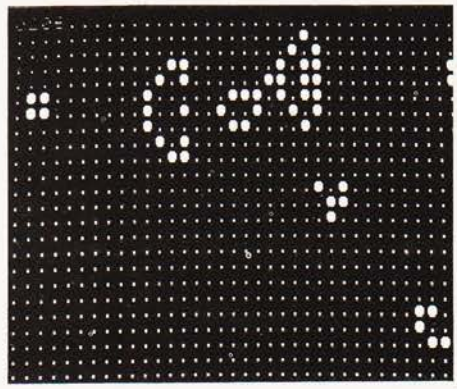
The index register holds the address of X but we cannot address A,B,C or D because indexed address offsets can only be positive, therefore (program steps 01BD to 01CF) it subtracts 19 so that the index register holds the address of A. Now we can increment the contents of A (as X), B (as X + 1), C as (X + 2), D as (X + 18) etc. It does not take into account the fact that edge cells should not affect eight neighbours, this is why the return, line-feed get overprinted and also why the isolation block is necessary. After this has been carried out for all of Gen1 then Gen2 contains the list of all the neighbours.

The subroutine NEWGEN is now used to load the next generation, taking into account how many neighbours and whether a cell is already alive or dead.









Note that once again it does not identify location 17 and 18 etc., and so they will have to be modified as described above. It then goes back and repeats from CLGEN2.

The input routine is possibly more complex than necessary but I have found it very frustrating in the past to run LIFE on a VDU and find an interesting sequence, but then realised that I hadn't noted the initial pattern. With my routine, it first clears the screen, then prints the message and then prints 27 blank spaces before accepting and printing each character as it is input. After 16 characters it gives 'return, linefeed' and 27 spaces etc. The result is that the initial pattern is offset 27 spaces to the right and remains there whilst leaving sufficient space for the main display to be watched. If you like the result then you still have a copy of the original pattern.

Finally, why the time delay? Well, it is so fast that on a 960 char/sec VDU the display is continually changing and can't really be seen. Counting down from FFFF gives a delay of about 1 S between generations. If you don't want the delay, replace 0116 and 0117 with 00 01.

This version of LIFE assumes a flat universe bonded by the edges of the matrix. A variation which could be added is to assume the opposite edges to be adjacent (similar to a Karnaugh map) so that the universe is a sort of sphere. It is, however, *not* a true sphere as the geometricians among you will have realised.

Program Listing

```
                        NAM CONLIFE
0100                    ORG $0100
                        OPT PAG
0100  86 16             LDA A #$16      CLEAR SCREEN
0102  BD E1 D1          JSR OUTCH       PRINT THE
                                        CHARACTER
0105  BD 01 2C          JSR INPUT       REQUEST INITIAL
                                        PATTERN
0108  86 1D     MAIN    LDA A #$1D      HOME THE
                                        CURSOR
010A  BD E1 D1          JSR OUTCH       PRINT THE
                                        CHARACTER
010D  86 19             LDA A #$19      DELETE TO END OF
                                        LINE
010F  BD E1 D1          JSR OUTCH       PRINT THE
                                        CHARACTER
0112  BD 01 7B          JSR PRINT       PRINTING
                                        ROUTINE
0115  CE FF FF          LDX #$FFFF      START OF DELAY
                                        LOOP
0118  09       DECREX  DEX
0119  26 FD             BNE DECREX      FINISH DELAY
                                        LOOP
011B  BD 01 ED          JSR CLGEN2      SET GEN2 TO ZERO
011E  BD 01 AE          JSR COUNT       COUNT THE
                                        NEIGHBOURS
0121  BD 01 FC          JSR NEWGEN      SET UP NEXT
                                        GENERATION
0124  86 0A             LDA A #$0A      LINE FEED
0126  BD E1 D1          JSR OUTCH       PRINT THE
                                        CHARACTER
0129  7E 01 08          JMP MAIN        REPEAT MAIN
                                        LOOP
                *       INPUT ROUTINE
012C  CE 02 45  INPUT   LDX #MESSG      INITIAL MESSAGE
012F  BD E0 7E          JSR PSTRING     PRINT IT
0132  CE 02 63          LDX #SHIFT      27 SPACES
0135  BD E0 7E          JSR PSTRING     PRINT IT
0138  CE 02 93          LDX #GEN1       START OF GEN1
013B  7F 02 44          CLR ROW         CLEAR ROW
                                        COUNTER
013E  7F 02 43  INPUT2  CLR LINE        CLEAR LINE
                                        COUNTER
0141  BD E1 AC  INPUT1  JSR INCHR       ACCEPT CHAR
                                        FROM KEYBD
0144  A7 00             STA A X         STORE IT
0146  08                INX             INCREMENT INDEX
0147  7C 02 43          INC LINE        INCREMENT LINE
                                        COUNT
014A  B6 02 43          LDA A LINE      PUT LINE COUNT
                                        IN ACCA
014D  81 10             CMP A #16       IS IT END OF LINE?
014F  26 F0             BNE INPUT1      NO--ASK FOR
                                        NEXT CHAR
0151  86 0D             LDA A #$0D      CARRIAGE
                                        RETURN
0153  BD E1 D1          JSR OUTCH       PRINT THE
                                        CHARACTER
0156  A7 00             STA A X         STORE CARRIAGE
                                        RETURN
0158  08                INX             INCREMENT INDEX
0159  86 0A             LDA A #$0A      LINEFEED
015B  BD E1 D1          JSR OUTCH       PRINT THE
                                        CHARACTER
015E  A7 00             STA A X         STORE LINEFEED
0160  08                INX             INCREMENT INDEX
0161  FF 02 41          STX TEMPX       SAVE INDEX
0164  CE 02 63          LDX #SHIFT      27 SPACES
0167  BD E0 7E          JSR PSTRING     PRINT IT
016A  FE 02 41          LDX TEMPX       GET INDEX
016D  7C 02 44          INC ROW         INCREMENT ROW
                                        COUNTER
0170  B6 02 44          LDA A ROW       LOAD ROW
                                        NUMBER TO ACCA
0173  81 10             CMP A #16       IS IT END OF
                                        FRAME?
0175  27 03             BEQ RET1        YES--BACK TO
                                        MAIN LOOP
0177  7E 01 3E          JMP INPUT2      NO--START THE
                                        NEXT LINE
017A  39        RET1    RTS
                *       PRINTING ROUTINE
017B  CE 02 93  PRINT   LDX #GEN1       START OF GEN1
017E  FF 02 41  PRINT1  STX TEMPX       SAVE INDEX
0181  86 0D             LDA A #$0D      CARRIAGE
                                        RETURN
0183  A7 10             STA A 16,X      STORE IN 16TH
                                        LOCATION
0185  86 0A             LDA A #$0A      LINE FEED
0187  A7 11             STA A 17,X      STORE IN 17TH
                                        LOCATION
0189  8C 03 A1          CPX #GEN1+270   END OF FRAME?
018C  27 15             BEQ             PRINTE
018E  86 12             LDA A #18       LOAD 18 TO ACC
0190  5F                CLR B           LOAD ZERO TO
                                        ACCB
0191  BB 02 42          ADD A TEMPX+1   ADDS 18 TO INDEX
0194  F9 02 41          ADC B TEMPX     I.E. SETS START
                                        OF NEXT LINE
0197  B7 02 42          STA A TEMPX+1
019A  F7 02 41          STA B TEMPX
019D  FE 02 41          LDX TEMPX       NEXT LINE
01A0  7E 01 7E          JMP PRINT 1     MODIFY NEXT
                                        LINE
01A3  86 04     PRINTE  LDA A #$04       ADD EOT TO END
                                        OF FRAME
01A5  A7 12             STA A 18,X
01A7  CE 02 93          LDX #GEN1       START OF GEN1
01AA  BD E0 7E          JSR PSTRING     PRINT THE STRING
```

```
01AD 39                    RTS
                  *  COUNTING ROUTINE
01AE CE 02 93  COUNT  LDX #GEN1      START OF GEN1
01B1 A6 00     NEXTX  LDA A X        LOAD IT TO ACCA
01B3 81 58            CMP A #'X     CHECK FOR LIVE
                                    CELL
01B5 26 2C            BNE NOT       NO--TRY NEXT
                                    CELL
01B7 FF 02 41         STX TEMPX     YES--SAVE INDEX
01BA BD 02 2A         JSR XOFSET    GET LOCATION OF
01BD B6 02 80         LDA A TEMPX1+1 CORRESPONDING
                                    POINT
01C0 F6 02 7F         LDA B TEMPX1  ON GEN2
01C3 80 13            SUB A #19     MOVE TO POINT
                                    THAT
01C5 C2 00            SBC B #0      IS ONE ROW UP
                                    AND
01C7 B7 02 80         STA A TEMPX1+1 ONE COLUMN
                                    LEFT IE
01CA F7 02 7F         STA B TEMPX1  POINT 'A'
01CD FE 02 7F         LDX TEMPX1    LOAD IT TO INDEX
01D0 6C 00            INC X         INCREMENT 'A'
01D2 6C 01            INC 1,X       INCREMENT 'B'
01D4 6C 02            INC 2,X       INCREMENT 'C'
01D6 6C 12            INC 18,X      INCREMENT 'D'
01D8 6C 14            INC 20,X      INCREMENT 'E'
01DA 6C 24            INC 36,X      INCREMENT 'F'
01DC 6C 25            INC 37,X      INCREMENT 'G'
01DE 6C 26            INC 38,X      INCREMENT 'H'
01E0 FE 02 41         LDX TEMPX     BACK TO GEN1
01E3 08        NOT    INX           INCREMENT INDEX
01E4 8C 03 B4         CPX #GEN1+289 END OF FRAME?
01E7 27 03            BEQ RET4      YES--BACK TO
                                    MAIN LOOP
01E9 7E 01 B1         JMP NEXTX     NO--GET NEXT
                                    LOCATION
01EC 39        RET4   RTS
          *  ROUTINE TO SET GENERATION #2 TO ZERO
01ED CE 03 C6  CLGEN2 LDX #GEN2     START OF GEN2
01F0 8C 04 E7  CLR    CPX #GEN2+289 END OF FRAME?
01F3 27 06            BEQ RET3      YES--BACK TO
                                    MAIN LOOP
01F5 6F 00            CLR X         NO--SET CELL TO
                                    ZERO
01F7 08               INX           INCREMENT INDEX
01F8 7E 01 F0         JMP CLR       NEXT CELL
01F8 39        RET3   RTS
          *  ROUTINE TO LOAD THE NEXT GENERATION
01FC CE 02 93  NEWGEN LDX #GEN1     START OF GEN1
01FF FF 02 41  AGAIN  STX TEMPX     SAVE IT
0202 BD 02 2A         JSR XOFSET    CORRESPONDING
                                    CELL IN GEN2
0205 A6 00            LDA A X       LOAD CELL
                                    CONTENT TO
                                    ACCA
0207 81 03            CMP A #03     CHECK FOR THREE
                                    NEIGHBOURS
0209 27 0E            BEQ NEIGH3    YES
020B 81 02            CMP A #02     CHECK FOR TWO
                                    NEIGHBOURS
020D 27 11            BEQ INX       YES
020F 86 2E            LDA A #'.     LOAD '.' TO ACCA
0211 FE 02 41         LDX TEMPX     CELL LOCATION IN
                                    GEN1
0214 A7 00            STA A X       PUT '.' IN CELL
0216 7E 02 20         JMP           INX
0219 86 58     NEIGH3 LDA A #'X     LOAD "LIVE CELL"
                                    TO ACCA
021B FE 02 41         LDX TEMPX     CELL LOCATION IN
                                    GEN1
021E A7 00            STA A X       PUT 'X' IN THE
                                    CELL
0220 FE 02 41  INX    LDX TEMPX     CELL LOCATION IN
                                    GEN1
0223 08               INX           NEXT CELL
0224 8C 03 C6         CPX #GEN2     END OF FRAME?
0227 26 D6            BNE AGAIN     NO--CHECK NEXT
                                    CELL
0229 39               RTS           YES--RETURN TO
                                    MAIN LOOP
          *  ROUTINE TO OFFSET TEMPX (TEMPX1 = TEMPX+307)
022A FF 02 7F  XOFSET STX TEMPX1    SAVE INDEX
022D 86 33            LDA A #$33    OFFSET OF 307 IE
022F C6 01            LDA B #01     289+18
0231 BB 02 80         ADD A TEMPX1+ ADD THE OFFSET
0234 F9 02 7F         ADC B TEMPX1
0237 B7 02 80         STA A TEMPX1+
023A F7 02 7F         STA B TEMPX1
023D FE 02 7F         LDX TEMPX1
0240 39               RTS
0241           TEMPX  RMB 2
0243           LINE   RMB 1
0244           ROW    RMB 1
E1AC           INCHR  EQU $E1AC
0245 49        MESSG  FCC 'INPUT PATTERN\16 x 16 GRID'
0246 4E 50
0248 55 54
024A 20 50
024C 41 54
024E 54 45
0250 52 4E
0252 2C 20
0254 31 36
0256 20 58
0258 20 31
025A 36 20
025C 47 52
025E 49 44
0260 0D               FCB $0D,$0A,4
0261 0A 04
0263 20        SHIFT  FCC '(19 spaces)'
0264 20 20
0266 20 20
0268 20 20
026A 20 20
026C 20 20
026E 20 20
0270 20 20
0272 20 20
0274 20 20
0276 20 20
0278 20 20
027A 20 20
027C 20 20
027E 04               FCB 4
E1D1           OUTCH  EQU $E1D1
E07E           PSTRING EQU $E07E
E0E3           CONTROL EQU $E0E3
027F           TEMPX1 RMB 2
0281           BLANK  RMB 18         TO ISOLATE THE
                                     MATRIX
0293           GEN1   RMB 289        GENERATION1 (16*
                                     18 + 1)
03B4           BLANK2 RMB 18         TO ISOLATE THE
                                     MATRIX
03C6           GEN2   RMB 289        GENERATION2
END

NO ERROR(S) DETECTED

SYMBOL TABLE:

AGAIN  01FF  BLANK  0281  BLANK2 03B4  CLGEN2 01ED  CLR
CONTRO E0E3  COUNT  01AE  DECREX 0118  GEN1   0293  GEN2
INCHR  E1AC  INPUT  012C  INPUT1 0141  INPUT2 013E  INX
NE     0243  MAIN   0108  MESSG  0245  NEIGH3 0219  NEWGEN
NEXTX  01B1  NOT    01E3  OUTCH  E1D1  PRINT  017B  PRINT1
PRINTE 01A3  PSTRIN E07E  RET1   017A  RET3   01FB  RET4
ROW    0244  SHIFT  0263  TEMPX  0241  TEMPX1 027F  XOFSET
```

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CLASSROOM COMPUTING?

With a price tag to suit the impoverished educational establishment and, as a by-product, attract the personal computer fan, the Acorn ATOM seems to be finding wide and rapid acceptance. Among the points often raised against it is the fact that the BASIC supplied is non-Microsoft, a criticism which implies that it might be difficult to program. Our reviewer has been spending time looking at just this aspect of the machine and he comes up with a number of very interesting conclusions. A review not to be missed if you are considering this computer for either your school or your home.

HAD AN ADVENTURE LATELY

Perhaps we should have given it a capital 'A' because the kind of adventure we're talking about is the computer-based game. If you are into the fantasy game market then don't spend your money until you've read this report on some of the best known offerings in the marketplace. The results will probably surprise you as much as they surprised us!

SOFTSPOT SPECIAL

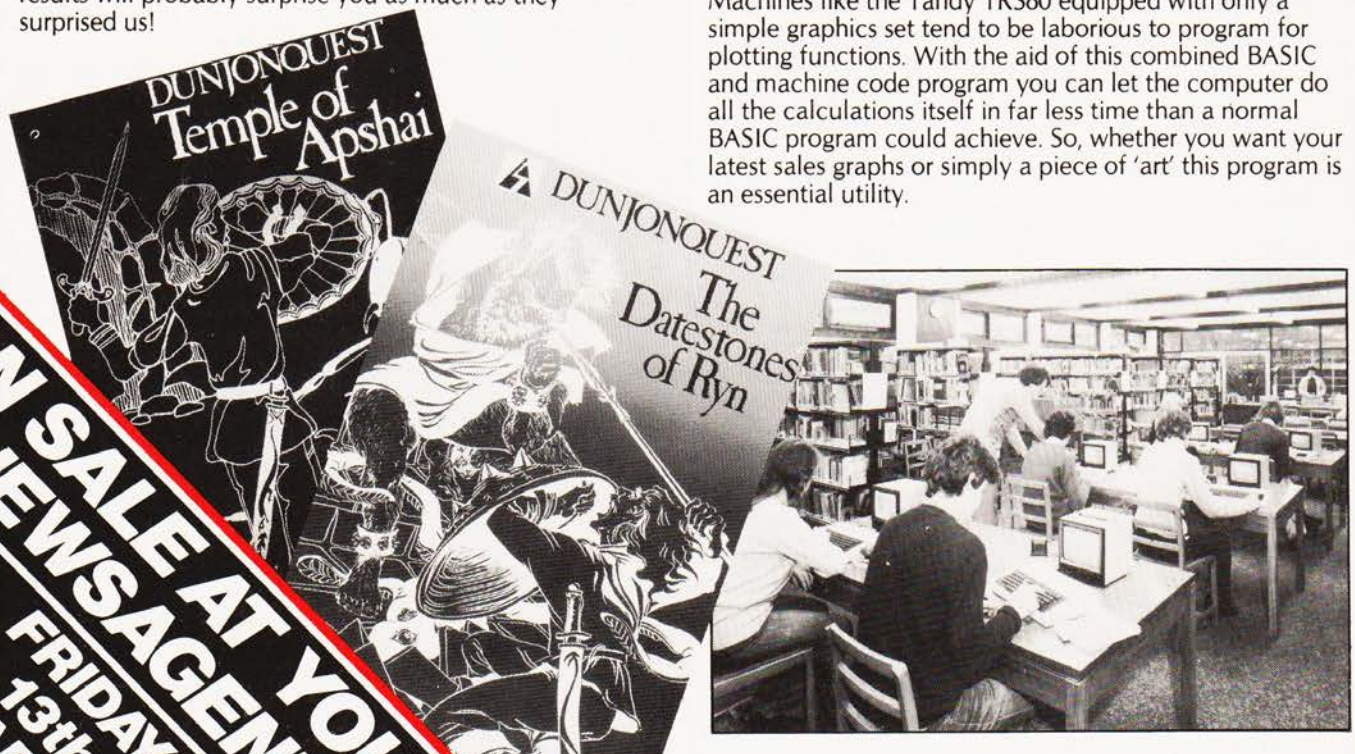
Once a year we turn the pages of the magazine over to the best of our readers' software offerings and this year is no exception. Applications, utilities, games and hints are all here for many of the popular microcomputers and, whatever machine you own, you're bound to pick up a few good ideas.

JUMPING ON THE BUSES

Motorola's challenger to the mighty Zilog Z80 is the 6809, the trouble is building it into anything. There are a few machines that offer the processor but the solution to this problem can be found in a rather old and neglected bus system called the SS50. We take a close look at what this has to offer together with some examples of the competition ranged against it.

DRAWING THE LINE

Machines like the Tandy TRS80 equipped with only a simple graphics set tend to be laborious to program for plotting functions. With the aid of this combined BASIC and machine code program you can let the computer do all the calculations itself in far less time than a normal BASIC program could achieve. So, whether you want your latest sales graphs or simply a piece of 'art' this program is an essential utility.



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Jim McCartney

The Sinclair ZX80 has really been bringing out the best in programmers. One popular technique is to use Boolean algebra and we show you how to make the logic work.

One of the advantages of owning a ZX80 with only 1K of memory is that you soon learn a lot about economical programming. You will have noticed that by the time you get to about the fortieth line, your listing starts to shrink in a rather distressing way, thus indicating that you are also using up your display memory as well.

This is especially noticeable when you are restricted to one statement per line, as on the ZX80, because if you have more than one instruction following an IF. . . THEN you will be forced to use several lines for them

A Case In Point

Consider the situation where you want a variable to change between 0 and 1 alternately as the line is executed. This usually occurs when you are playing games and want to use 'turns'. The flowchart for this would be something like Fig. 1.

If we had a machine that could handle multi-statement lines then we could write:

```
10 LET F=0
.
80 IF F=0 THEN LET F=1:GOTO 200
90 LET F=0
```

The extra statement on line 80 is only executed if the previous condition is met,

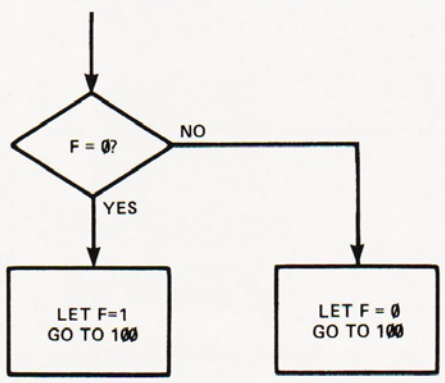

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Fig.1. The alternate branch flowchart.

but you can't do this on the ZX80 so we have to have line 200 setting F=1. All this takes up valuable memory space. This sort of operation and more besides can be taken care of using Boolean or logical statements.

AND And OR

As well as the usual arithmetic operators, we have a number of logical operators available which work on the actual machine code numbers stored inside the computer. The AND function will only leave a bit set in the result if the corresponding bit is set in *both* the words under comparison. Figure 2 gives the truth table for a typical operation.

The OR operator works in a similar way except that it will leave a bit set if it has occurred in *either* of the words under comparison, Fig. 3 gives an example. There is also a NOT function which turns all the 1s into 0s.

If we generate a table for both of these functions we can see that a simple connection emerges;

1 AND (any odd number) = 1
1 AND (any even number) = 0

If, for example, we wanted a variable to increment in steps of one to a maximum of three and then reset itself we could simply write,

LET F=F+1 AND 3

In fact we could use any value of 2^n-1 instead of three. It is also worth noting that X AND 0=0 where X is any number and that X OR 0=X where X is any number.

We can now see a couple of other ways of writing that alternating branch, each of which saves us a line.

```
10 LET F=0
.
80 LET F=F+1 AND 1
90 IF F=1 THEN GOTO 200
```

or we could try,

```
80 LET F=F+1
90 IF F AND 1=1 THEN GOTO 200
```

The Power Of Logic

The sheer power of this type of logic doesn't become obvious until we realise that each comparison we make is assigned the value of −1 if true and 0 if false. Using two-byte integer arithmetic, as the ZX80 does, we know that −1 is represented as 1111111111111111 and so the following is true, X AND −1=X. However, as −1 is already the truth value it follows that:

X AND (a true statement)=X
X AND (a false statement)=0

If we write the code LET F=F=0 AND X where the initial value of F is 0 the following pattern is produced X0X0X0X0. . .

We can now re-write the loop code in a further two ways;

```
10 LET F=0
.
80 LET F=F=0 AND 1
90 IF F=1 THEN GOTO 200
```

or, alternatively,

```
80 LET F=F=0 AND 100
90 GOTO F+100
```

DECIMAL	BINARY
10	1010
AND 6	0110
= 2	0010

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Fig.2. The AND function.

DECIMAL	BINARY
10	1010
OR 6	0110
= 14	1110

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Fig.3. The OR function.

AND	0	1	2	3	4	5	6	7
0	0	0	0	0	0	0	0	0
1	0	1	0	1	0	1	0	1
2	0	0	2	2	0	0	2	2
3	0	1	2	3	0	1	2	3
4	0	0	0	0	4	4	4	4
5	0	1	0	1	4	5	4	5
6	0	0	2	2	4	4	6	6
7	0	1	2	3	4	5	6	7

OR	0	1	2	3	4	5	6	7
0	0	1	2	3	4	5	6	7
1	1	1	3	3	5	5	7	7
2	2	3	2	3	6	7	6	7
3	3	3	3	3	7	7	7	7
4	4	5	6	7	4	5	6	7
5	5	5	7	7	5	5	7	7
6	6	7	6	7	6	7	6	7
7	7	7	7	7	7	7	7	7

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Fig.4. The comparative truth tables.

This type of instruction becomes even more powerful if we have more than two options, consider the following.

```
50 IF X < A THEN LET F = 100
60 IF X = A THEN LET F = 200
70 IF X > A THEN LET F = 300
80 GOTO F
```

Using our new found knowledge we can write

```
50 LET F = X < A AND 100 OR X = A
   AND 200 OR X > A AND 300
80 GOTO F
```

An example like this is given in the ZX80 manual but there is no indication of how and why it works. In the example above we use both the AND and the OR functions but it should be remembered that ANDs are always executed before ORs. With an extension of this technique we can make a variable alternate between two values on a single line,

```
LET F = F = X AND X OR F = Y AND X
```

The Reversible Subroutine

Some of the above examples prove to be 'reversible lines' and this technique can be expanded to give complete subroutines with a bit of care. The function of the routine is to carry out the complete opposite of its previous function on alternate passes.

An example of this is given in the short but aggravating game listed below. In this case we have gained several lines and thus fitted rather more into 1K than expected

The game starts with 11 counters in the display and your task is to split the line of counters in such a way as to leave two lines of different lengths. The last player to be able to do this wins the game. For example a line of four counters may be split 'three and one' but not 'two and two'. The computer takes the second move.

The game strategy is given in lines 340 and 350, the number of lines containing three, six or nine and the number of lines containing five or eight must both be even for a winning 'leave'. The tests are made in the above lines and if both F and G are zero then the machine has found a winning 'leave' and finishes its turn. If it can't, then it sets H equal to 1 (line 420) and it takes the first available move, line 300.

The program for the machine's turn works by examining all possible moves in the double loop between 250 and 400. The array is re-distributed by line 290 and subroutine 700 and is then tested in lines 330 to 370. If a satisfactory result isn't found the array is put back as it was by line 380 and the next possible move is tested.

In the reversible subroutine, lines 700 to 760, the variable N(X) alternates between the values of Y and Y + Z. The K loop looks for the first vacant array space and puts the counters (Z) taken from N(X) into the space. When we leave the loop at line 730 the K value stays where it is. The next time round we skip the loop entirely, line 710, and use this K value to find the counters and put them back again.

The Proof Of The Pudding

If you don't believe that Boolean algebra can be this effective then just try to re-write this program in 1K without it! The game itself is a mathematical variant of NIM and was invented by a mathematician called Grundy. It is actually called Distich and it can be played with any number of lines or piles of any number of counters. The winning strategy depends on leaving an even quantity of 'Grundy' numbers (F and G in this example) for your opponent. Given that number 11 is itself a Grundy number you can amuse yourselves by trying out more complicated versions.

Program Listing

```
100   CLEAR
110   DIM N(10)
120   LET N(1) = 11
130   GOSUB 500
140   PRINT "LINE?"
150   INPUT X
160   IF X > 10 THEN GOTO 900
170   PRINT "TAKE AWAY?"
180   INPUT Z
190   IF Z > N(X) - 1 OR Z < 1 OR 2*Z = N(X) THEN GOTO 900
200   LET Y = N(X) - Z
210   GOSUB 700
220   GOSUB 500
230   PRINT "MY TURN.KEY 0, NEWLINE."
240   INPUT H
250   FOR X = 1 TO 10
260   IF N(X) < 3 THEN GOTO 400
270   FOR Z = 1 TO N(X) - 1
275   LET Y = N(X) - Z
280   IF 2*Z = N(X) THEN NEXT Z
290   GOSUB 700
300   IF H = 1 THEN GOTO 130
310   LET F = 0
320   LET G = 0
330   FOR J = 1 TO 10
340   IF N(J) = 3 OR N(J) = 6 OR N(J) = 9 THEN LET F = F = 0 AND 1
350   IF N(J) = 5 OR N(J) = 8 THEN LET G = G = 0 AND 1
360   NEXT J
370   IF F = 0 AND G = 0 THEN GOTO 130
380   GOSUB 700
390   NEXT Z
400   NEXT X
410   IF H = 1 THEN GOTO 800
420   LET H = 1
430   GOTO 250
500   CLS
510   FOR K = 1 TO 10
520   PRINT K; " ";
530   IF N(K) = 0 THEN GOTO 570
540   FOR J = 1 TO N(K)
550   PRINT "■";
560   NEXT J
570   PRINT
580   PRINT
590   NEXT K
600   RETURN
700   LET N(X) = N(X) = Y + Z AND Y OR N(X) = Y AND Y + Z
710   IF N(X) = Y + Z THEN GOTO 750
720   FOR K = 1 TO 10
730   IF N(K) = 0 THEN GOTO 750
740   NEXT K
750   LET N(K) = N(K) = 0 AND Z
760   RETURN
800   CLS
810   PRINT "YOU WIN."
820   GOTO 1000
900   CLS
910   PRINT "INVALID MOVE. YOU LOSE."
1000  PRINT
1010  PRINT "FOR NEW GAME, KEY 0,NEWLINE."
1020  INPUT H
1030  GOTO 100
```

Why the Sinclair ZX80 is Britain's best-selling

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Kit: £79.95

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* Unique syntax check. A cursor identifies errors immediately.
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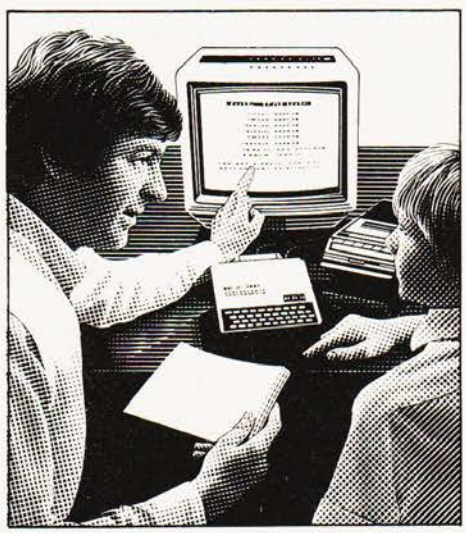
* Up to 26 single dimension arrays.
* FOR/NEXT loops nested up to 26.
* Variable names of any length.
* BASIC language also handles full Boolean arithmetic, condition expressions, etc.
* Randomise function, useful for games and secret codes, as well as more serious applications.
* Timer under program control.
* PEEK and POKE enable entry of machine code instructions.
* High-resolution graphics.
* Lines of unlimited length.

Unique RAM

The ZX80's 1K-BYTE RAM is the equivalent of up to 4K BYTES in a conventional computer – typically storing 100 lines of BASIC.

No other personal computer offers this unique combination of high capability and low price.



The ZX80 as a family learning aid. Children of 10 years and upwards are quick to understand the principles of computing – and enjoy their personal computer.

The Sinclair teach-yourself BASIC manual

If the specifications of the Sinclair ZX80 mean little to you – don't worry. They're all explained in the specially-written 128-page book (free with every ZX80). The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming – from first principles to complex programs.

Kit or built – it's up to you

In kit form, the ZX80 is pleasantly easy to assemble, using a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9V DC nominal unregulated. If not, see the coupon.

Both kit and built versions come complete with all necessary leads to connect to your TV (colour or black and white) and cassette recorder. Plug in and you're ready to go. (Built versions come with mains adaptor.)

personal computer.

Now available for the ZX80...
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Massive add-on memory. Only £49.95.
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How to order

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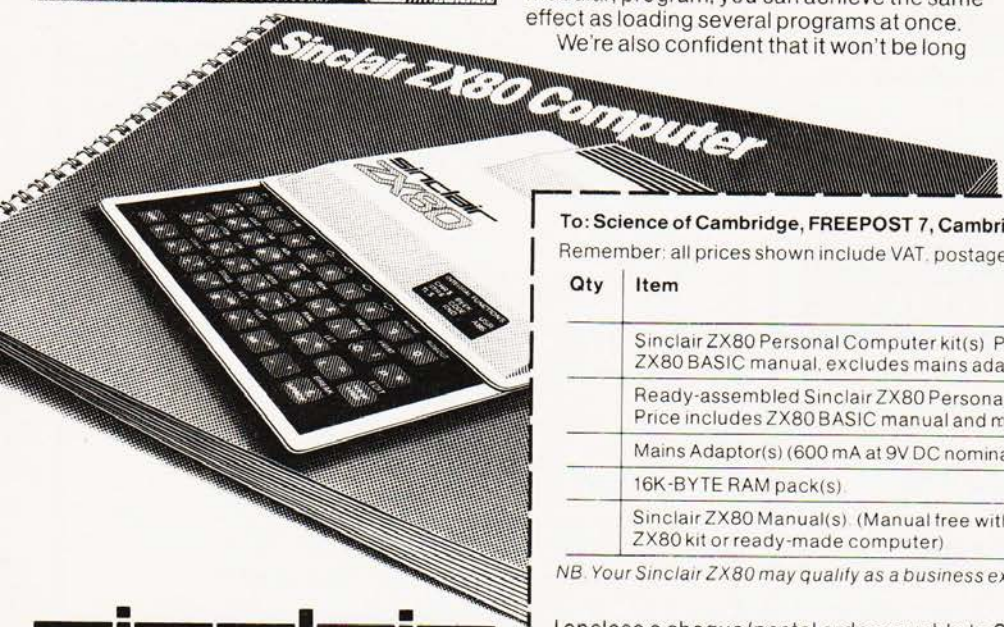

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	16K-BYTE RAM pack(s).	18	49.95	
	Sinclair ZX80 Manual(s). (Manual free with every ZX80 kit or ready-made computer)	06	5.00	

NB. Your Sinclair ZX80 may qualify as a business expense. **TOTAL: £**

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ZX80

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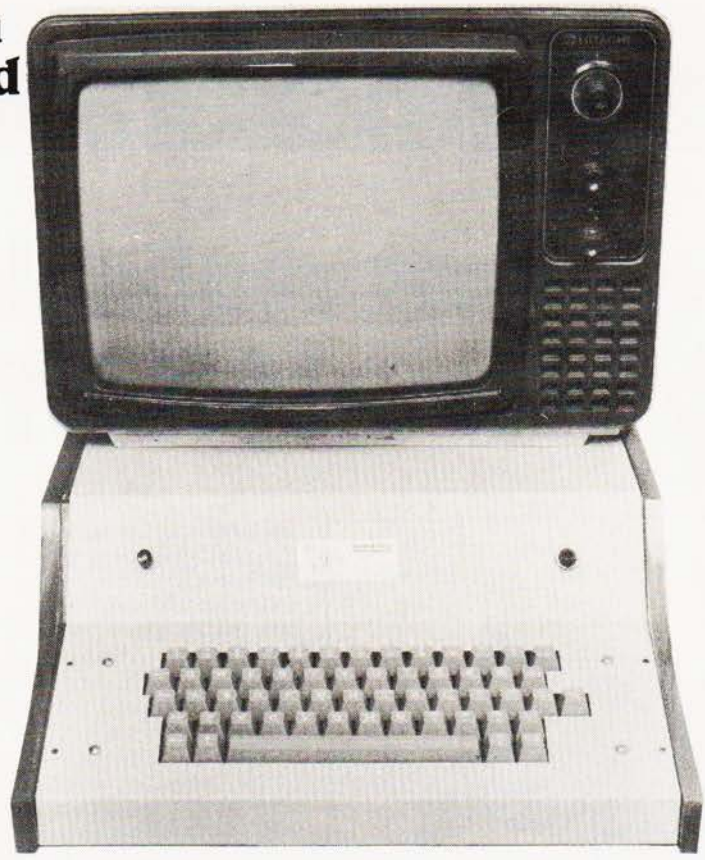
A really neat little game in NASCOM BASIC that could be easily modified to use the recently published joysticks.



This program was written for an 8K NASCOM 1 using the T4 monitor with the 8K ROM BASIC and the NAS-GRA-V3 graphics ROM. With suitable modification it would be possible to run this program under NAS-SYS.

You are sat at the controls of a rebel Star-fighter. Your mission is to seek out and destroy as many rogue Eti-fighters as possible within the confines of the energy reserves available.

To steer your fighter the following four keys on the NASCOM keyboard are used:

–	. . . UP
@	. . . LEFT
BACKSPACE	. . . RIGHT
NEW-LINE	. . . DOWN

Only one key may be pressed at any one time until you fire the LASER which is activated by depressing all your four keys at once. It must be remembered that you are steering towards the Eti-fighter and it may seem, at first, to be back to front.

A double bar at each end of the sight indicates that a target is present within the sight, or that the LASER is recharging. Angled brackets signify that the target is central within the sight.

You start out on your mission with 500 units of energy, on each burst of LASER fire you consume 10 units of energy.

A score of 10 points is awarded for a hit on the main hull of the Eti-fighter, whereupon a hopefully satisfying explosion will ensue. To gain additional marks, a point is given for every stabilising fin which is shot off. There are four fins in all, two per wing, giving a possible score of 14.

When your energy has been exhausted, an appropriate comment will be printed, this being dependent on *your* performance. If your score has exceeded the best recorded score, the program will invite you to enter your name which will be displayed beside your score until this, in turn, is exceeded.

With only minor modifications to the subroutine at line 7000 onwards, it would be possible to use this program with a Joystick interface, perhaps even with a trigger to fire the LASER (Line 170).

Program Listing

```
60    WIDTH 255
70    INPUT"Enter previous high score ";BEST
80    INPUT"by whom ";NAME$
90    GOSUB 3000:REM**Convert name to lower case
100   MARK=0:ENERGY=500:CLS
110   LEFT=149:RIGHT=151
120   GOSUB 1000:REM**Print out best score
130   GOSUB 2000:REM**Print out best score & energy
140   X=INT(RND(1)*46+2):Y=INT(RND(1)*15+1)
150   GOSUB 4000:REM**Draw sight
160   GOSUB 5000:REM**Draw fighter
170   IF INP (0)=152 THEN GOSUB 6000:REM**Fire laser
180   IF ENERGY=0 THEN 220
190   IF E=1 THEN E=0:GOTO 110
200   GOSUB 7000:REM**Move fighter
210   GOTO 150
220   F=0:IF MARK>BEST THEN BEST=MARK:F=1
230   IF MARK>100 THEN MARK=100
240   RESTORE:SCREEN 1,15
250   FOR C=1 TO MARK/20:READ COMMENT$:NEXT
260   PRINT COMMENT$
270   IF F=1 THEN INPUT"What is your name ";NAME$
280   INPUT"Another game?";COMMENT$
290   IF LEFT$(COMMENT$,1)="N" THEN END
300   IF F=1 THEN GOSUB 3000:REM**Lower case
310   IF F=1 THEN PRINT"May the force be with you"
320   FOR C=1 TO 2000:NEXT:GOTO 100
1000  SCREEN 24,16
1010  PRINT"Best"BEST" by "NAME$;:RETURN
2000  SCREEN 1,16
2010  PRINT"Score"MARK" Energy"ENERGY;:RETURN
3000  IF LEN (NAME$)<2 THEN RETURN
3010  TEMP$=MID$(NAME$,2,1)
3020  IF TEMP$<"A" OR TEMP$>"Z" THEN RETURN
3030  TEMP$=LEFT$(NAME$,1)
3040  FOR L=2 TO LEN(NAME$)
3050  IF MID$(NAME$,L,1)=" " THEN 3080
3060  TEMP$=TEMP$+CHR$(32+ASC(MID$(NAME$,L,1)))
3070  NEXT
3080  NEXT$=TEMP$
3090  RETURN
```

NAS WARS!

```
4000  REM**Draw sight
4010  POKE 2402,154:POKE 2658,153
4020  POKE 2533,151:POKE 2527,149
4030  M=PEEK(2530):IF M=210 OR E=1 THEN 4070
4040  IF PEEK(2661)=147 THEN POKE 2661,32
4050  POKE 2399,32:POKE 2405,32:POKE 2655,32
4060  GOTO 4090
4070  IF PEEK(2661)<>130 THEN POKE 2661,147
4080  POKE 2655,146:POKE 2399,144:POKE 2405,145
4090  IF M <>32 THEN M=148
4100  POKE 2526,M:POKE 2534,M:RETURN
5000  REM**Draw fighter
5010  POKE Z-1,32:POKE Z+1,32:POKE Z,32
5020  X=X+X1:Y=Y+Y1:X1=0:Y1=0
5030  REM**Keep fighter on screen
5040  IF X>47 THEN X=47
5050  IF X<2 THEN X=2
5060  IF Y<1 THEN Y=1
5070  IF Y>15 THEN Y=15
5080  Z=1993+X+64*Y
5090  POKE Z,210:POKE Z-1,LEFT:POKE Z+1,RIGHT
5100  RETURN
6000  REM**Fire laser
6010  M=PEEK(2530):ENERGY=ENERGY-10
6020  E=0:IF M=210 THEN E=1
6030  REM**Damage fighter
6040  IF M=146 OR M=144 THEN LEFT=152:MARK=MARK+1
6050  IF M=147 OR M=145 THEN RIGHT=152:MARK=MARK+1
6060  IF M=149 THEN MARK=MARK+1:LEFT=146:IF RND(1)<.5
      THEN LEFT=144
6070  IF M=151 THEN MARK=MARK+1:RIGHT=147:IF RND(1)<.5
      THEN RIGHT=145
6080  FOR L=1 TO 2:C=2986
6090  FOR R=2971 TO 2530 STEP -63
6100  POKE R,32:IF L=1 THEN POKE R,131
6110  POKE C,32:IF L=1 THEN POKE C,130
6120  C=C-65:NEXT
6130  GOSUB 4000:REM**Draw sight
6140  IF E=0 THEN GOSUB 7000:GOSUB 5000
6150  NEXT
6160  GOSUB 4000:REM**Draw sight
6170  IF E=0 THEN GOSUB 2000:RETURN
6180  MARK=MARK+10
6190  REM**Explosion
6200  GOSUB 5000:REM**Draw fighter
6210  GOSUB 2000:REM**Print score
6220  FOR L=1 TO 2
6230  FOR R=1 TO 4
6240  FOR C=0 TO 6.28 STEP .78
6250  X=49+R*SIN(C) : Y=22+R*COS(C)
6260  RESET(X,Y) : IF L=1 THEN SET (X,Y)
6270  NEXT:GOSUB 4000:REM**Draw sight
6280  NEXT:NEXT:RETURN
7000  REM**Move fighter
7010  I=INP(0)
7020  X1=INT(RND(1)*3-1):Y1=INT(RND(1)*3-1)
7030  IF I=159 THEN X1=1:REM**Left
7040  IF I=190 THEN X1=-1:REM**Right
7050  IF I=187 THEN Y1=1:REM**Top
7060  IF I=189 THEN Y1=-1:REM**Bottom
7070  RETURN
8000  DATA You have failed you miserable dog...
8010  DATA Your humble attack was of little consequence.
8020  DATA The Empire continues its reign of terror.
8030  DATA Well done you shot down an entire squadron.
8040  DATA Congratulations...You have defeated the Empire
```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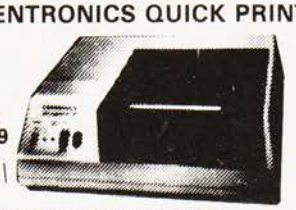

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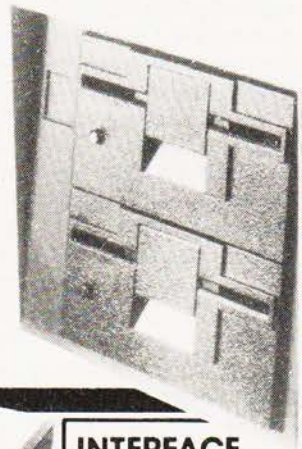

D-DOS SYSTEM
The disc unit is also available without CP/M to enable existing Nas-Sys software to be used. Simple read, write routines are supplied in EPROM. The unit plugs straight into the Nascom PIO.

Single drive system ..... £395 + VAT
(please state which Nascom the unit is for)

Certain parts of the CP/M and D-DOS disc systems are available in kit form. Details available on request.

ENCLOSURE FOR N2+5

The Kenilworth case is a professional case designed specifically for the Nascom 2 and up to five additional 8" x 8" cards. It has hardwood side panels and a plastic coated steel base and cover. A fully cut back panel will accept a fan, UHF and video connectors and up to 8 D-type connectors. The basic case accepts the N2 board, PSU and keyboard. Optional support kits are available for 2 and 5 card expansion.

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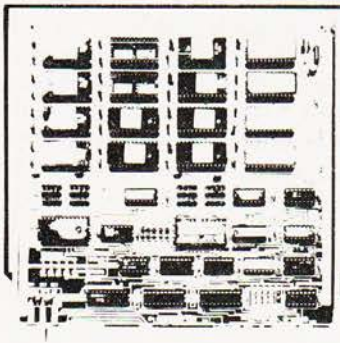
The Castle Interface is a built and tested add-on unit which lifts the Nascom 2 into the class of the fully professional computer. It mutes spurious output from cassette recorder switching, adds motor control facilities, automatically switches output between cassette and printer, simplifies 2400 baud cassette operating, and provides true RS232 handshake.

Castle Interface Unit .. **£17.50** + Vat



EPROM EXPANSION

The Nasbus compatible EPROM board accepts up to 16,2708 or 2716 EPROMs. It has a separate socket for the MK36271 8K BASIC ROM for the benefit of Nascom-1 users. And for Nascom-2 users, a wait state for slower EPROMs. The board also supports the Nascom Page Mode Scheme.

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Milham A-D Converter (built and tested) **£49.50** + Vat

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A P Stephenson

Does your computer use a 6502? If so, then this new series on machine code programming is for you.

There is no great shortage of literature on machine code programming. There are many books and a goodly assortment of magazine articles which are expertly written, particularly with reference to the 6502 microprocessor. In spite of this, the number of computer hobbyists who survive the first few chapters is very small; the majority slowly return to the peace and warmth of BASIC. There must be various reasons for this, the most probable is the tendency of writers to commence with a few soothing remarks, reassuring us that machine code programming is not *really* difficult. Now any one who is a dedicated hobbyist, whatever the subject, is seldom put off by a little thing like "difficulty".

It is common sense to realise at the outset that machine code programming is not easy. It is laborious. It is mind bending. In fact it is probably the most frustrating mental torture ever thrust upon the mind of man. Once this is established, if you try hard but still fail there is no nagging worry at the back of your mind that your intellect is suspect.

The examples which come later are quite unpretentious and may even be regarded as naïve. Nevertheless, they must be judged as building bricks which can be slotted together to produce useful programs or subroutines. The emphasis throughout is on the PET but, in general, most of it is applicable to other 6502 based machines except, of course, references to particular address blocks and screen memory. The appropriate modifications can be made by consulting the memory mapping.

The 6502 itself is worth a few remarks. Is it "better" than say the 8080 or the 6800 or the Z80? The question is really not worth answering except to say that the best micro is the one *you* know. The feature of the 6502 which I find the most frustrating is the single accumulator and the fact that you can't increment it directly . . . a most amazing omission, although no doubt the designers would have a ready explanation. On the other hand the multiple addressing modes and the two index registers are useful assets. Post-indexed and pre-indexed indirect addressing is available although the necessity to occupy page zero addresses (which are almost completely dominated by the BASIC software workspace) severely restricts their use. It is not essential to write an entire program in machine code. It is easy to write part of a program in some high level language (such as BASIC) and nip smartly into a machine code subroutine whenever a speed or memory preservation problem arises.

Which Machine Code?

BASIC is a universal language, meaning that any make of computer which has a resident interpreter will be able to understand a program written in BASIC . . . apart from a few fairly trivial modifications to suit differences in dialect. This is not so with machine code programs. The central processor of a small computer is a MICROPROCESSOR and each particular make has its own *unique* machine code. Thus a machine code program written for one computer will only run on another make of computer if it happens to use the *same* microprocessor.

Fortunately, a knowledge of the detailed anatomy of the machine is not required. Nevertheless, it is necessary to be aware of:

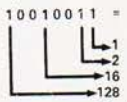
a. The major REGISTERS in the machine which are available to the programmer, particularly their length (can they hold one byte or two bytes?).

b. The safe areas in the memory map for the storage of machine code, ie where it will be safe from the conflicting claims of the BASIC monitor or any other resident software.

c. The machine addresses of any hardware input/output ports.

Theoretical Knowledge

If you are already at home with binary and hexadecimal then the following will not interest you. *Binary* is a method of counting in animal grunts of "1" and "0" called BITs. A collection of bits can represent a number by assuming that the value of a "1" doubles each time it "moves" to the left. Thus,



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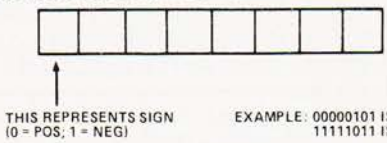
How binary is "weighted".

A collection of eight bits is called a byte and this is the width of one memory cell in the 6502 family.

When addition or subtraction instructions are used, the computer assumes the number is in this format:



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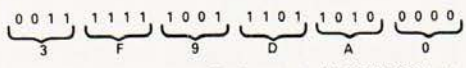
Using the MSB to indicate the sign of a number.

The +5 above is easy to follow but the negative relies on a funny rule . . . in fact hilarious;

To produce the equivalent negative, invert *all* the bits and *add* 1. Although this is absurd for humans, the machine is able to perform arithmetic very efficiently and with the minimum of electronic circuitry.

Hexadecimal

This is a shorthand code to describe a string of bits, although some arithmetic significance is also implied. It is widely used in computer literature and has almost superseded an earlier system called octal. There are 16 characters in the code . . . 0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F. The letters A to F are used to represent 10 to 15 respectively. The code is easy to grasp by study of the following example, which is based on bytes but artificially separated into four-bit NIBBLES to assist comprehension.



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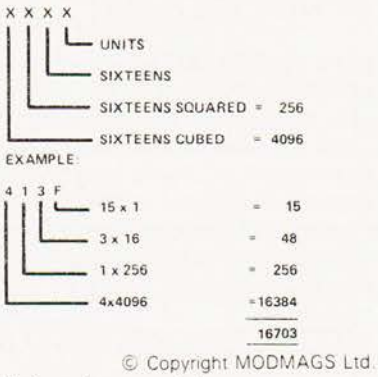
Breaking bytes into nibbles gives Hex quickly.

It is seen that one byte can be described concisely by just two Hex digits. When writing in machine code, addresses of individual memory cells are assumed by the system to be in Hex rather than decimal. An obvious criticism here would be a charge of unnecessary obscurity but, in reality, it is (in some respects) an advantage. The address bus

6502 PROGRAMMING COURSE

of a microprocessor has 16 wires and there are 2^{16} ways of arranging "1s" and "0s". Now this is equal to 65,536 decimal so the possible address range is from 0 to 65,535 which, frankly, is a disagreeable sort of figure rather lacking in taste. However, the same address range in four Hex digit notation is 0000 to FFFF which is neater and far more refined . . . don't you think? It is worth understanding how we count in Hex. Each Hex digit goes up in powers of SIXTEEN as we proceed from right to left in accordance with the following plan:



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Hex weighting values revealed.

As an exercise, satisfy yourself that FFFF Hex = 65,535. It is customary to break down the memory space into BLOCKS of four kilobytes, PAGES of 256 bytes and ITEMS within each page. Thus the total memory space can be divided (mentally) into 16 blocks, each of 16 pages with 256 items in each page.

Monitors And Assemblers

There are three methods of entering a machine code program depending on the computer, the money available to buy support aids and the personality of the programmer. If you don't have a resident monitor in ROM (or a tape loaded monitor) you can use a series of POKEs . . . if your version of BASIC has POKE in its repertoire.

A machine code monitor is one of the traditional techniques for conveniently entering and running machine code programs. It is basically a program written in machine code itself and provides facilities for entering machine code, displaying the contents of any desired block of memory bytes, executing the program from a specific starting address, displaying the contents of the major registers, saving and loading the program on tape (or other kind of backing store) and last, but not least, steer a course for "home" and return to the shelter of mother BASIC. Some computers have monitors resident in ROM and others require the purchase of a tape or disk which will require loading. An ASSEMBLER is a more convenient way to aid the machine code programmer and is a more sophisticated example of support software. Because of the length of an assembler, few small computers can waste the memory space required to house it in a ROM. The superior qualities of an assembler can only be appreciated by comparison with a machine code monitor. The major advantage is the ability to use letter groups for the operation code instead of hexadecimal characters. The letter groups are chosen to provide memory association (human memory that is) with the effect they produce. For example, to increment the index register X (add 1 to it) the machine code in the 6502 is "E8". An assembler would allow the use of "INX" which is easily converted in the mind to "increment index register X". Another useful property is the use of labels (chosen by the programmer) to replace machine addresses and, in some cases, to replace the destinations in branch type instructions.

However, it must not be though that an assembler makes machine language programming easy. In fact, it is just as difficult to program with the assembler as it is with the machine monitor. All an assembler does is to make machine programming less error prone and easier to correct for mistakes, providing you know where they are! A simple (almost crude) "mini assembler" is provided later in this series. Some readers may find it useful.

The PET Monitor

This is given the homely name of "TIM" meaning Terminal Interface Monitor. Owners of the 8K PETs are unlucky because they have to buy it separately on cassette tape. Those with the 16K or 32K with new ROMs have TIM resident and can enter its clutches by typing SYS 1024 followed by RETURN. To those unused to it, the effect is rather an anti-climax because a rather motly string of characters are displayed which later on may take on some meaning.

```
 PC  SR  AC  XR  YR  SP
 C6  ED  00  20  00  F5
```

(With some machines an extra group IRQR appears)

PC stands for PROGRAM COUNTER, SR for PROGRAM STATUS REGISTER, AC for ACCUMULATOR, XR for INDEX REGISTER X and SP for STACK POINTER. Beneath each of the headings is a pair of hexadecimal digits which represent the current contents of the register and this will therefore not necessarily match the previous example contents. The presentation after typing SYS 1024 is said to "default to the REGISTER DISPLAY mode". The word "default" is used glibly in many manuals and textbooks but is seldom explained. It is a jargon term (and badly chosen jargon at that) in the computing world implying "a state to which a system reverts in the absence of specific commands to the contrary". Thus we didn't ask for a display of the registers . . . TIM thrusts it upon us.

Although the facilities offered by TIM are laid out in the PET manual perhaps the following provides additional help to those who found it read somewhat like an early Sanskrit manuscript. Firstly, all input and output numbers to TIM are in Hex. Spaces are important and TIM will reject if a space is missing or if you type a space where there shouldn't be one. The prompt from TIM is a "." which is expected to be followed by any one of the letters M,R,G,X,L,S depending on the desired facility. These are all given in Table 1.

Putting It To Use

This completes the initial skirmish with the machine code monitor. Only one irritating little worry remains . . . how do we know what bytes to put in the address? In other words, how do we write a program in machine code? As previously mentioned, the first essential step is to search through your bundle of documents to find a copy of the Machine Codes appropriate to the microprocessor used. PET owners who find that their manual does not include such "luxuries" are advised to cough up about £5.00 and purchase a copy of the "MOS 6500 Programming Manual". Sadly, it is not too kind to the poor old beginner and does little to encourage a desire to learn machine code. The accompanying "6502 Machine Code" tables are my attempt at such a classification which I use propped up in front of me during bouts of coding . . . next to the bottle of aspirins. The contents of each little box displays three items of information:

a. Small figure at top left is the NUMBER OF BYTES in the instruction.

b. The letter groups at the bottom are the ASSEMBLER MNEMONIC CODES

c. The two large characters at right are the HEXADECIMAL MACHINE CODES.

DISPLAY MEMORY CONTENTS (Function "M"). Type after the prompt, .M 0340,0348 (don't forget the space after the M).
On pressing RETURN the monitor will output something like,

```
.:0340  A2  45  38  B4  E5  AA  AA  F9
.:0348  36  69  EF  57  D4 79   24   48
```

```
.M FF40,FF48
.:FF40 C8 C0 10 F0 C9 D0 EA A5
.:FF48 B4 C9 06 D0 E2 20 22 F3
.
```

Because this function is important and probably will be used more than the others, it is worth detailed study. The first block of four Hex digits, 0340, is the machine address in which the first byte, A2 is stored and the next seven bytes on the row are stored in consecutive addresses with the last byte, F9, occupying address 0347. The second row is headed by the machine address, 0348, of the first byte, 36, and consequently the address of the last byte, 48, will be 034F. As many blocks of eight byte rows as desired can be displayed but remember that asking for 0340, FFF0 will spew out page after page of scrolling byte patterns because you are asking for all bytes between 0340 and FFF0!

The main use of the M function is that it enables a machine code program to be entered very easily. All we have to do is to expose a block of memory into which the program is to be housed and then simply use the cursor to change the existing bytes to those we want. After keying in a row of new bytes, pressing RETURN will automatically place these in memory, ie, they replace the previous contents.

DISPLAY REGISTER CONTENTS (Function "R"). Type after the prompt, .R

```
### COMMODORE BASIC ###
 31743 BYTES FREE

READY.
SYS1024

B*
     PC  IRQ  SR AC XR YR SP
.;  0401 E62E 32 04 5E 00 F8
.;
```

On pressing RETURN, the contents of the registers are displayed as previously described in the default situation after SYS 1024. This is very useful during debugging bouts because it tells you what was in, say the Accumulator, instead of what you thought was in it.

SAVE PROGRAM ON TAPE (Function "S"). Type after the prompt, .S "BLOGS", 01,XXXX,ZZZZ
This will save on cassette 1, a program called BLOGS, occupying a range of addresses XXXX to ZZZZ. On pressing RETURN the usual PRESS PLAY AND RECORD message will appear. A word of advice here; make a habit of SAVING your program on tape *before* you run it.

```
.S"BLOGS",01,0300,0400
PRESS PLAY & RECORD ON TAPE #1
OK

WRITING BLOGS
```

Why? . . . because, like the writer, you will have bugs in the program and it is possible (in fact highly probable) that the machine will crash causing a furious re-entering exercise accompanied by curses and obscenities. Remember that TIM has no patience with you and lacks the humanity of BASIC.

LOAD PROGRAM FROM TAPE (Function "L"). Type after the prompt, .L "BLOGS",01

```
.L"BLOGS",01
PRESS PLAY ON TAPE #1
OK

SEARCHING FOR BLOGS
```

This will load the program BLOGS from cassette 1 into a block of addresses. Note it is unnecessary to state the addresses because the original SAVE action automatically placed this information on the tape header.

RUN PROGRAM (Function "G"). Type after the prompt, .G XXXX.
This causes the execution of the program starting at the address XXXX. Thus if we type G 033A, the byte stored in address 033A will be the first code to be executed and the machine will carry on executing every succeeding byte until it reaches some kind of "stop" code. The character "G" of course stands for "GO" and is the equivalent of RUN in BASIC.

EXIT TO BASIC (Function "X"). Type after the prompt, .X.

```
B*
     PC  IRQ  SR AC XR YR SP
.;  0401 E62E 32 04 5E 00 DC
.X
READY.
```

This will allow an escape from TIM back to the shelter of BASIC as soon as RETURN is pressed. The familiar READY message appears again.

This table, remember, is in addition to and does not replace the Programming Manual. Another useful aid (before beginning to code) is an address map of the PET screen area giving the addresses of the first character in each line in both decimal and hexadecimal. This will save much tedious conversion exercises; for other machines check your documentation or see our Graphic Details series.

Understanding And Writing Code

Each line of a machine code program is called an INSTRUCTION and normally consists of two parts, the operation code (OP CODE) which tells the machine *what* particular action is required and the OPERAND which tells the machine *where* the data is which requires the action. An instruction therefore has this format:

OP CODE	OPERAND
85	6F

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(both parts in Hex code).85 6F is an example of an instruction which will STORE the contents of the ACCUMULATOR in the address 6F. Don't worry if you can't see why at the moment. First of all, what is an ACCUMULATOR? A computer requires a general purpose storage cell capable of performing various arithmetic and other weird operations on its contents. The majority of the data stored in RAM and ROM must be passed to the accumulator in order to be processed in some way before being returned back. The majority of instruction in the machine code repertoire refer implicitly to the accumulator.

It is capable of holding eight bits (one byte) and is therefore the same "width" as the RAM and ROM memory. Its data content can be specified by two hexadecimal digits. The meaning attached to the bits is whatever the programmer wants them to mean. If the process is arithmetical in nature, then the programmer obviously intends the bits to represent a number. This number will be in the, so-called, "two's-complement" form which will be explained later. At other times, the bits might be an ASCII code for some particular character or perhaps a set of signals for an outside system.

In addition to the accumulator, the 6502 has two registers termed X and Y and which have their main use in "IN-

6502 PROGRAMMING COURSE

3 AD LDA	2 A9 LDAIM	2 A5 LDAZ	2 B5 LDAZX	3 BD LDAX	3 B9 LDAY	TRANSFER
3 8D STA		2 85 STAZ	2 95 STAZX	3 9D STAX	3 99 STAY	
3 6D ADC	2 69 ADCIM	2 65 ADCZ	2 75 ADCZX	3 7D ADCX	3 79 ADCY	ARITHMETIC
3 ED SBC	2 E9 SBCIM	2 E5 SBCZ	2 F5 SBCZX	3 FD SBCX	3 F9 SBCY	
3 2D AND	2 29 ANDIM	2 25 ANDZ	2 35 ANDZX	3 3D ANDX	3 39 ANDY	LOGICAL
3 0D ORA	2 09 ORAIM	2 05 ORAZ	2 15 ORAZX	3 1D ORAX	3 19 ORAY	
3 4D EOR	2 49 EORIM	2 45 EORZ	2 55 EORZX	3 5D EORX	3 59 EORY	
3 0E ASL	1 0A ASLA	2 06 ASLZ	2 16 ASLZX	3 1E ASLX		SHIFT ROTATE
3 4E LSR	1 4A LSRA	2 46 LSRZ	2 56 LSRZX	3 5E LSRX		
3 2E ROL	1 2A ROLA	2 26 ROLZ	2 36 ROLZX	3 3E ROLX		
3 6E ROR	1 6A RORA	2 66 RORZ	2 76 RORZX	3 7E RORX		
3 EE INC		2 E6 INCZ	2 F6 INCZX	3 FE INCX		+1
3 CE DEC		2 C2 DECZ	2 D6 DECZX	3 DE DECX		-1
3 CD CMP	2 C9 CMPIM	2 C5 CMPZ	2 D5 CMPZX	3 DD CMPX	3 D9 CMPY	COMPARE
3 AE LDX	2 A2 LDXIM	2 A6 LDXZ	2 B6 LDXZY	1 CA DEX	3 BE LDXY	
3 8E STX		2 86 STXZ	2 96 STXZY	1 E8 INX		X
3 EC CPX	2 E0 CPXIM	2 E4 CPXZ				
3 AC LDY	2 A0 LDYIM	2 A4 LDYZ	2 B4 LDYZX	3 BC LDYX		
3 8C STY		2 84 STYZ	2 94 STYZX	1 88 DEY		Y
3 EC CPY	2 C0 CPYIM	2 C4 CPYZ		1 C8 INY		

2 10 BPL	2 30 BMI	2 70 BVS	2 50 BVC	2 90 BCC	2 B0 BCS	2 D0 BNE	2 F0 BEQ	CONDITION BRANCHES
1 18 CLC	1 38 SEC	1 58 CLI	1 78 SEI	1 B8 CLV	1 D8 CLD	1 F8 SED		PROCESSOR STATUS REGISTER
3 4C JMP	3 6C JMPI	3 20 JSR	1 60 RTS	1 40 RTI	1 00 BRK	1 EA NOP		JUMPS
1 AA TAX	1 8A TXA	1 A8 TAY	1 98 TYA	1 BA TSX	1 9A TXS			REGISTER TRANSFERS
1 48 PHA	1 68 PLA	1 08 PHP	1 28 PLP					STACK POINTER
3 2C BIT	2 24 BITZ							BIT TEST
2 A1 LDAIX	2 81 STAIX	2 61 ADCIX	2 E1 SBCIX	2 21 ANDIX	2 41 EORIX	2 01 ORAIX	2 C1 CMPIX	INDEXED INDIRECT (PRE-INDX)
2 B1 LDAIY	2 91 STAIY	2 71 ADCIY	2 F1 SBCIY	2 31 ANDIY	2 51 EORIY	2 11 ORAIY	2 D1 CMPIY	INDIRECT INDEXED (POST-INDX)

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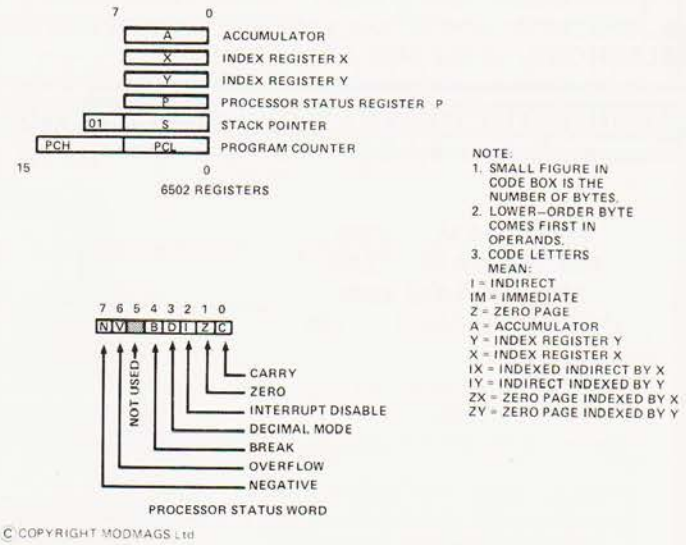
The 6502 Assembly Codes and what they do.



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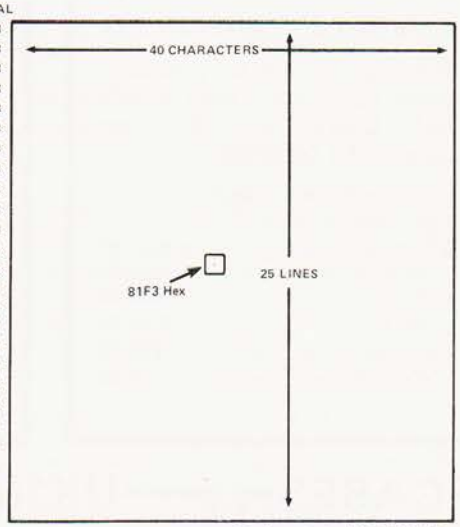
The 6502 registers and status word and their functions.

LINE	ADDRESSES HEX	DECIMAL
1	8000	32768
2	8028	32808
3	8050	32848
4	8078	32888
5	80A0	32928
6	80C8	32968
7	80F0	33008
8	8118	33048
9	8140	33088
10	8168	33128
11	8190	33168
12	81B8	33208
13	81E0	33248
14	8230	33288
15	8230	33328
16	8258	33368
17	8280	33408
18	82A8	33448
19	82D0	33488
20	82F8	33528
21	8320	33568
22	8348	33608
23	8370	33648
24	8398	33688
25	83C0	33728



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The PETs screen memory map.

DEXED" addressing (to be explained later) but can also serve as registers (but not capable of such sophisticated operations as the accumulator).

An important register used to indicate the current status of the machine is the "Processor Status Register". It is not a register in the usual sense of being a data storage device. Each bit is a "flag", signalling the processor in a "yes/no" fashion — such things as overflow, carry out, negative number etc. Its primary use is during BRANCH IF type operations.

The Stack-pointer is another special register used to point to an address in a bunch of memory addresses called the "STACK".

The PROGRAM COUNTER is the most important register in the machine. Its current contents is the address of the *next* instruction to be executed and it is the only register which is 16 bits wide (two bytes).

All the registers are included at the bottom of the Machine Code Table.

Examples: 4th Character position on line 17 has the address 8283 Hex;33411 Dec.
Middle of screen is line 13 + 19 = 81E0 + 13 Hex = 81F3 Hex = 33248 + 19 = 33267 Dec.
The APPLE and ITT 2020 Text Page is schematically the same but the addresses start at 0400 Hex (1024 Dec) instead of 8000 Hex.

At this point we'll take a breather. Our next foray into the world of machine code will deal with the various addressing modes that allow you to decide how and where you are going to store your information and programs.

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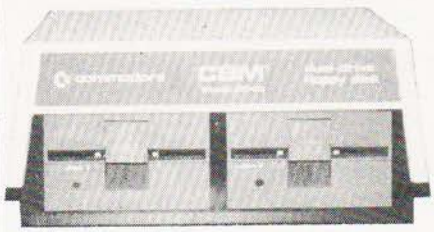

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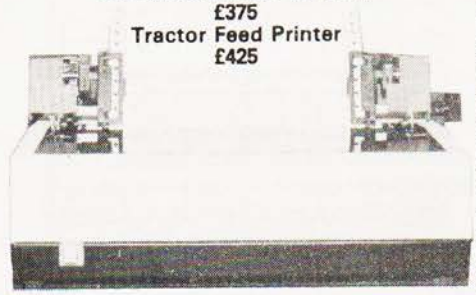

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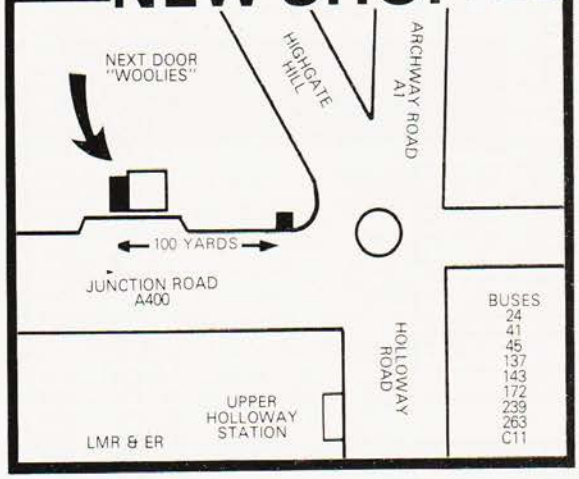

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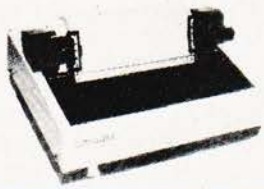

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SUPERSCRIPT

SuperScript is a series of machine language programs which will permanently customise Tandy's Scripsit to a user's own requirements, particularly as to his printer. It also adds a number of enhancements to the original Scripsit program. The program includes a number of features which we do not have space to list here, but the three principal ones are that the user can now access the Disk Directory from within SuperScript, listing all files and the number of free granules on the diskette. Files can be killed from within SuperScript so as to make extra space to fit in a large text file. The third and perhaps the most important enhancement is to permit almost any printer to be used with Scripsit. It includes eight driver routines for both serial and parallel printers and these include utilities to enable the user to sculpture a customised serial or parallel driver to his own particular requirements. If your printer will backspace then underlining and slashed zeroes are options. Dedicated drivers in the package are for Diablo parallel and serial, NEC5330 parallel and serial and two general purpose drivers.

Disk for minimum single drive 32K machines **£19.50**

DUEL-N-DROIDS

A "second generation" Android Nim. Leo Christopherson has done it again! Two androids battle it out before your eyes with laser swords! There are two forms of play. In the first the player controls one android and the computer the other. The player must achieve a certain rank of skill as a swordsman to enable the android to go on to fight a tournament. The player's android is controlled by four keys and the higher the rank that the player can attain the better the chance that his android will beat the computer when it enters the tournament. Tournaments are of two types. In one, the player's android is pitted against an equally ranked android controlled by the computer. In the other the player's android fights against androids controlled by the computer of random ranking. Android Nim by Christopherson created something of a revolution in microcomputer games and Duel-N-Droids follows on in this same tradition. Excellent sound is provided in the program.

Tape version 16K TRS-80 or video genie .....**£9.50**, Disk version 32K one drive **£12.50**

BASKETBALL

Another highly graphically orientated machine language action game with sound. Each game lasts four minutes and either two players take part or one player plays the computer. The graphics are based on a three dimensional depiction of a basketball court on which there are two players. One is controlled by each human player if two are playing, or when a human player plays against the computer the home player is controlled by the computer. The appeal of the game is its realism. The court player may be controlled in one of four directions, may dribble and shoot for the basket. The player who scores the most baskets in the four minutes of play wins the game.

Tape version 16K TRS-80 or video genie .....**£9.50**, Disk version 32K one drive **£12.50**

QUAD

Quad is three dimensional noughts and crosses. As its name implies, it is played on a cube of four layers each with four ranks. Like noughts and crosses the aim of the game is to get crosses or noughts in a line either horizontally, vertically or diagonally. The cube is depicted graphically on the VDU and either two players may take part or a single player may play the computer. Four levels of difficulty are provided and a time clock is also included for each move. A particularly important feature of the game is that the cube on which the game is played may be rotated so that the player can see it from a different angle. A number of commands are provided including setting up previous positions, backing up to a previous position, progressing to the next position, reversal of order of play and switching of opponents. This is a complex game of strategy in which the player will need all of his skills.

Tape version 16K TRS-80 or video genie .....**£9.50**, Disk version 32K one drive **£12.50**

CODE BREAKER

Code Breaker is a logic game with sound effects. It is not necessary to describe this program in great detail because it is essentially a computer adaptation of the well known logic game Mastermind. The object of the game is to determine with as few moves as possible the colours and positions of four secret code pegs. For each move the colour and position of four pegs is chosen and the response of the computer is with a black, white or pink peg in respect of each position of the player's peg. These three colours have different meanings and from their positioning it is possible to logically deduce the position of the hidden pegs. The program features sound effects and a graphic layout of the code pegs.

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COMPUTER GOLF

Leonard Keighley

A golf game simulation written in Standard BASIC suitable for use on almost any micro. It'll also save you a fortune in lost balls!

Golf — that game played by out-of-condition executives in search of the nineteenth hole. Does it summon up visions of people pushing a little white ball round a large area of waterlogged grass in the pouring rain? Because, if so, we have found an answer. A full eighteen-hole course with all the usual obstacles, but without the rain, and you can have all this in the comfort of your own, private nineteenth hole — your living room.

This implementation, which even allows you to program in your favourite course, is written in as near 'Standard BASIC' as possible and has been proved on a Honeywell mainframe.

Playing Equipment

You are provided with a bag of clubs containing three woods, a set of irons from number two to number nine and a second set of irons which may be used at less than full strength. When you reach the Green you will automatically be given a Putter. The clubs are coded in the following way.

Woods; 1 = Driver, 2 = Brassie,
3 = Spoon (full strength swing only)
Irons; 12 = Two iron, ... 19 = Nine iron (full swing only)
Irons; 22 = Two iron, ... 29 = Nine iron (partial swing)

When you use a partial swing iron you will be asked for the percentage strength that you require, this must be a number between 1 and 99. Your handicap must also be within the PGA rules limits of 0 to 30.

On reaching the green you will be asked for the potency of your putt, this must be a number greater than zero and the bigger the number the farther the ball will go. As a rough guide 0.2 is one foot.

Conversion Possibilities

Providing that your computer's version of BASIC can handle arrays you should have absolutely no trouble at all in implementing this game on your system. Indeed, anyone who has an Extended BASIC can probably enhance the program very considerably by using strings, ON . . GOTOs etc. Really ambitious types can even have a go at putting graphics into it.

Program Listing

```
0450 DIM L(10)
0460 LET X=2
0470 LET N=.8
0480 LET S2=0
0490 LET F=1
0500 PRINT "WHAT IS YOUR HANDICAP";
0510 INPUT H
0520 IF H>30 THEN 1100
0530 IF H<0 THEN 1100
0540 IF H>9 THEN 570
0550 PRINT "OH-OH, A HOT SHOT!"
0560 GOTO 590
0570 IF H>20 THEN 590
0580 PRINT "ANYONE FOR TENNIS?"
0590 PRINT "DIFFICULTIES AT GOLF INCLUDE:"
0600 PRINT "0=HOOK, 1=SLICE, 2=POOR DISTANCE, 4=TRAP
     SHOTS, 5=PUTTING"
0610 PRINT "WHICH (ENTER ONLY ONE) IS YOUR WORST";
0620 INPUT T
0630 IF T>5 THEN 590
0640 IF T<0 THEN 590
0650 LET S1=0
0660 FOR Z=1 TO ((H+1)/(T+1))*10
0670 LET R=RND(0)
0680 NEXT Z
0690 LET L(0)=0
0700 LET J=0
0710 LET Q=0
0720 LET S2=S2+S1
0730 LET K=0
0740 IF F=1 THEN 910
0750 PRINT "YOUR SCORE ON HOLD"F-1" WAS"S1
0760 IF S1>P+2 THEN 810
0770 IF S1=P THEN 830
0780 IF S1=P-1 THEN 850
0790 IF S1=P-2 THEN 870
0800 GOTO 910
0810 PRINT "KEEP YOUR HEAD DOWN."
0820 GOTO 910
0830 PRINT "A PAR. NICE GOING."
0840 GOTO 910
0850 PRINT "A BIRDIE, AND TWEET-TWEET TO YOU."
0860 GOTO 910
0870 IF P=3 THEN 900
0880 PRINT "A GREAT BIG EAGLE."
0890 GOTO 910
0900 PRINT "A HOLE IN *O*N*E*  LUCKY"
0910 IF F=19 THEN 2760
0920 LET S1=0
0930 PRINT
0940 IF S1=0 THEN 2550
0950 IF L(0)<1 THEN 2090
0960 LET X=0
0970 IF L(0)>5 THEN 2130
0980 PRINT "SHOT WENT"D1" YARDS - IS"D2" YARDS FROM
     HOLE."
0990 PRINT "BALL IS"INT(O)" YARDS OFF LINE IN ";
1000 GOSUB 1020
1010 GOTO 1240
1020 IF L(X)=1 THEN 1120
1030 IF L(X)=2 THEN 1140
1040 IF L(X)=3 THEN 1160
1050 IF L(X)=4 THEN 1180
1060 IF L(X)=5 THEN 1200
1070 IF L(X)=6 THEN 1220
1080 PRINT "OUT OF BOUNDS."
1090 GOTO 2700
1100 PRINT "PGA RULES HANDICAP = 0-30"
1110 GOTO 500
1120 PRINT "FAIRWAY."
1130 GOTO 2700
1140 PRINT "ROUGH."
1150 GOTO 2700
1160 PRINT "TREES."
1170 GOTO 2700
1180 PRINT "ADJACENT FAIRWAY."
1190 GOTO 2700
1200 PRINT "TRAP."
1210 GOTO 2700
1220 PRINT "WATER."
1230 GOTO 2700
1240 PRINT
1250 PRINT "WHAT CLUB DO YOU WANT";
1260 INPUT C
1270 PRINT
1280 IF C<1 THEN 1370
1290 IF C>29 THEN 1370
1300 IF C>4 THEN 1400
1310 IF L(0)<5 THEN 1430
1320 IF C=14 THEN 1430
1330 IF C=23 THEN 1430
1340 GOTO 1370
1350 LET S1=S1-1
1360 LET W=1
1370 PRINT "YOU MADE BOO-BOO.  THINK!"
1380 PRINT
1390 GOTO 1240
1400 IF C<12 THEN 1370
```

```
1410 LET C=C-6
1420 GOTO 1310
1430 LET S1=S1+1
1440 LET W=1
1450 IF C>13 THEN 1770
1460 IF F/3=INT(F/3) THEN 1720
1470 IF C<4 THEN 1490
1480 GOTO 1500
1490 IF L(0)=2 THEN 1580
1500 IF S1>7 THEN 1610
1510 LET D1=INT(((30-H)*2.5+187-((30-H)*.25+15)*C/2)+25*
     RND(0))
1520 LET D1=INT(D1*W)
1530 IF T=2 THEN 2110
1540 LET O=(RND(0)/.8)*(2*H+16)*ABS(TAN(D1*.0035))
1550 LET D2=INT(SQR(O↑2+ABS(D-D1)↑2))
1560 IF D-D1<0 THEN 1630
1570 GOTO 1650
1580 PRINT "YOU DUBBED IT."
1590 LET D1=35
1600 GOTO 1540
1610 IF D<200 THEN 2240
1620 GOTO 1510
1630 IF D2<20 THEN 1650
1640 PRINT "TOO MUCH CLUB. YOU ARE PAST HOLE."
1650 LET B=D
1660 LET D=D2
1670 IF D2>27 THEN 1900
1680 IF D2>20 THEN 2040
1690 IF D2>.5 THEN 2060
1700 LET L(0)=9
1710 GOTO 2430
1720 IF S2+Q+(10*(F-1)/18)<(F-1)*(72+((H+1)/.85))/18 THEN
     1740
1730 GOTO 1470
1740 LET Q=Q+1
1750 IF S1/2<>INT(S1/2) THEN 1860
1760 GOTO 1580
1770 PRINT "PERCENT FULL SWING";
1780 INPUT W
1790 LET W=W/100
1800 PRINT
1810 IF W>1 THEN 1350
1820 IF L(0)=5 THEN 2230
1830 IF C=14 THEN 1500
1840 LET C=C-10
1850 GOTO 1500
1860 IF D<95 THEN 1580
1870 PRINT "BALL HIT TREE - BOUNCED INTO ROUGH"D-75"
     YARDS FROM HOLE."
1880 LET D=D-75
1890 GOTO 1240
1900 IF O<30 THEN 2090
1910 IF J>0 THEN 2090
1920 IF T>0 THEN 1980
1930 IF (S2+1)/15=INT((S2+1)/15) THEN 1990
1940 PRINT "YOU HOOKED-";
1950 LET L(0)=L(2)
1960 IF O>45 THEN 2020
1970 GOTO 940
1980 IF (S2+1)/15=INT((S2+1)/15) THEN 1940
1990 PRINT "YOU SLICED-";
2000 LET L(0)=L(1)
2010 GOTO 1960
2020 PRINT "BADLY."
2030 GOTO 940
2040 LET L(0)=5
2050 GOTO 940
2060 LET L(0)=8
2070 LET D2=INT(D2*3)
2080 GOTO 2320
2090 LET L(0)=1
2100 GOTO 940
2110 LET D1=INT(.85*D1)
2120 GOTO 1540
2130 IF L(0)>6 THEN 2210
2140 PRINT "YOUR SHOT WENT INTO WATER."
2150 LET S1=S1+1
2160 PRINT "PENALTY STROKE ASSESSED. HIT FROM PREVIOUS
     LOCATION."
2170 LET J=J+1
2180 LET L(0)=1
2190 LET D=B
2200 GOTO 1240
2210 PRINT "YOUR SHOT WENT OUT OF BOUNDS."
2220 GOTO 2150
2230 IF T=3 THEN 2260
2240 LET D2=1+(3*INT((80/(40+H))*RND(0)))
2250 GOTO 2320
2260 IF RND(0)>N THEN 2300
2270 LET N=N*.2
2280 PRINT "SHOT DUBBED, STILL IN TRAP."
2290 GOTO 1240
2300 LET N=.8
2310 GOTO 2240
2320 PRINT "ON GREEN"D2" FEET FROM PIN. PUTT POTENCY
     NUMBER:";
2325 PRINT
2330 INPUT I
2340 PRINT
2350 LET S1=S1+1
2360 IF S1+1-P>(H*.072)+2 THEN 2430
2370 IF K>2 THEN 2430
2380 LET K=K+1
2390 IF T=4 THEN 2500
2400 LET D2=D2-T*(4+2*RND(0))+1.5
2410 IF D2<-2 THEN 2520
2420 IF D2>2 THEN 2470
2430 PRINT "YOU H*O*L*E*D IT"
2440 PRINT
2450 LET F=F+1
2460 GOTO 690
2470 PRINT "PUTT SHORT."
2480 LET D2=INT(D2)
2490 GOTO 2320
2500 LET D2=D2-T*(4+RND(0))+1
2510 GOTO 2410
2520 PRINT "PASSED BY CUP."
2530 LET D2=-D2
2540 GOTO 2480
2550 READ D,P,L(1),L(2)
2560 P2=P2+P
2570 PRINT
2580 PRINT "READY TO GO? (0=NO, 1=YES)"
2590 INPUT R
2600 IF R=0 THEN 2760
2610 PRINT
2620 PRINT "YOU ARE ON THE TEE OF HOLE"F", DISTANCE"D"
     YARDS, PAR"P
2630 PRINT "ON YOUR RIGHT IS ";
2640 LET X=1
2650 GOSUB 1020
2660 PRINT "ON YOUR LEFT IS ";
2670 LET X=2
2680 GOSUB 1020
2690 GOTO 1240
2700 RETURN
2710 DATA 361,4,4,2,389,4,3,3,206,3,4,2,500,5,7,2
2720 DATA 408,4,2,4,359,4,6,4,424,4,4,2,388,4,4,4
2730 DATA 196,3,7,2,400,4,7,2,560,5,7,2,132,3,2,2
2740 DATA 357,4,4,4,294,4,2,4,475,5,2,3,375,4,4,2
2750 DATA 180,3,6,2,550,5,6,6
2760 PRINT
2770 PRINT "TOTAL SCORE FOR"F-1" HOLES WAS"S2
2780 IF F<>19 THEN 2800
2790 P2 = P2+P
2800 PRINT"PAR FOR" F-1 "HOLES IS" P2-P
2810 END
```

The Sinclair ZX80 is innovative and powerful. Now there's a magazine to help you get the most out of it.

Get in sync

SYNC magazine is different from other personal computing magazines. Not just different because it is about a unique computer, the Sinclair ZX80 (and kit version, the MicroAce). But different because of the creative and innovative philosophy of the editors.

A Fascinating Computer

The ZX80 doesn't have memory mapped video. Thus the screen goes blank when a key is pressed. To some reviewers this is a disadvantage. To our editors this is a challenge. One suggested that games could be written to take advantage of the screen blanking. For example, how about a game where characters and graphic symbols move around the screen while it is blanked? The object would be to crack the secret code governing the movements. Voila! A new game like Mastermind or Black Box uniquely for the ZX80.

We made some interesting discoveries soon after setting up the machine. For instance, the CHR$ function is not limited to a value between 0 and 255, but cycles repeatedly through the code. CHR$ (9) and CHR$ (265) will produce identical values. In other words, CHR$ operates in a MOD 256 fashion. We found that the "=" sign can be used several times on a single line, allowing the logical evaluation of variables. In the Sinclair, LET X=Y=Z=W is a valid expression.

Or consider the TL$ function which strips a string of its initial character. At first, we wondered what practical value it had. Then someone suggested it would be perfect for removing the dollar sign from numerical inputs.

Breakthroughs? Hardly. But indicative of the hints and kinds you'll find in every issue of **SYNC**. We intend to take the Sinclair to its limits and then push beyond, finding new tricks and tips, new applications, new ways to do what couldn't be done before. **SYNC** functions on many levels, with tutorials for the beginner and concepts that will keep the pros coming back for more. We'll show you how to duplicate commands available in other Basics. And, perhaps, how to do things that can't be done on other machines.

Many computer applications require that data be sorted. But did you realize there are over ten fundamentally different sorting algorithms? Many people settle for a simple bubble sort perhaps because it's described in so many programming manuals or because they've seen it in another program. However, sort routines such as heapsort or Shell-Metzner are over 100 times as fast as a bubble sort and may actually use less memory. Sure, 1K of memory isn't a lot to work with, but it can be stretched much further by using innovative, clever coding. You'll find this type of help in **SYNC**.

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Applications and software are the meat of **SYNC**. We recognize that along with useful, pragmatic applications, like financial analysis and graphing, you'll want games that are fun and challenging. In the charter issue of **SYNC** you'll find several games. Acey Ducey is a card game in which the dealer (the computer) deals two cards face up. You then have an option to bet depending upon whether you feel the next card dealt will have a value between the first two.

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A P Stephenson

We take a close and detailed look at Commodore's bid for the small business market. Can a £3000 system really compete in this field? Read on and find out.

This system consists of a new microcomputer bearing the series number 8000, a new, dual-drive flopy disc unit providing over 1 Mb of non-volatile storage (8050), an intelligent tractor feed printer (3020) and supporting software. Although primarily aimed at the small businessman it should be equally valuable in science, education and even "home" situations. Commodore Business Machines are showing signs of embarrassment with their original choice of names. The hitherto famous and friendly word "PET" no longer appears on the front panel of their models. Perhaps they have made deeper inroads into the small business, workshop and educational fields than they originally estimated and now feel "PET" is a name lacking in prestige. It would appear they are fighting a battle because even their latest brainchild has been cheekily dubbed the "Super PET" by magazines, advertisers and trade journals.

The correct title of this machine is simply "MODEL 8032" which is a compound of the "8000" series and the internal RAM capacity of 32K. All this equipment was not mine unfortunately, it just happened that the Editor of CT gave me the opportunity of reviewing the system. In one respect it is nice to have the loan of such an expensive box of tricks for a while without having to pay considerable amounts of cash per day to hire it. Against this however, is the pain of parting with it because, contrary to the teachings of our famous bard, . . . parting is *not* such "sweet sorrow". In this case, parting will be downright painful because I must say immediately that, subject to some reservations, the system is impressive.

The Big Box

The first box opened was of course the SuperPET (sorry, the 8032). Superficially, the appearance is that of the rest of the traditional PET stable, a mixture of modernity and ancient Egyptian, the most obvious difference being the larger Sphinx-like head. After a preliminary examination for superficial damage, the machine was plugged in and the 230 volt AC fuel supply injected. Expecting to find after a few seconds that familiar little message concerning the number of bytes free, it was frightening to stare at a solitary exclamation mark bang in the middle of the screen. After a very short time, even *this* suddenly vanished and the screen took on an impassive, almost sullen air of nothingness. Switching off and on again several times produced a marginally improved response in the form of the machine code monitor display. Again this vanished after about five seconds to give way to a screen full of colons and asterisks. Resisting the desire to clout the wretch with a five pound hammer (which I keep specially for such occasions) I tried typing "X" which normally returns you to BASIC, but to no avail. It did, however, respond to "M XXXX,ZZZZ" which indicated that at least the machine code monitor appeared to be working and so it was considered a possible line of attack to view the contents of addresses C000 Hex onwards where the BASIC interpreter normally resides in the traditional models. Nothing but streams and streams of AA bytes!. Even to my impoverished mental equipment the symptoms would indicate a defective ROM (or ROMs). Opening up the innards displayed the row of ROM chips (socketed fortunately) on the right hand side of the board. After switching off the supply, the ROMs were gently eased up at one end and pushed back again (which often removes a dust or grease spot). The emergency operation finished, the abdominal cavity was then closed and life support reactivated. The patient responded immediatly by outputting the following text on the screen:

```
***commodore basic 4.0***
31743 bytes free
ready
```

The familiar flashing cursor completes the message which is all in lower case, exactly as shown.

Not being used to lower case, I pushed the shift-lock down and entered the line 100 A = 250 and then RUN. This produced a syntax error and confirms the first major difference in the Super PET which is, it powers up in lower case and the BASIC will not accept commands in upper case. For traditional PET owners, they may be relieved to know that 'POKE 59468,12' will still operate and allow coding to take place in upper case 'POKE 59468,14' will produce a reversion back to the new "norm".

With regard to the screen display, there are three major differences. There are now 80 characters on a line and the screen is 12" diagonally which gives an effective screen display of 9.5" by 7.5" approx. The characters are slimmer because there are twice as many characters on the line but the tube is *not* twice as big. The effect is good from an aesthetic viewpoint. The character font includes a row of blank dots (if you see what I mean) at the bottom, which provides neat separation between lines. This, I believe, is a truly major improvement. A complete page of text on traditional PETs could only effectively occupy 13 lines unless you were prepared to put up with atrocious overcrowding. If we bear this in mind, the SuperPET is not only 80 characters wide (double the usual) but a full, usable, 25 lines deep. So much for the screen, now the keyboard.

The keyboard layout is similar in most aspects to an ordinary office typewriter which is only to be expected in a machine primarily designed for business. The top row of keys are the numerics and are duplicated on a separate eleven-key pad to the right of the main board with the zero-key which is double width, (these keys have *no* alternative shifted characters). There are the usual cursor controls, a SHIFT key on either side and a SHIFT LOCK. A welcome addition is a REPEAT key which paints a stream of characters until released and operates on all characters

including the cursor controls and the space bar.

Another innovation is a key marked ESCAPE which literally allows you to escape from that infuriating condition which results from trying to move the cursor after a single quote has been typed. Previously, the only way way out was a RETURN and start again or punching a dummy closing quote. Typists will also appreciate the new TAB key which allows the pre-setting of column positions, particularly when entering data. It is worth mentioning that the CLEAR/HOME key has been repositioned only two keys away from the SHIFT. Since these two keys are frequently used in conjunction there is no longer the agony of strained tendons after a bout of keyboard bashing. The REVERSE/OFF key is still present in its original position, enabling characters to be printed in reverse highlights but the expected facility of slowing up the display during LIST with this key produced no effect. This function, found by trial and error, resides in the key marked ← which is extreme left hand, top row. Holding this down slows a LISTing down to two lines per second in both the shifted and unshifted positions. There is still no "RESET" facility and a system crash is still a surgical emergency, necessitating a short sharp shock to the Power switch. This is not a criticism because we must again bear in mind that the machine is primarily intended for business use. A RESET key can be highly dangerous when operating professional, non-crashable (?) software. The mechanincal feel of the keyboard is the same; very positive and a tiny bit "clangy" which to delicate 'Establishment' ears may be a trifle irksome. Personally, I like a bit of a clang . . . provides a tactile and aural indication that you still have enough energy to operate the keys! Finally, a nice little extra; a pleasant tinkle escapes from the machine (a piezo electric transducer) when the cursor reaches six characters from the edge of the screen.

The User's Guide

Before continuing with further details of the hardware it would be appropriate to mention the instruction manual which arrived with the machine. It is entitled "User's Guide" and presents a modern, glossy, professional appearance. Alas, study of the contents leads to the depressing conclusion that the cover is indeed the best part. From a purely literary viewpoint it is faultless . . . not a split infinitive or an incorrect tense anywhere. It is a most beautifully written piece of non-information and should arouse envy in most diplomatic circles of the Foreign Office. It is little more than a sales brochure and, remarkably, devotes most of its pages to the description of the floppy disc and the printer. The SuperPET itself is treated in a most perfunctory manner but does include an example "program" which includes the astoundingly complex lines,

```
1 print "Hello!"
2 print"I am your new CBM."
3 print" So long for now."
run
```

It is amazing that Commodore can produce such excellently designed products but continues to ignore the wave of criticism directed at their supporting documentation. But still, we must be thankful this time . . . they have at least improved the cover!

The Operating System

There have been two previous operating systems. The first which controlled the original 8K model with the small calculator-type keyboard was known as "Revision 2.0" and, later, by the somewhat disparaging title of "Old ROM" to distinguish it from the "New ROM" or "Revision 3.0". Both of them were *almost* software compatible except for annoying discrepencies in POKE numbers. The SuperPET has yet another version, the "Revision 4.0" which awaits a colloquial title . . . perhaps the "Super New ROM"?

There is a warning in the "User's Guide" regarding a change in some POKE numbers, but no hint whatsoever of the details of these changes. There are no details either of the pointer locations in pages zero, one and two so it must be left to the usual enterprising few to dig out the list from the Commodore boffins. Perhaps "The SuperPET Revealed" may soon be on the bookshelves of the high street microcomputer shops. I have written to Commodore for some of the more guarded secrets buried in the (Super)ROM. The BASIC interpreter is still Microsoft's (as far as I know) but enhanced by a group of commands relating to floppy disc transactions. SAVE and LOAD still relate to tape transfers, DSAVE and DLOAD are the corresponding commands relating to floppy disc transfers. Thus the command DSAVE"BLOGS",D1 will save the program named BLOGS on Drive No 1 of the dual drive unit. DLOAD"BLOGS",D0 will load the program BLOGS from drive No 0. This is an improvement as far as the operator is concerned since it is unnecessary to define the IEEE device number (8). The disc directory can be obtained (without destroying the existing program in RAM) by typing DIRECTORY or the short form DI.

The set of benchmark tests defined in Henry Budgett's article which appeared in a recent edition of CT were tried out. The timings for all tests showed there is no significant speed advantage in the SuperPET. The microprocessor is still the old and faithful 6502 and there are one or two other "old faithfuls" as well. We *still* get the message "out of data error" when the RETURN falls through READY although it is a change to see it in lower case. STEP 0.1 in a FOR/NEXT loop *still* outputs a stream of unrounded nines when it feels like it. By the way, there is no pi function key which is the cue to discuss the graphic facilities.

There is no hint from the keys that graphics exist at all but 'POKE 59468,12' reveals that a SHIFT spews out the familiar little lines and squiggles. The key/character match is the same as before except that the graphics normally

The keyboard layout is similar to the existing types but with some extra functions and no graphics ledgends.

available on the top row are confiscated (by the numerics). The graphics normally coexisting with the separate numeric keypad are also banished from the repertoire. Nevertheless, the popular graphics are still available even if there are two snags in using them. The characters are not engraved on the keys, to avoid trial and error guessing games you will have to use stick-on labels. Secondly, as a direct consequence of the inherent gap between text lines mentioned previously, vertical lines can no longer be joined up. Programs with such lines written for traditional PETs will appear as broken lines but still quite pleasant. Finally, the Machine-code Monitor (TIM) resides in its old home at SYS 1024 and appears to offer the same facilities.

Software Compatibility

Programs written in BASIC during the pre-Super era appear to operate successfully on the new machine . . . at least mine do. There are, however, a few irritations. Firstly, text displays only inhabit the left-hand half of the screen although some parts of a program may wander at times into the vacant half. To quote an example, a subroutine to print a border round the screen using POKE characters with 32768 would bend round too early and the second half appear reversed on the right half of the screen. This is nothing to do with change of POKE numbers (fortunately) and it is simply a consequence of the 80 character screen width, easily corrected by changing a constant. It would be fair to mention that my programs are fairly straightforward and are relatively free from operating system POKEs. I subscribe to the belief that an opeating system should be tolerated, defects as well. POKEing pointer locations to "improve" a system may give short term advantages but are a headache to modify and certainly kill off any pretence of portability. Perhaps the best test of compatibility was an ASSEMBLER program I wrote (in BASIC) which did use a few POKEs and a few more PEEKs. This ran perfectly, so it is safe to conclude that whatever changes there are in the Revision 4.0 ROM they are minor in character. It is advisable to add the line POKE 59468,12 to the top of previous programs to restore the upper case and graphic characters and to remember that some of them are missing in the new PET.

Hardware Details

Superficially, there are no staggering changes in the appearance of the insides. The single board holding the chips looks much the same as in previous models but this applies to most circuit boards in this "high-technology" age. Rows and rows of black rectangles with the occasional lonely resistor to break the monotony. The RAMs are the usual 16K by one and are socketed, they are the well tried 4116 species. The ROMs are on the rights, five in all, and socketed. Two spare ROM sockets are provided, both looking a little sad from being unemployed. Let's hope the Toolkit will give one of them something to do. I lacked the courage to remove my own and try it out in the spare position . . . probably would have worked, but in the absence of specific knowledge it could have damaged the SuperPET or, even worse, damaged my £47 Toolkit!

There are five 40 pin sockets which house the 6502 microprocessor and the various input/output chips. The keyboard, tube electronics and power supply lines are each separately socketed for easy maintenance. As with all PET versions, there is ample space for servicing under the bonnet.

The communications with the outside world are as before. An "unintelligent" parallel user port . . . very useful if you know how to make it tick. An intelligent general purpose standardised bus system known as the IEEE 488 on which up to fourteen peripheral devices can be "daisy-chained". Each of these can be individually controlled and, in some cases, can control the others. The floppy disc and printer plug straight into this bus. A tape recorder plug is also provided on the board itself although this will entail opening up the bonnet. A large edge connector is available at the side for expanding the memory.

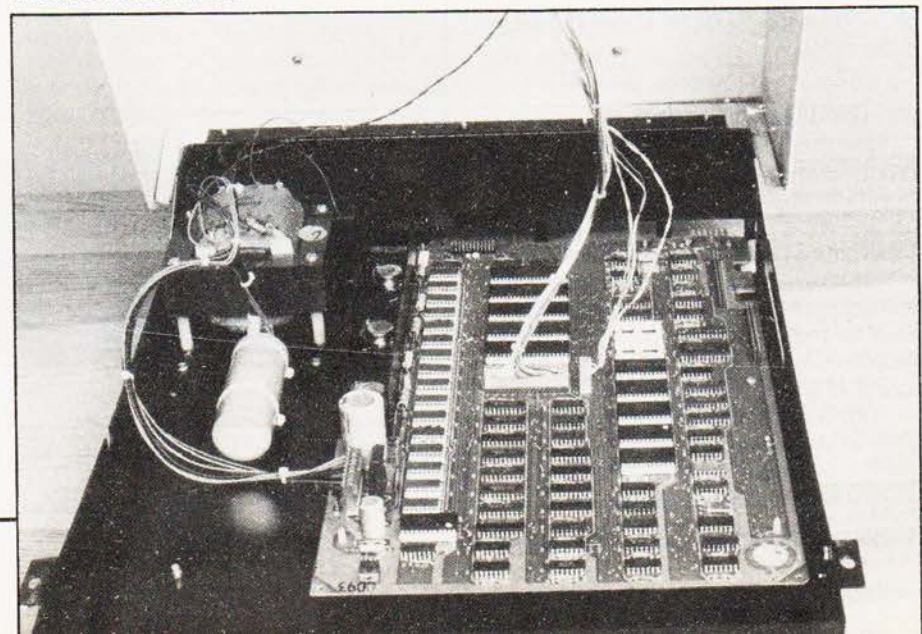
The upper compartment housing the screen and associated electronics is very nicely laid out and clean in appearance. Removal of two screws at the back enables the entire surround to be lifted off giving excellent accessibility. For those who wish to risk forfeiting their guarantee and are confirmed twiddlers, there are three horizontally mounted preset potentiometers beneath the tube and a little left of central. Looking from the back and reading from left to right they function as SYNC, VERTICAL LINEARITY and VERTICAL HEIGHT respectively. The width of the display can be adjusted by rotating a slug inside a coil which is wrapped around a plastic tube mounted vertically. It is located beneath and to the right of the tube connection socket. The picture is centred by rotating any one of two metal plates which surround the tube neck. It must be emphasised, however, that the above description of the adjustments has *not* been obtained from authoritative documents. They are the result of cautious twiddling and noting the effects. Remember that adjustments to presets should *NEVER* be carried out using an ordinary metal screwdriver . . . several thousand volts are lurking around and can take an agonising bite out of unprotected flesh!

Conclusions

An impressive machine in most respects with superb editing facilities. The introduction of the 80 column display is a major improvement and will probably become the norm for the coming generation of microcomputers. Modern accountants seem to want multiple columns for displaying the results of their cooking, with each column occupying several character positions plus decimal points and spaces.

Of all the factors which could influence the businessman (and indeed any other group of would-be purchasers) reliability outshadows them all. In this

The internal appearance of the 8032 is neatly ordered and board/component removal should not be difficult in the case of failure.



respect, the previous models of the PET family (except perhaps the very earliest) have been of proven quality. The teaching establishment where I am employed has been using a number of them for almost two years in the most appalling, anti-computer environment. Blackboard chalk, cigarette ash, coffee drippings, the untrained fingers of irreverent youth, the trained but equally lethal fingers of enraged teachers, should all combine towards hospitalisation of any box of delicate electronic equipment. But none of them have ever shown the slightest frown on their flat green faces. The new SuperPET is built on the same lines, in fact, apart from the increased screen width, the internal hardware is practically indistinguishable from its forebears. As far as the computer hobbyist is concerned, it must be a personal decision whether the financial loss of a trade-in is justified by the pleasure of gazing at an extra forty characters pre line. There may, of course be further sophistication which, because of the lack of information in the "User's Guide" I have been unable to comment upon in detail. Since beginning the writing of these notes, I have learned from CT that a separate manual on the programming details for this machine is available from Commodore but this is .... wait for it .... an OPTIONAL extra! (£10.00 Ed) Without being disrespectful to the firm, this is tantamount to buying a car, only to learn that the carburettor is an "optional extra". Nevertheless, I like the Super PET and wish I could afford to trade-in my present "microscreen" version for one. And yet ... perhaps I should wait another year or so in case a Super (Super) PET is launched with *truly* revolutionary improvements. The good old 6502 is, let's face it, beginning to show its age and like other micros of the first generation (even the "powerful" Z80) must eventually become a Senior Citizen of the silicon age.

The 8050 Dual Floppy Disc Unit

Although the computer has provisions for using a tape cassette as backing store it is not a practical device for business use. The 8050 has several advantages over the earlier 2040 and 3040 models. Each disc (or, more correctly, diskette) is the standard 5¼" diameter and can store a total of 533,248 bytes, so the total on-line capacity of both drives is, for all practical purposes, one million bytes (a byte equates to a character from a storage viewpoint). Businessmen who may not be familiar with computer jargon should be aware of applying simple arithmetic to these figures. For example, if we assume that one record (such as the typical inventory with items quantities, locating, re-order limits, cost and selling value etc) consumes say 200 bytes, arithmetic suggests that 5000 such records could be stored .... 1,0000,000/200. Unfortunately there are a considerable amount of overheads or "invisible exports" associated with disc storage and it would be wise to assume only half this number would be nearer to the mark. The actual percentage of "waste" depends mainly on the quality of the controlling software rather than deficiencies in the disc drives.

There are 77 tracks per disc with an average of 27 blocks per track, the outer tracks having a greater block density than the inner tracks in order to preserve a reasonably constant packing density when recording. A total of 224 files (program or data) can be individually named and displayed when the disc DIRECTORY is asked for. The number of blocks per file, the type of file and the total number of free blocks remaining on the disc always appears in the DIRECTORY display for the drive. The right-hand drive is called "drive 0" and the left "drive 1". A disc is simply pushed in the drive slot (after power has been applied) until it clicks. The immediate response is a gentle purr which lasts for about three seconds indicating that the disc is being INITIALISED. This is one of the improvements in the 8050 over previous versions ... initialisation of the disc is automatic on insertion instead of requiring a keyboard command string. The door mechanism has also been improved.

Removal of two screws allows the cover to be opened and hinged backwards. Apart from the two drives there are two circuit boards crammed with the usual chips. There are two microcomputers (6502 variety), one for the drive control functions and the other for the computer interface via the IEEE bus. Also fighting for recognition is a 6530 I/O chip with on-board RAM and ROM, two 6532s, etc etc. A total of 4K of RAM is shared by both controller and interface sections. This is an impressive armament of silicon intelligence and we should expect a correspondingly high system performance. The sophistication it offers is undeniable, it is not the easiest of systems to program but this seems to be a law of nature ... the inevitable trade off between ease of operation and versatility.

The new floppy drive appears to have conquered some of the earlier reliability problems.

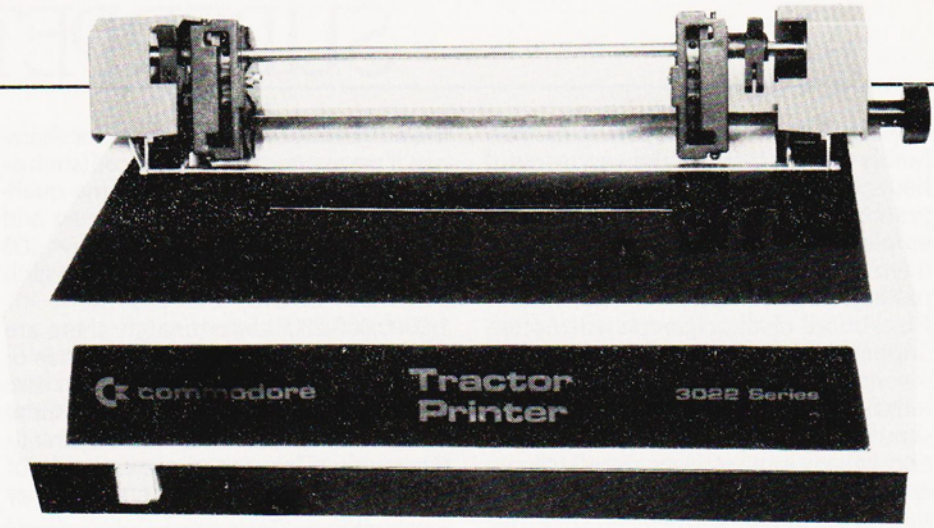
Disc Reliability

The effects of overheating which sometimes plagued the 2040 and, to a lesser extent, the 3040 appear to be absent in the 8050. I have left it running many hours a day and, remarkably, have never had a read or write error except from the result of my own mistakes. However, the mains transformer and the fiery voltage regulators are positioned on the left hand side which, theoretically, should cause drive 1 to be the least reliable. The top ventilation holes are potentially dangerous for coffee drinkers; an overturned cup would stream straight down on to an unprotected circuit board directly beneath ... but of course no one would *dream* of resting a cup there!

Each drive has its own green light which turns on during motor activity and sometimes when the channel is open without the drive running ... I have not quite fathomed out the exact significance (needless to say, there is no hint in the "manual"). During data transfers, the middle light often flickers between red and green, which although not indicative of an error condition, is vaguely disturbing if (like me) you have a worrying nature. Great emphasis is made in the manual on the danger of switching the power on when a disc is in position but no mention of why! Is it because of a mains spike degrading the recorded data

or is it the more serious danger of damaging the drive mechanism? If the latter, then it is highly dangerous for the possibility to be allowed to arise . . . even the most careful of us can have a momentary lapse in attention. A microswitch could surely be incorporated to prevent power-on conditions should a disc inadvertantly be left in. All computer equipment should cater for both amateur and professional idiots. There is one other rather important point to watch when initially connecting up the 8050 and the printer to the IEEE bus. There are two IEEE interconnecting cables and it is worth emphasising that the 8050 *must* be the first one in the chain, ie, the cable which fits into the back of the PET must be the one which connects directly to the disc. I wonder why these cables cost £25 each? It would be boring at this point to go systematically through all the disc command syntax. The form of this syntax is, to put it as kindly as possible, long winded. Fortunately, for general purpose direct commands a disc unit arrives with a program called "TEST/DEMO" which, amongst other things, includes a program with the strange title of "UNIVERSAL WEDGE" although, surprisingly, when it is loaded it announces itself as "UNIVERSAL DOS SUPPORT". Once this program has been RUN, it hides itself out of the way of the working area until the machine is switched off. Direct disc commands are now refreshingly simple and make disc transfers easy enough for a child to operate. Another advantage of BASIC 4.0 is the ease of loading the *first* program on a disc in drive 0. Simply hold the SHIFT down and press RUN/STOP . . . no typed command is necessary. Thus if the UNIVERSAL WEDGE program is copied first on all discs (as a matter of habit) it can be used without effort. The symbol " > ' ' is now used to direct commands to the DOS SUPPORT. For example, the directory can be obtained by typing > $ 0 for drive 0 or > $ 1 for drive 1. The directory is placed in screen memory so it does not effect an existing program in RAM. With similar ease, RENAME, COPY, SCRATCH operations can be performed on disc files. Programs can be loaded and run by typing ↑ followed by the program name. There is, however, a restriction. DOS SUPPORT can only be used in the direct command mode and will not accept program lines. This means a reversion back to normal syntax.

There have been several DOS versions, each presumably offering improvements on the previous, but there may be a slight penalty to pay for them.



Commodore's tractor printer. Simple but effective for general use.

For example, discs previously formatted on the earlier 2040 model will not load when used on the 8050. This should be restated . . . I have not managed to do so up to now although it is quite possible that some way exists. It is not too serious a problem anyway, because tape copies of a disc on the 2020 can be saved on cassette and reloaded back onto the 8050 formatted disc.

The Commodore 3022 Printer

This is an established member of the Commodore range and, as such, cannot very well be "reviewed". It does however complete the trio of the business system hardware and merits some attention. The 3022 is an "intelligent" device and, like the disc unit, has an impressive array of ICs including its own microprocessor. The printing rate is about 70 lines per minute and like most impact printers is a shade on the noisy side although a silencing cover can be obtained. The printing head has a 6x7 character font which gives adequate resolution for all general office work except sales brochures. The feed is a tractor type and handles standard 8½" computer fanfold. The printer operates under the IEEE 488 protocol (jargon for 'plug it in to the existing daisy chain'). When using the OPEN file to printer, the device is No. 4. To print out a LISTing, use OPEN 1,4:CMD 1 : LIST. CMD causes the computer to treat the printer as the primary output device rather than the video display. As with the disc unit, the in-built sophistication adds a little to the programming task.

Software Packages

Software, to the business person, is more important than the hardware. Some will write their own programs tailored towards their specific needs, providing they have the time, energy, know-how and the right temperament. Most will have to rely on ready-made programs from one of the numerous "software houses". Most of the programs arrive as a disc plus supporting documentation describing the operating procedures. A bewildering array of programs are available covering the needs of most aspects of business and accounting and management. Many of them are good but some are absolute rubbish, hardly worth pushing into the drive slot. Cost and quality are not necessarily related. The trouble with many of the ready-made programs is their generality. However "general" purpose, there will inevitably be a certain area in which a particular business exhibits unique features and thus is not covered by the program. The criteria used to assess the worth of a program should include ease of operation. In fact this quality should over-ride most of the remaining virtues. However sophisticated the program, it will cease to be used if it has cumbersome operating procedures demanding the attention of a highly trained operator. Training costs time and, therefore, money which few small businessmen can afford.

A stack of professional software arrived with the equipment but the time limit imposed on its return prevented detailed examination of it all. In any case, some of it was specialised and my lack of expertise in the field of business management would not allow me to make judgements of any value. However, there was one particular program which, because of its complete generality, deserves to be included at the top of any list of software purchases. This program is called "OZZ. THE INFORMATION RETRIEVAL WIZARD".

The title lacks dignity and because of the Walt Disney associations would be likely to dissuade some buyers who may be cursed with a sober nature. Apart from the choice of title I thought the pro-

gram was magnificent and although I have not yet discovered the price, it will probably be worth every penny of it! (£400.00 including training Ed.) It was a delight to operate and the accompanying documentation was superb. Basically, it is a program for entering records of any description and retrieving any one of them in a second or so. The particular format of a record is first "drawn" by the operator (quite easy) and the resultant skeleton stored on disc. These formats can be of any form and could be provided quickly (a few minutes only) . . . this is a one-off job anyway. The following is a typical example of such a format:

```
                STUDENT                    RECORD

NAME    |                              | COURSE  |                          |

Age  |     | Marital status  |     | Sex |    | Occupation  |                |

STUDENT NUMBER  |              | Fees owing  |     .   | Behaviour |            |

        SUBJECT                          RESULT

MATHEMATICS    Phase 1                    |    |
MATHEMATICS    Phase 2                    |    |          FINAL   GRADE
ELECTROMAGNETICS                          |    |          |            |
ELECTRONICS                               |    |
SERVOMECHANISMS                           |    |
DIGITAL COMPUTERS                         |    |
SYSTEMS                                   |    |

                AVERAGE    MARKS  |    |
```

```
                STUDENT                    RECORD

NAME    | Snibbleshank  Silas P        | COURSE  | Electronic Systems  412  |

Age  |  32 | Marital status  | Mar | Sex | M  | Occupation  | Unemployed      |

STUDENT NUMBER  |     1235066 | Fees owing  |   23.00 | Behaviour | Excellent |

        SUBJECT                          RESULT

MATHEMATICS    Phase 1                    | 82 |
MATHEMATICS    Phase 2                    | 67 |          FINAL   GRADE
ELECTROMAGNETICS                          | 82 |          |            |
ELECTRONICS                               | 85 |
SERVOMECHANISMS                           | 92 |
DIGITAL COMPUTERS                         | 32 |
SYSTEMS                                   |    |

                AVERAGE    MARKS  |    |
```

A total of ten different named files are allowed per disc with each file holding perhaps several hundred records. The number of records per file and the number of files collectively determine the disc capacity . . . you can of course serialise files on different discs. All the usual record keeping facilities are available plus some powerful extras. Some idea of the repertoire can be gained by studying the following printout of the menu:

SHORT FORM	FUNCTION	PAGE
AR	AMEND RECORD	76
C	CALCULATE	33
CS	COPY SCREEN	77
DR	DELETE RECORD	76
DM	DISPLAY MEMORY	46
EA	EXECUTE AUTO	67
EO	EXIT OZZ	79
FS	FILE STATUS	77
FI	FINISH PRINTOUT	67
FF	FORMAT NEW FILE	12
FP	FORMAT PRINTOUT	48
GC	GET CALC PROGRAM	45
GP	GET PRINT FORMAT	58
GR	GET RECORD	26
H	HELP	08

OZZ PROGRAM OPTIONS

SHORT FORM	FUNCTION	PAGE
IR	INSERT RECORD	23
LF	LIST FILE	61
NR	NEXT RECORD	29
P	PRINTOUT	63
PR	PRIOR RECORD	29
RC	RUN CALC PROGRAM	45
SR	SEARCH FILE	30
SF	SELECT FILE	22
SA	SET ANALYSIS	70
SC	SET CALC PROGRAM	42
UR	UPDATE RECORD	76
VD	VERIFY DATABASE	78
ZM	ZERO MEMORY	46

Above: Some typical displays produced by OZZ together with the 'MENU' of functions.

Left: The complete system ready to go.

Final Summary

The complete system consisting of the Super PET, 8050 floppy disc, the printer an OZZ *should* provide a powerful aid to any business venture and, subject to the choise of extra software, *should* pay for itself quickly. With regard to cost, there should still be some change out of £3000 even if extra sofware is required. There are other systems of equal merit and value on the market but it is probable that within this kind of price bracket, there are not many of them which can boast such a range of software from so many sources and on such diverse subjects.

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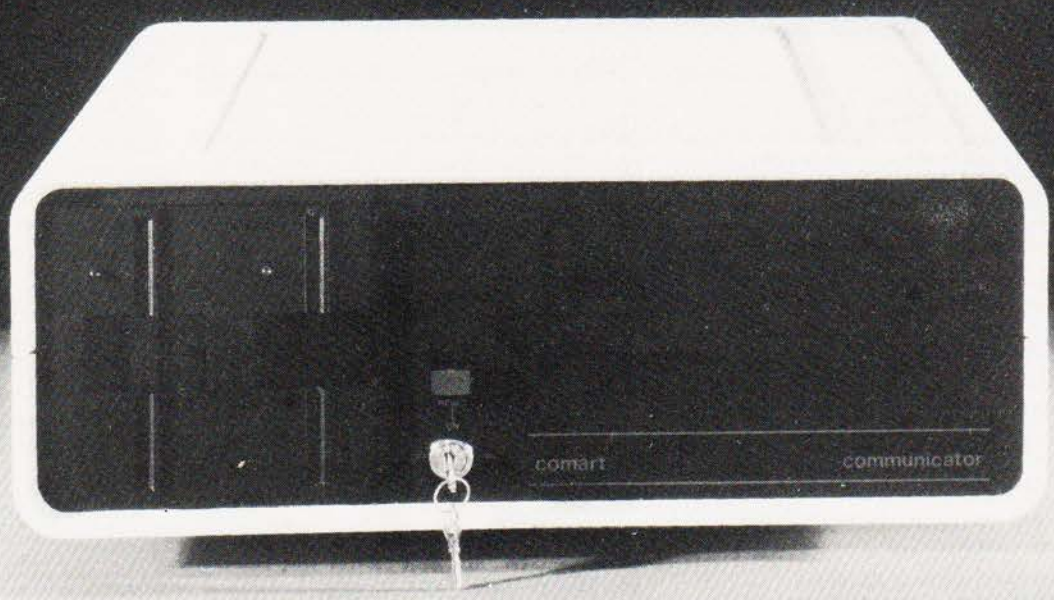

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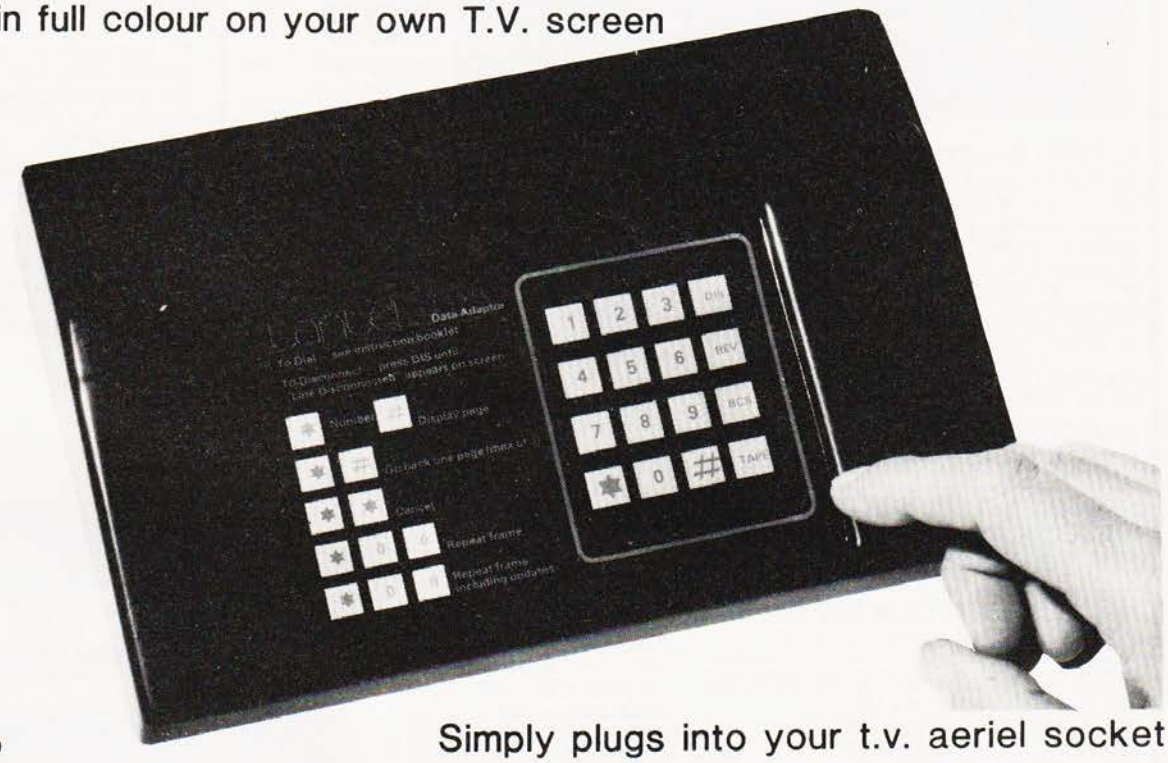

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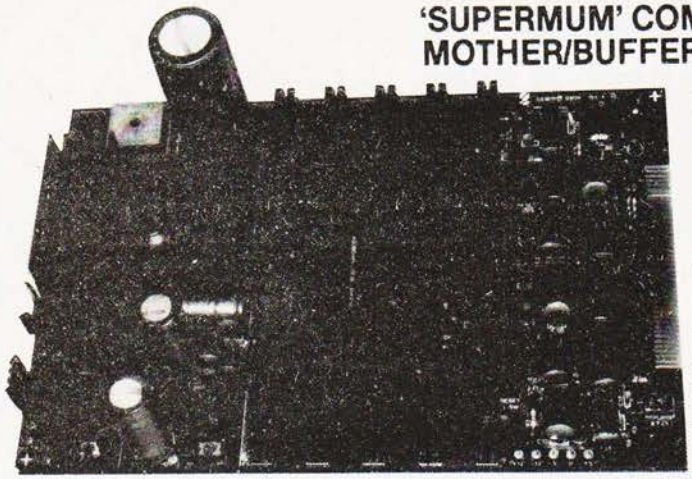

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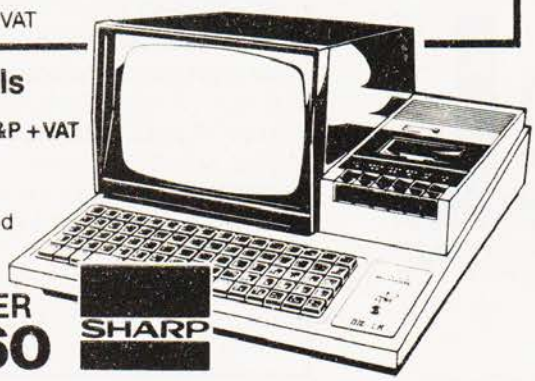

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CATCH

I Soutar

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Program Listing

```
 1   RANDOMISE
 2   LET B=16
 4   LET A=6
 6   LET M=0
 8   LET P=0
10   LET W=0
12   LET D=0
14   LET C=0
20   LET Z=-1
25   GOSUB 700
30   FOR I=1 TO 9
40   PRINT , , , ,
50   NEXT I
52   GOSUB 700
60   GOSUB 500
70   POKE W + 181, 20
80   LET Z = Z + 1
90   INPUT C
100  GOSUB 500
110  GOSUB 600
120  POKE M,0
130  IF C=6 AND A<10 OR C=7 AND A>1 THEN LET A=A-2
     * C + 13
140  IF C=5 THEN LET B=B-1
150  IF C=8 THEN LET B=B+1
160  GOSUB 600
170  IF PEEK (M)=128 THEN GOTO 400
180  POKE M, 20
190  LET D=RND(4)
195  IF A=10 AND D=4 OR A=1 AND D=3 THEN GOTO 190
200  LET D=(D=1)-1*(D=2)+33*(D=3)-33*(D=4)
210  GOSUB 500
220  GOSUB 600
230  POKE M + D, 128
240  GOTO 80
400  CLS
410  PRINT "YOU LASTED FOR" ; Z ; "MOVES"
499  STOP
500  LET P=PEEK(16397)
510  IF P>127 THEN LET P=P-256
520  LET W=PEEK(16396)+P*256
530  RETURN
600  LET M=W+(A-1)*33+B
610  RETURN
700  FOR I=1 TO 32
710  PRINT CHR$ (128);
720  NEXT I
730  RETURN
```

NASCOM TITLES

A C Ellis

Preserve yours with this simple routine

It was recently brought to my attention by a fellow NASCOM owner that if you wish to keep your program title on the screen, then any use of the CLS (CLear Screen) command will remove it. The two obvious ways around the problem are to write a subroutine that puts the title back or to use the screen in scrolling mode so that the top line remains in place

An alternative method is to use this simple machine code routine, actually a modification of part of the NAS-SYS monitor. The routine is called from BASIC by a USR and effectively re-joins the monitor at the end of its CLS function. The routine is written into RAM from location 0C80H and is not affected by a BASIC cold start. The starting address for the USR is transferred by the single BASIC statement DOKE 14100, 3200. For those unfamiliar with NASCOM, omission of this command will result in the dreaded FC error. As a check to this you should find that the command has loaded addresses 1004 and 1005 with 80H and 0CH respectively.

Program Listing

```
0C80   F5          PUSH AF
0C81   21 0A 08    LD HL, 1st line
0C84   E5          PUSH HL
0C85   06 30       LD B, (30H)
0C87   36 20  CR1  LD (HL),30H
0C89   23          INC HL
0C8A   10 FB       DJNE CR1
0C8C   06 10       LD B, (10H)
0C8E   36 00  CR3  LD (HL),0
0C90   23          INC HL
0C91   10 FB
0C93   EB          EX DE,HL
0C94   E1          POP HL
0C95   E5          PUSH HL
0C96   01 70 03    LD BC
0C99   ED B0       LD IR
0C9B   C3 74 01    Re-enter CLS routine at 'Home cursor'
                   stage.
```

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Using the 6522 PIO to generate regular interrupts proves a quick and efficient way to produce a real-time clock display.

The following program allows you to run a real-time clock on your MICRON, or Microtan 65 if you have Tanex. It is written for a system configured with the minimal 2K of RAM installed on Tanex but can easily be relocated to suit the amount of memory you have. The functions of the computer can be used almost as normal without disrupting the clock display which is produced in the top left-hand corner of the VDU.

The only keyboard functions which will affect the clock are RESET, LOAD, SAVE or the use of the XBUG translator or assembler. These small sacrifices are not *that* drastic as the clock would normally be used as a reference in a program and initialised from this.

Implementation

The software makes use of the timer built into the 6522 I/0 device of the Tanex. This timer can be programmed to give continuous, regular interrupts which can be serviced by a short machine code routine and used to update the clock display.

A minor problem is that the keyboard is itself interrupt driven and a check must be made to establish what caused the interrupt. Fortunately the 6522 has an interrupt flag register which can be polled to establish which device caused the interrupt.

It is important to note that the first actions taken by any interrupt service routine is to save the curent values of the accumulator and the two index registers, just as its last action is to restore them. This prevents any apparent change in the main program although a slight decrease in speed might be noticeable. The processor's status word is automatically saved by the CPU on detecting an interrupt.

The Software

The main program, when called by the timer, increments the memory location 'A' and then checks to see if the total is 50. The time interval between interrupts is set at 20 mS so there are 50 interrupts per second. When 'A' has reached 50 it is cleared and location 'B', the seconds counter, is incremented. The process continues which minutes, 'C', and hours, 'D'. The final program segment places the clock on the screen and updates it at every interrupt, faster than the eye can see, so there should be no visible 'flicker'.

The short set-up program initialises the 6522 to operate its timer in the continuous interrupt mode and sets the interrupt vectors to point to the start of the main program (0B00). The timer is then loaded with the interrupt interval value and started by writing to its 'high' byte.

When using the BASIC the initial 'MEMORY SIZE?' query should be answered with 2816, given that you have only 2K of RAM and haven't re-located the program. It is important to note that the clock uses BCD so when initialising its time under BASIC you must also use this form. For example the time 12:25:15 would appear as 18:37:21 when coded by the program.

Program Re-location

The machine code set-up routine is directly re-locatable so no code changes are needed unless the main program has been moved. If the main program is relocated then the two interrupt vectors will need to be changed to suit the new starting address, the high byte goes in 0006 and the low byte goes in 0005. When BASIC is in use you must obviously restrict the memory so as not to overwrite the program. To set up in BASIC use the program lines given below as the start of your own program, SS = Seconds, MM = Minutes and HH = Hours. The machine code set-up routine should have the last two lines omitted if it is intended to be used as part of another problem because they return the computer to TANBUG.

Program Listing

```
0B00  78        SEI
0B01  48        PHA
0B02  8A        TXA
0B03  48        PHA
0B04  98        TYA
0B05  48        PHA
0B06  AD CD BF  LDA   $BFCD
0B09  29 40     AND   #$40
0B0B  D0 08     BNE   $0B15
0B0D  68        PLA
0B0E  A8        TAY
0B0F  68        PLA
0B10  AA        TAX
0B11  68        PLA
0B12  4C C3 FE  JMP   $FEC3
0B15  F8        SED
0B16  18        CLC
0B17  AD A4 0B  LDA   $0BA4
0B1A  69 01     ADC   #$01
0B1C  8D A4 0B  STA   $0BA4
0B1F  C9 50     CMP   # $50
0B21  F0 02     BEQ   $0B25
0B23  D0 41     BNE   $0B66
0B25  A9 00     LDA   # $00
0B27  8D A4 0B  STA   $0BA4
0B2A  18        CLC
0B2B  AD A3 0B  LDA   $0BA3
0B2E  69 01     ADC   # $01
0B30  8D A3 0B  STA   $0BA3
0B33  C9 60     CMP   $60
0B35  F0 02     BEQ   $0B39
0B37  D0 2D     BNE   $0B66
0B39  A9 00     LDA   # $00
0B3B  8D A3 0B  STA   $0BA3
0B3E  18        CLC
0B3F  AD A2 0B  LDA   $0BA2
0B42  69 01     ADC   # $01
0B44  8D A2 0B  STA   $0BA2
0B47  C9 60     CMP   # $60
0B49  F0 02     BEQ   $0B4D
0B4B  D0 19     BNE   $0B66
0B4D  A9 00     LDA   # $00
0B4F  8D A2 0B  STA   $0BA2
0B52  18        CLC
0B53  AD A1 0B  LDA   $0BA1
0B56  69 01     ADC   # $01
0B58  8D A1 0B  STA   $0BA1
0B5B  C9 24     CMP   # $24
0B5D  F0 02     BEQ   $0B61
```

MICRON CLOCK

```
0B5F  D0 05      BNE   $0B66
0B61  A9 00      LDA   # $00
0B63  8D 01 0B   STA   $0BA1
0B66  A2 03      LDX   # $03
0B68  A0 08      LDY   # $08
0B6A  BD A0 0B   LDA   $0BA0,X
0B6D  29 0F      AND   # $0F
0B6F  69 30      ADC   # $30
0B71  99 00 02   STA   $0200,Y
0B74  88         DEY
0B75  BD A0 0B   LDA   $0BA0,X
0B78  29 F0      AND   # $F0
0B7A  6A         ROR
0B7B  6A         ROR
0B7C  6A         ROR
0B7D  6A         ROR
0B7E  69 30      ADC   # $30
0B80  99 00 02   STA   $0200,Y
0B83  88         DEY
0B84  88         DEY
0B85  CA         DEX
0B86  D0 E2      BNE   $0B6A
0B88  A9 3A      LDA   # $3A
0B8A  8D 06 02   STA   $0206
0B8D  8D 03 02   STA   $0203
0B90  A9 20      LDA   # $20
0B92  8D 00 02   STA   $0200
0B95  A9 40      LDA   # $40
0B97  8D CD BF   STA   $BFCD
0B9A  68         PLA
0B9B  A8         TAY
0B9C  68         PLA
0B9D  AA         TAX
0B9E  68         PLA
0B9F  58         CLI
0B0A  40         RTI
0BA1  00         'D'
0BA2  00         'C'
0BA3  00         'B'
0BA4  00         'A'
```

```
5    POKE 49099,64
10   POKE 5,0:POKE 6,11
15   POKE 49102,192
20   POKE 49094,138
25   POKE 49095,61
30   POKE 49093,61
35   POKE 2979,SS
40   POKE 2978,MM
45   POKE 2977,HH
```

Above: The BASIC control routine.
Below: Controlling the clock in machine code.

```
0BA5  A9 40      LDA   # $40
0BA7  8D CB BF   STA   $BFCB
0BAA  A9 00      LDA   # $00
0BAC  85 05      STA   $05
0BAE  A9 0B      LDA   # $0B
0BB0  85 06      STA   $06
0BB2  A9 C0      LDA   # $C0
0BB4  8D CE BF   STA   $BFCE
0BB7  A9 8A      LDA   # $8A
0BB9  8D C6 BF   STA   $BFC6
0BBC  A9 3D      LDA   # $3D
0BBE  8D C7 BF   STA   $BFC7
0BC1  8D C5 BF   STA   $BFC5
0BC4  A2 FF      LDX   # $FF
0BC6  4C 16 FC   JMP   $FC16
```


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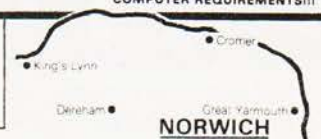

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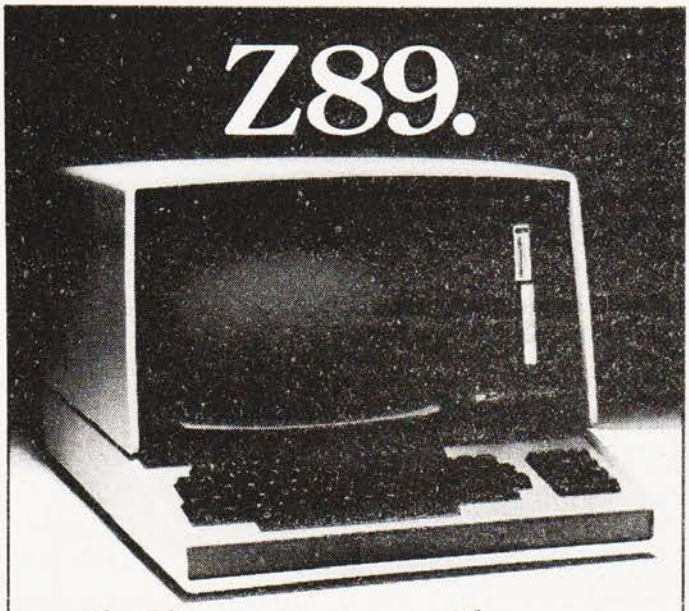

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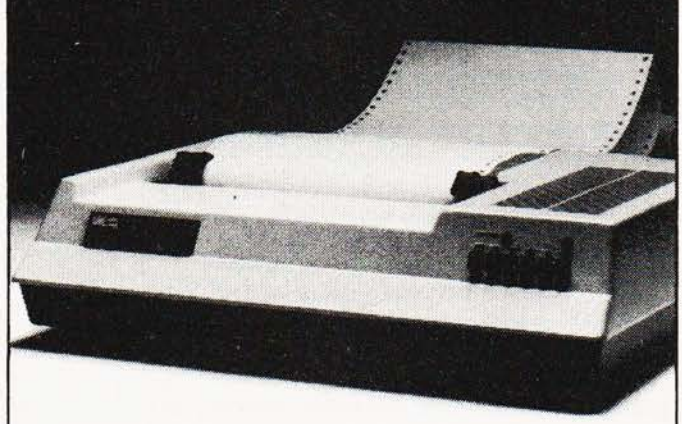

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W S Lounds

Getting the best out of NASCOMs BASIC can be helped by understanding how the computer stores the programs.

This article is intended to give NASCOM owners some insight into how their version of the BASIC Interpreter stores programs. Some programs, both in machine code and BASIC, are given to illustrate the points and a games program is also given that uses a number of the techniques.

Interpretations

As each line of the program is entered the Interpreter searches for keywords, commands such as FOR, THEN etc., and replaces them with a single byte code or 'token'. For example END becomes 80H, GOTO becomes 88H etc. The actual code used depends upon the position of the keyword in a look-up table that is stored in the BASIC ROM from E143H onwards, END is the first entry and MID$ the last. Within this table the keywords are stored in ASCII coded form. However, the first character of the keyword has its most significant bit set allowing the start of each keyword to be easily identified. As an example of this the normal ASCII code for END would be 45 4E 44 but it is actually stored as C5 4E 44. This single byte replacement obviously shortens the program and saves on memory space. When the program is LISTed the full representation of the command is recovered from the look-up table.

Having replaced the keywords, the program line is moved from a temporary storage area, 1061H upwards, to the main program storage area. This starts at location 10F9H and when BASIC is entered through a conventional J command three null bytes (00 00 00) are entered from 10F9H. These indicate the end of the program storage area and are moved up through memory as the program is keyed in.

Each line of the program is preceded by a five byte header. The first byte is a null to mark the boundary between lines, the second and third form a pointer to the start of the *next* line and the final pair are the Hex form of the decimal line number. The following short program is shown as it is stored in RAM.

```
10  A=5
20  B=8
30  PRINT A,B
```

Location	Contents	Meaning
10F9	00	Header
10FA	02	Pointer to next line
10FB	11	
10FC	0A	Line number
10FD	00	(10 in Hex)
10FE	41	A
10FF	B4	=
1100	35	5
1101	00	Newline
1102	0A	Pointer to next line
1103	11	
1104	14	Line number
1105	00	(20 in Hex)
1106	42	B
1107	B4	=
1108	38	8
1109	00	Newline
110A	13	Pointer to next line
110B	11	
110C	1E	Line number
110D	00	(30 in Hex)
110E	9E	PRINT
110F	41	A
1110	2C	
1111	42	B
1112	00	Newline
1113	00	End of program marker
1114	00	

How the short BASIC program is stored in RAM.

Pointing The Way

The pointer given by the 'end of program' marker is 00 00 so when the program is being LISTed, for example, the Interpreter knows that it has found the end. An interesting experiment is to enter the above program and then type, in direct mode, the statement DOKE 3271,4346. Now try to LIST the program and see what happens. What you've done is to set the program pointer to its own beginning by loading locations 1113H and 1114H with address 10FAH. When you escape from the LIST type NEW or DOKE 4371,0 to restore sense.

When you type NEW, or CLOAD, the only effect on the stored program is that the contents of 10FAH and 10FBH are set to 00 so that the end of program marker is at the start of the program storage area. This suggests that there might be a way of restoring 'lost' programs if one could discover the first pointer value. Unfortunately it is not as simple as that because the Interpreter keep its own pointers to the program and data storage tables that follow during a RUN. If we can discover and restore these we can recover a 'lost' program.

This machine code program searches for the first 'end-of-line' marker and then enters the correct value at 10FA. It then continues through the program until it finds the end marker and places the correct pointers for these into BASIC's own workspace. If you are an habitual typer of CLOAD when you really meant CSAVE then this is a vital program to have in your library, it will only work after a NEW or CLOAD and will *not* restore programs after an inadvertent J command. The program can be stored anywhere in 'free' RAM, eg 0C80H and tested by keying it in, going to BASIC and writing a short program followed by NEW. Reset the machine and type E 0C80, you should find that you can now LIST the program.

```
21 FD 10        LD HL 10FD      ;First line proper, -1
23          XX  INC HL          ;
7E              LD A (HL)       ;Get byte into A
B7              OR A            ;Is it zero?
20 FB           JR NZ XX        ;Go back if not
23              INC HL          ;Move HL to correct
22 FA 10        LD 10FA (HL)    ;pointer and load into 10FA
5E          YY  LD E (HL)       ;Get next pointer
23              INC HL          ;into DE register
56              LD D (HL)       ;pair
BA              CP D            ;Is it zero?
EB              EX DE HL        ;Swap HL,DE
20 F9           JR NZ YY        ;If D not zero go back
EB              EX DE HL        ;Get end address back
23              INC HL          ;into HL and move
23              INC HL          ;past zero pointer
22 D6 10        LD 10D6 (HL)    ;Reset BASIC
22 D8 10        LD 10D8 (HL)    ;pointers to
22 DA10         LD 10DA (HL)    ;end of program
C3 FD FF        JP FFFD         ;'Z' start for BASIC
```

Simple machine code program to restore 'lost' BASIC programs.

```
21 00 00          LD HL 0000      ;Set HL to zero
11 0A 00          LD DE 000A      ;Set DE to 10
D9                EXX             ;Save in alternate registers
21 FA 10          LD HL 10FA      ;First pointer address
5E          QQ    LD E (HL)       ;Get next pointer into
23                INC HL          ;DE register pair
56                LD D (HL)       ;
ED 53 XX XX       LD (XXXX) DE    ;Save at a spare address
AF                XOR A           ;Clear A
BA                CP D            ;Is D zero?
CA FD FF          JP Z FFFD       ;If yes then end of program
D9                EXX             ;Retrieve line numbers
19                ADD HL DE       ;Increment count
E5                PUSH HL         ;Save line number
D9                EXX             ;
D1                POP DE          ;Get it back
23                INC HL          ;Then INC HL so that
73                LD (HL) E       ;number can be put
23                INC HL          ;into correct location
72                LD (HL) D       ;
2A XX XX          LD HL (XXXX)    ;Get pointer into HL
18 E6             JR QQ           ;Go back for next
```

Cheap and cheerful renumbering program for BASIC. It takes advantage of the way line numbers are stored by BASIC.

Simple Renumber

The following short program utilises the fact that the line numbers can easily be found in the header. It is a BASIC renumber program. It will only renumber the lines, it makes no attempt to sort out GOTOs and GOSUBs, from 10 in steps of 10. You can locate it anywhere in free RAM, possibly following the above example.

To run the program leave BASIC by a reset or MONITOR command and execute from the start of the machine code program. The value of XX XX must be any location 'safe' to use as a temporary store. Control is returned to BASIC and a LIST will reveal the new numbering. If you wish to alter the step value then change the value stored in DE but bear in mind that there are no safeguards against overflow.

Both programs can be called and loaded from BASIC. The following program will load both of the previous machine code programs and set the BASIC program pointer to 1004H. To test the renumber routine enter the program and RUN it. Now type M=USR(40) and then LIST. You should find that it has renumbered itself. The step value is the 10 in line 32. You can check that the restore function is working by typing NEW, LIST should give you nothing, and then entering the direct command DOKE 4312,16000:DOKE 4314,16000: M=USR(0). Typing LIST should now reveal the program.

Machine Code Subroutines

We can use the NASCOM's powerful Z80 CPU to provide machine code subroutines that speed up BASIC programs. It is quite possible to have more than one such subroutine within a BASIC program, indeed the Roadrace game uses them extensively.

Provided that you load the starting address of your subroutine into location 1004H the routine can be called by the BASIC command USR, eg 150 X=USR(0). The whole of this line is simply saying to the computer 'call the routine whose address is stored at 1004H'. Both the X and the number in the bracket are dummy variables, they don't mean anything, but they *can* be used if you want. The X can bring a value back from the machine code subroutine provided the number was placed in the AB register pair as a signed 16 bit binary number. The NASCOM keyboard scan uses this technique.

The number contained in brackets can provide a very efficient method of selecting one of many machine code routines. The normal method of selection is to change the value that is stored in 4100D (1004H) with a DOKE statement before calling the USR. This method requires two BASIC statements each time you change the routine, but there is a better way. To do this you need to set up a decoder routine pointing at 4100D which can use the number contained in the brackets. The value of this number is loaded into the DE register pair by a subroutine within BASIC itself, located from E98BH. If we load the decoder routine at 0C80H then we must remember to set the location in BASIC by a DOKE 4100,3200.

```
10 FOR J=3200 TO 3206 STEP 2
11 READ A:DOKE J,A:NEXT
12 DATA -29747,8681,3216,-5863
13 REM**THIS SETS DECODER ROUTINE
   AT 0C80H
20 FOR J=3216 TO 3248 STEP 2
21 READ A:DOKE J,A:NEXT
22 DATA -735,8976,-18562,-1248,8739,
   4346
23 DATA 9054,-17834,8427,-5127,8739,
   4310
24 DATA -10206,8720,4314,-3551,-5648
25 REM**THIS SETS UP 'FINDER'
   PROGRAM AT 0C90H
30 FOR J=3256 TO 3290 STEP 2
31 READ A:DOKE J,A:NEXT
32 DATA 33,4352,10,8665,4346,9054
33 DATA -4778,-30637,-20724,-13638,
   -3854
34 DATA 6617,-9755,9169,9075,10866,
   3208,-6632
35 REM**THIS SETS UP RENUMBER
40 DOKE 4100,3200:REM**SET BASIC
   POINTER
```

A BASIC program containing both the 'Finder' and the 'Renumber' routines.

```
0C80    CD 8B E9    CALL E98BH
0C83    21 90 0C    LD HL 0C90H
0C86    19          ADD HL DE
0C87    E9          JP (HL)
```

Multiple machine code routines from BASIC with this decoder.

The routine works by using the number to give the number of bytes after 0C90 that the required routine starts. Thus to call the keyboard scan at 0C90 we would use the statement M=USR(0) which would return 00 00, thus still pointing to 0C90 for the jump instruction. A routine that started at 0CB0 would be accessed by M=USR(32), 0CB0 being 32D bytes after 0C90.

Why have so many machine code routines you may ask? Well, it's far more efficient to handle tasks like printing to the screen in machine code than in BASIC, you may notice that in the Roadrace program there are no PRINTs apart from the text and comments.

All the various routines must end with a controlled return to BASIC, the following four bytes do this;

```
21 F2 F0    LD HL F0F2
E9          JP (HL)
```

Typical advantages gained by using machine code can be seen by looking at the routines at 0C80H, 0C90H, 0CA0H, 0CC0H, 0CE0H and 0D00H.

Remember that when you load the program you should omit all the REMs and check the data very carefully or you might do unpleasant things to your memory!

Program Listing

```
 1 GOSUB 4000:REM**SET UP MACHINE CODE ROUTINES
 2 PRINT"THIS PROGRAM SIMULATES DRIVING ALONG"
 3 PRINT"A ROAD WITH MADMEN COMING THE OTHER
   WAY"
 4 PRINT"YOU STEER LEFT WITH THE N KEY AND RIGHT
 5 PRINT"WITH THE M KEY. YOU HAVE 11 CRASHES
   BEFORE"
 6 PRINT"YOU ARE DISQUALIFIED FROM DRIVING"
 7 PRINT"IF YOU DO CRASH MOVE BACK ONTO THE ROAD"
 8 PRINT"USING THE N AND M KEYS. PRESS S TO RESTART"
 9 PRINT"THE ROAD GETS PROGRESSIVELY NARROWER"
10 PRINT"SO YOU HAVE TO BE CAREFUL!!"
11 PRINT"CHANGE GEAR AT ANY TIME WITH 1 2 AND 3
   KEYS"
21 DOKE 4100,3200:REM**LOAD (ADDRESS OF M/C
   ROUTINES)
25 REM**M=USR(0) CALLS KEYBOARD SCAN
26 PRINT"TOUCH S TO START";
27 M=USR(0):IF M=0 THEN 27
28 IF M<>83 THEN 27
29 REM**A(J) CONTAINS RANDOM BEND DATA
30 DIM A(41)
31 FOR J=2 TO 40 STEP 2:A(J)=INT(14*RND(1)+1)
32 A(J-1)=A(J):NEXT
33 A(41)=-1
38 D=2954
39 A$="CRASH COUNT = 0      GEAR   "
40 REM**PUT TITLE ONTO TOP LINE - UNSCROLLED
41 CLS
42 FOR J=1 TO LEN(A$):SCREEN 10+J,16
43 PRINT MID$(A$,J,1):NEXT
45 T=0:REM**CRASH COUNTER SET TO 0
46 POKE 3053,49:REM**PUT 1 AFTER GEAR ON TOP LINE
47 POKE 3261,25:REM**SET DELAY FOR GEAR 1
50 M=USR(112):REM**CALLS SET UP SCREEN ROUTINE
79 REM**P IS INITIAL CAR POSITION(B,C ROAD SIZE)
80 P=2465:S=64:B=15:C=17:E=-1
90 POKE P,111:R=P:REM**PUT CAR ON SCREEN
91 REM**R REMEMBERS WHERE
95 PRINT"TOUCH S TO START";
96 M=USR(0):IF M=0 THEN 96
97 IF M<>83 THEN 96
98 PRINT CHR$(27);:POKE 4267,0:REM**CLEAR MESSAGE
99 K=0:REM**SET DATA COUNTER FOR BEND NUMBERS
100 K=K+1:A=A(K):REM**GET BEND SIZE INTO A
108 REM**IF AT END OF BENDS RESET AND NARROW
109 REM**THE ROAD. WHEN ROAD REACHES 7 FINISH
110 IF A=-1 THEN K=1:A=A(K):C=C-2:IF C<9 THEN 400
120 FOR I=1 TO A
130 GOSUB 3000:REM**SCAN ROUTINE
150 POKE 3208,B:M=USR(16):REM**PRINT L H BARRIER
160 GOSUB 3000:REM**SCAN
180 POKE 3208,C:M=USR(48):REM**PRINT ROAD
183 REM**GET RANDOM MADMAN ONTO ROAD
184 X=RND(1):IF X>.2 THEN 190
185 Z=D+B+INT(C*RND(1)+1):POKE Z,7
190 GOSUB 3000:REM**SCAN
210 POKE 3208,47-B-C:M=USR(80):REM**R H BARRIER
220 GOSUB 3000:REM**SCAN
239 REM**COVER OLD POSITION, SEE IF CRASH AT NEW
240 POKE R,32:PRINT:IF PEEK(P)<>32 THEN GOSUB 1000
245 POKE P,111:POKE R-S,32:R=P:REM**RESET R
250 B=B+E:NEXT I:REM**DEC/INC BENDS
260 E=-E:REM**SWOP FROM R H TO L H BEND
270 GOTO 100:REM**GO BACK FOR NEXT BEND
400 PRINT"WELL DONE YOU GOT TO THE END OF THE"
410 PRINT"ROAD WITHIN 11 CRASHES"
500 FOR J=1 TO 1000:NEXT
510 PRINT"YOU CRASHED"T"TIMES DO YOU WANT"
520 PRINT"ANOTHER GO";:FOR J=1 TO 1000:NEXT
525 INPUT X$
530 IF X$="YES" THEN 31
535 IF X$="NO" THEN STOP
540 GOTO 525
997 REM**CRASH ROUTINE PUTS ***** AT CRASH
998 REM**INCREASE COUNTER T,PUT NO. ON TOP LINE
999 REM**GET LEFT OR RIGHT MOVE OR GEAR CHANGE
1000 T=T+1:FOR J=-3 TO 3:POKE P+J,42:NEXT
1001 IF T>10 THEN PRINT"TOO MANY CRASHES":GOTO 500
1002 IF T<10 THEN POKE 3042,T+48:GOTO 1010
1003 Q=INT(T/10):V=T-Q*10
1004 POKE 3041,Q+48:POKE 3042,V+48
1010 M=USR(0)
1011 IF M=49 THEN POKE 3261,25:POKE 3053,M:GOTO 1010
1012 IF M=50 THEN POKE 3261,12:POKE 3053,M:GOTO 1010
1013 IF M=51 THEN POKE 3261,1:POKE 3053,M:GOTO 1010
1014 IF M=78 THEN POKE P,32:P=P-1:GOTO 1030
1020 IF M=77 THEN POKE P,32:P=P+1
1025 IF M=83 THEN RETURN
1030 IF PEEK(P)=88 THEN 1000
1035 IF P<2443 OR P>2485 THEN GOSUB 2000
1040 POKE P,111:GOTO 1010
1999 REM**PUT CAR BACK IF TOO FAR TO RIGHT
2000 FOR J=1 TO 47
2010 IF PEEK(2442+J)=32 THEN P=2442+J:RETURN
2020 NEXT J
2999 REM**WHICH KEY PRESSED SUBROUTINE
3000 M=USR(0):IF M=0 THEN RETURN
3005 IF M=78 THEN P=P-1:RETURN
3010 IF M=77 THEN P=P+1:RETURN
3015 REM**IF GEAR CHANGE SET DELAY AND TOP LINE
3020 IF M=49 THEN POKE 3261,25:POKE 3053,M:RETURN
3030 IF M=50 THEN POKE 3261,12:POKE 3053,M:RETURN
3040 IF M=51 THEN POKE 3261,1:POKE 3053,M:RETURN
3050 RETURN
3999 REM**DECODE ROUTINE TO 0C80(H)
4000 FOR J=3200 TO 3206 STEP 2:READ A:DOKE J,A:NEXT
4009 REM**USR(0) ROUTINE SCAN KEYBOARD
4010 FOR J=3216 TO 3226 STEP 2:READ A:DOKE J,A:NEXT
4019 REM**USR(16) ROUTINE (L H 'WALLS')
4020 FOR J=3232 TO 3250 STEP 2:READ A:DOKE J,A:NEXT
4029 REM**USR(48) ROUTINE (ROAD ITSELF)
4030 FOR J=3264 TO 3282 STEP 2:READ A:DOKE J,A:NEXT
4039 REM**USR(80) ROUTINE (R H 'WALLS')
4040 FOR J=3296 TO 3320 STEP 2:READ A:DOKE J,A:NEXT
4044 REM**USR(112) ROUTINE (SET UP SCREEN START)
4045 FOR J=3328 TO 3378 STEP 2:READ A:DOKE J,A:NEXT
4046 RETURN
4049 REM**DATA FOR M/C ROUTINES
4050 DATA -29747,8681,3216,-5863,25311,312
4060 DATA 18351,8623,-3854,2025,-30662,18188
4070 DATA 22590,-30175,30475,4131,8956,3209
4080 DATA -3551,-5648,-30662,18188,8254,-30422
4090 DATA 30476,4131,8956,3209,-3551,-5648
4100 DATA -30662,18188,22590,-30422,30476
4110 DATA 4131,15100,3261,-20665,4351,8701
4120 DATA -3854,8425,2337,4360,16,1542,1733
4130 DATA 13872,9048,-1264,-4103,-3056,2054
4140 DATA 1733,13839,9048,-1264,4358,8246,4131
4150 DATA 1787,13840,9048,-1264,-16103
4160 DATA -6640,-3551,-5648
```

The Roadrace game takes full advantage of the multiple machine code routine trick.

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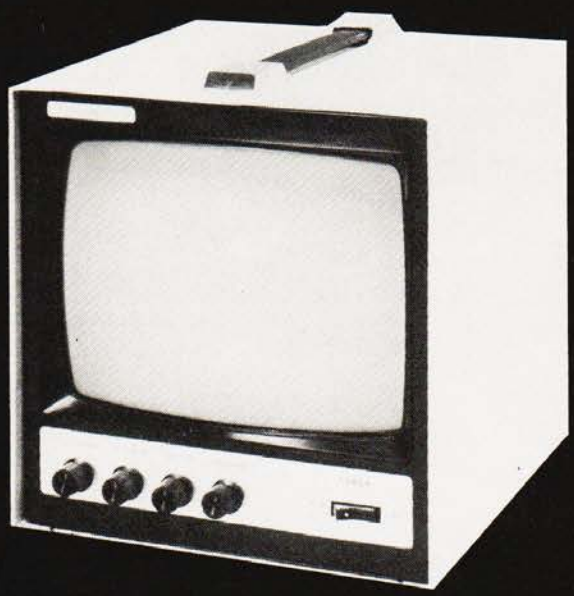

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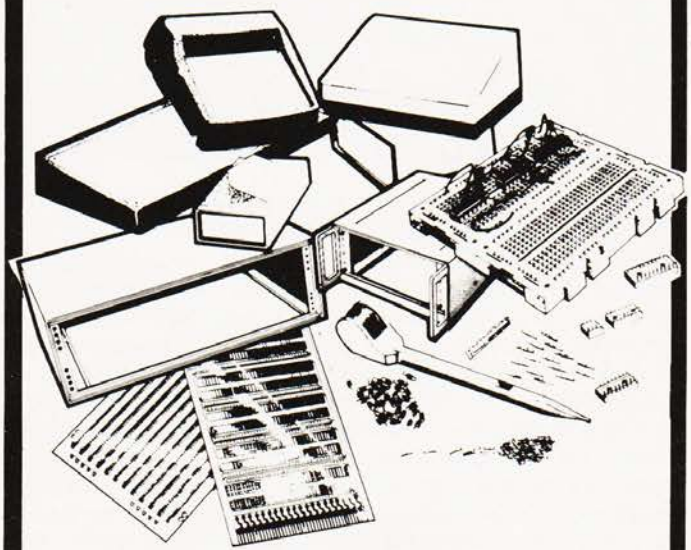

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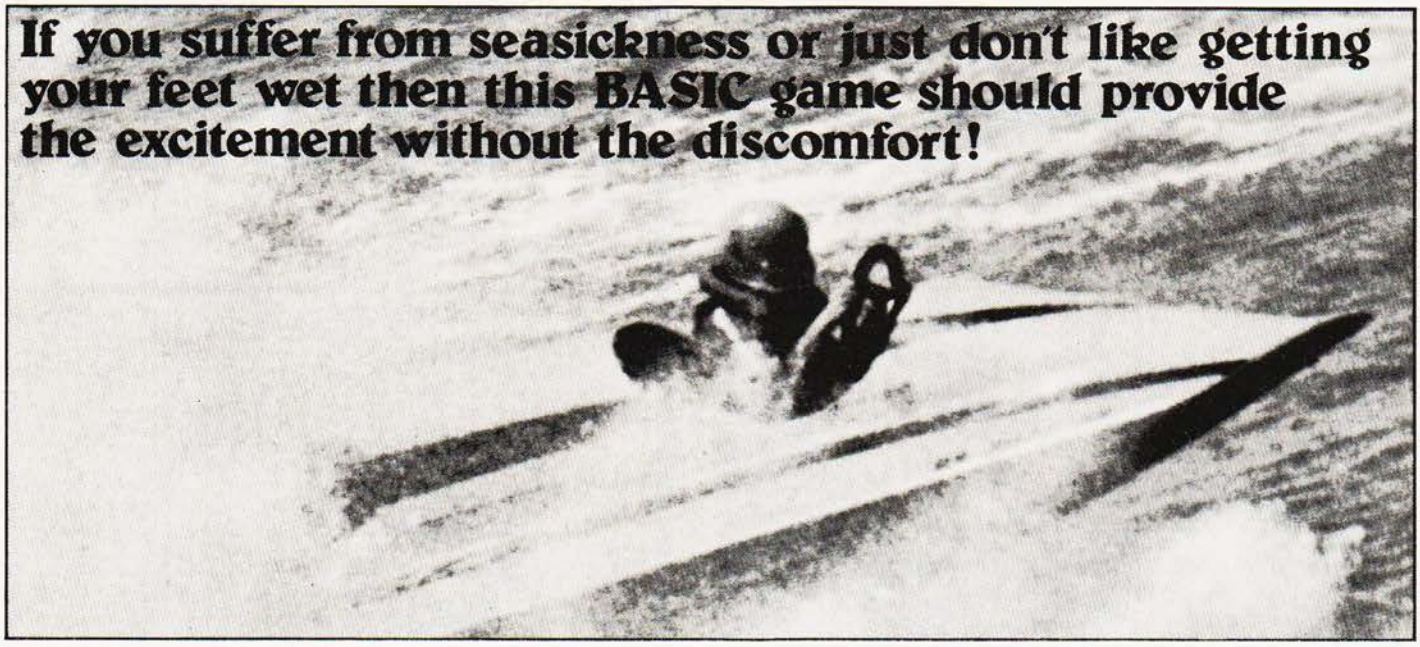

OK 'HANDS UP' how many of you are dry-land sailors, or have trouble with navigational aids? If you are one, then here is the ideal program for you, it saves you from getting your feet wet — or *does it?*

You are in complete (?) control of an extremely powerful, fast power boat; in a race against other top power boat champions. The course and weather conditions vary on each game, though the weather conditions will not alter during the game. The course is marked out with buoys which will give you the direction and the maximum speed for that particular section (there are 20 sections in all). The direction is given in the form of the radius of the necessary turning circle (the program assumes that you are intelligent enough to know which way to turn).

To make the turn you must enter in the amount of RUDDER you need. Too much and you will cut the corner, too little and you will overshoot the corner though 'slightly' cutting the corner will help you gain distance and position. Both of the above will gain you immediate disqualification, just to hinder you. The lower the number entered for the rudder the smaller the turning circle and hence the smaller the radius. There is, however, one special case — '0' which will cause your boat to go straight. This has suprisingly been done to make the navigation easier, but be warned! The ratio between the rudder and the radius varies from 1 to 10 when stationary, to 1 to 5 at top speed just to make the game a *little* more difficult. To complete the course you must also regulate your speed to a value near to or, preferably, slightly above the maximum speed for the section.

The power to the drive is *not* the speed, but the amount of power you supply to the drive. The more power you supply to the drive the faster the boat will go. If you put too much power in, you run the risk of converting your boat into an aeroplane and flipping over. Life jackets are compulsory whilst using this program, in case you get a bit too excited!

The program is written in a standard PET Microsoft BASIC and should present no real difficulty in converting to other machines. Note that PRINT CHR$(147) is a Clear Screen command and line 190 can be replaced with 190 INPUT A$.

For those of you who wish to alter the game the following list of variables may help.

- C is the difference between actual and rated turning circles.
- D is the distance to the leader.
- E is the previous 'power to the main drive'
- E1 is the present 'power to the main drive'.
- F is the amount of fuel remaining.
- M is the maximum speed for the section.
- P is your position.
- R is the rated turning circle.
- S is your present speed.
- T is the rudder position.
- W is the prevailing weather condition.
- X is the section number.

Program Listing

```
 10  PRINT CHR$(147);TAB(10);"POWER BOAT RACE"
 20  PRINT TAB(10)"_ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _"
 30  PRINT
 40  PRINT"YOU ARE IN CHARGE OF A FAST MOTOR BOAT"
 50  PRINT"WITH A 20 SECTION COURSE TO COMPLETE."
 60  PRINT
 70  PRINT"YOU ONLY HAVE 2 CONTROLS ON THE BOAT :-"
 80  PRINT
 90  PRINT"1 _ _ THE POWER TO THE MAIN DRIVE (NOTE"
100  PRINT"THIS IS NOT YOUR SPEED)."
110  PRINT"2 _ _ RUDDER CONTROL TO STEER YOUR BOAT"
120  PRINT"(NOTE THE EFFECTIVENESS ALTERS WITH"
130  PRINT"SPEED)."
140  PRINT
150  PRINT"WARNING IF YOU OVER OR UNDER STEER YOUR"
160  PRINT"BOAT WILL CRASH."
170  PRINT
176  PRINT"EXCEEDING THE MAXIMUM SPEED BY TOO MUCH"
177  PRINT"WILL ALSO CRASH YOUR BOAT."
178  PRINT
179  PRINT"YOU ONLY HAVE A LIMITED AMOUNT OF FUEL"
180  PRINT"ON BOARD."
181  PRINT
182  PRINT"HIT ANY KEY TO CONTINUE."
190  GET A$:IF A$=""THEN 190
195  PRINT CHR$(147)
```

POWER BOAT

```
200   FOR I = 1 TO 6
210   READ A$(I)
220   NEXT I
230   W = INT(RND(1)*6) + 1
235   LET S = 0
240   PRINT"CONDITION IS";A$(W)
250   F = 1000:REM**FUEL
260   P = 5 :REM**POSITION
270   D = 10 :REM**DISTANCE TO LEADER
280   E = 0
300   FOR X = 1 TO 20
305   PRINT:PRINT:PRINT
310   IF RND(1) > 0.7 THEN R = 0:M = 55 + INT(RND(1)*55) - W*2:
      GOTO 340
320   R = INT(RND(1)*90) + 10
330   M = INT(30 + RND(1)*20 + R/3) - W*2
340   PRINT"SECTION ";X
350   PRINT"POSITION";P
355   IF D < 0 THEN PRINT"YOU LEAD BY";ABS(INT(D))
      "METRES":GOTO 365
360   PRINT"DISTANCE TO LEADER";INT(D)"METRES"
365   PRINT
370   PRINT
380   PRINT"SPEED MAX SPEED RADIUS FUEL"
390   PRINT INT(S),INT(M),INT(R),INT(F)
400   PRINT
410   INPUT"POWER TO MAIN DRIVE";E1
420   IF E1 > = 100 OR E1 < 0 THEN PRINT"I SAID";:GOTO 410
430   INPUT"RUDDER POSITION ";T
440   IF T > = 10 OR T < 0 THEN PRINT"I SAID ";:GOTO 430
445   PRINT
450   IF E1 - E > 50 - W*2 THEN 1000
460   C = (S/100 + 1)*10*T - R
470   IF ABS(C) > 18 - W THEN 1020
480   IF C < 6 THEN 510
490   PRINT"YOU TOOK THE CORNER FAR TO WIDE !!"
500   C = 12
510   IF C > -6 THEN 540
520   PRINT"YOU CUT THAT CORNER TO CLOSE !!"
530   C = 18
540   E = E1
550   S = S/3 + E/1.2 - (T/10)
555   IF S < 1 THEN S = 1
560   IF S > 1.1*M + 10 - W THEN 1080
570   D = D + M - S + C/2
580   P = INT(D/10 + RND(2) + 2):IF P < 2 THEN P = 2
590   IF D < = 0 THEN P = 1
600   F = F - ((E/10)↑2 + E)/2
610   IF F < 0 THEN 1100
620   NEXT X
630   IF P > 1 THEN 670
640   PRINT"CONGRATULATIONS !!! YOU NOT ONLY"
650   PRINT"FINISHED BUT ACTUALY WON THE RACE."
660   GOTO 1200
670   IF D > 30 THEN 710
680   PRINT"YOU FINISHED THE RACE AND WERE NOT FAR"
690   PRINT"BEHIND THE LEADER."
700   GOTO 730
710   PRINT"WELL AT LEAST YOU FINISHED THE RACE."
720   PRINT
730   PRINT
740   PRINT"YOU FINISHED";P
745   PRINT
750   PRINT"DISTANCE TO THE LEADER WAS";INT(D);
      "METRES."
760   GOTO1200
800   DATA CALM,MILD, CHOPPY,ROUGH, VERY ROUGH,
      STORMY
1000  PRINT"YOUR BOAT CAPSIZED FROM TOO MUCH"
1105  PRINT"ACCELERATION !!!"
1010  GOTO 1200
1020  PRINT"CRASH !! YOU WENT THROUGH THE MARKERS"
1025  PRINT"AND WERE IMMEDIATLEY DISQUALIFIED !!"
1030  IF C > 0 THEN 1060
1040  PRINT"YOU SHOULD NOT TAKE THE CORNERS SO
      WIDE!"
1050  GOTO 1200
1060  PRINT"YOU SHOULD NOT CUT THE CORNERS !!"
1070  GOTO 1200
1080  PRINT"CRACK!! YOU DAMAGED THE BOAT BY GOING"
1085  PRINT"SO FAST !!!"
1090  GOTO 1200
1100  PRINT"PHUT ! I AM AFRAID YOU HAVE JUST RUN OUT"
1110  PRINT"OF FUEL !!"
1200  PRINT
1210  INPUT"DO YOU WANT ANOTHER GAME";Q$
1220  IF LEFT$(Q$,1) = "Y" THEN PRINT CHR$(147):GOTO 230
9999  END
```

```
        **** SAMPLE RUN ****

YOU ARE IN CHARGE OF A FAST MOTOR BOAT
WITH A 20 SECTION COURSE TO COMPLETE.
YOU ONLY HAVE 2 CONTROLS ON THE BOAT :-
1 -- THE POWER TO THE MAIN DRIVE (NOTE
     THIS IS NOT YOUR SPEED).
2 -- RUDDER CONTROL TO STEER YOUR BOAT
     (NOTE THE EFFECTINESS ALTERS WITH
     SPEED).
WARNING IF YOU OVER OR UNDER STEER YOUR
BOAT WILL CRASH.
EXCEEDING THE MAXIMUM SPEED BY TOO MUCH
WILL ALSO CRASH YOUR BOAT.
YOU ONLY HAVE A LIMITED AMOUNT OF FUEL
ON BOARD.
HIT ANY KEY TO CONTINUE.

CONDITION IS ROUGH
SECTION  1
POSITION 5
DISTANCE TO LEADER 10 METRES

SPEED      MAX SPEED        RADIUS          FUEL
 0            54             77            1000
POWER TO MAIN DRIVE? 40
RUDDER POSITION    ? 7.4

SECTION  2
POSITION 5
DISTANCE TO LEADER 29 METRES

SPEED      MAX SPEED        RADIUS          FUEL
 32           55             94            972
POWER TO MAIN DRIVE? 60
RUDDER POSITION    ? 7

SECTION  3
POSITION 5
DISTANCE TO LEADER 24 METRES

SPEED      MAX SPEED        RADIUS          FUEL
 60           72             0             924
POWER TO MAIN DRIVE? 80
RUDDER POSITION    ? 0
CRACK!! YOU DAMAGED THE BOAT BY GOING
SO FAST !!!
DO YOU WANT ANOTHER GAME
READY.
```

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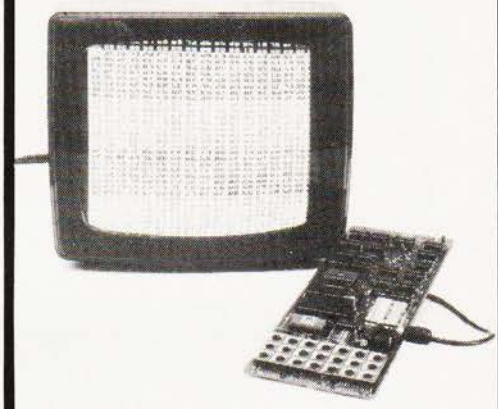

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Dear Sir,

I have a Video Genie and encountered the same problem with Mr Archer's "Mousetrap" as Mr Huntington. My adaption is much simpler as it only involves changing one line.

If 110 G=PEEK(14400)
becomes 110 G=PEEK(14352) then keys 3 to 7 will operate the game.

Key 7 takes the place of the space bar and keys 3 to 6 replace the arrow keys of the TRS-80.

Yours faithfully,
David Jones.

8 Charlton Road,
Edmonton,
London N9 8EG.

(* Many thanks to all those who suggested various mods and to Lowe Electronics who contacted Mr Huntington direct with the answer he needed. Ed. *)

Dear Sir,

I would like to inform the readers of 'Computing Today' of the formation of a SHARP PC-1211 USERS CLUB. The club has been formed to share news and programs on the PC-1211 and TRS-80 pocket computers.

Membership is charged at £5 per year for twelve issues of 'OUTPUT', the club newsletter, and in return members are entitled to discounts on software etc.

The club would also like to give its full support to the inclusion of PC-1211 programs in 'Computing Today' as this is a very practical and useful machine.

Yours faithfully,
Jonathon Pakeyne.

281 Lidgett Lane,
Leeds LS17 6PD,
Yorkshire.

Dear Sir,

"Nascom Re-number" in January's Computing Today contains two bugs:

1. The line numbered 01E0 should read ZICOPY EQU 49. To correct the program, change the contents of 0DB6 to 49 (Hex). Without this correction the program calls the wrong monitor copy routine with spectacular results.

2. A more insidious fault: The BASIC routine PHTOA used by the program has an anti-social habit of printing 'carriage return' every 48th character (the width of the screen). The fault may or may not occur, depending on what *width* it is set to, and the length/complexity of the program. To cure :

Change the contents of 0D4A,B,C to CD 38 0E

Insert a patch at 0E38:

```
0E38 21 00 00   PATCH LD HL,0
0E3B 22 AB 10   LD (10AB),HL
0E3E 2A E6 0D   LD HL,(LINNUM)
0E41 C9         RET
```

This patch clears BASICs count of the numbers printed to zero before PHTOA is called.

Note also that (for people with assemblers) line 0DF0 should read LD (HL),A. If you have just typed the machine code in Hex, it doesn't matter. Once fixed, a fine program.

Graham Smith.

22 Naples Road,
Edgeley, Stockport,
Cheshire SK3 0TN.

Dear Sir,

While I appreciate that BASIC and machine code are the most commonly used hobby languages, please spare a thought for the rest of us who do not have a computer of our own and use school or business computers. My school has an Apple II plus which is set up for Pascal, and the teachers are *very* anti-BASIC! So what about thinking of other languages? e.g. Pascal, simple, (yes simple!!), RPN etc.

Also, what has happened to the SOFTSPOTs?? I thought they were the best thing since the two-piece swimsuit!! Thumbing through my latest few CTs I have found nothing!

Thanks muchly,
Glenn McAllister.

281 Karori Rd.,
Karori,
Wellington 5,
New Zealand.

(* Softspots are still with us, we are just presenting them in a slightly different format. Ed. *)

Dear Sir,

Whilst flattered that my previous letter to you has started a correspondence, I feel driven to reply to Mr Watson's comments in your January issue.

He has missed my point completely; I am not asking for a program as such, just a printed collection of routines which the user can then incorporate into his own machine code programs. Thus the program overhead is nil as none is required. The whole point of the idea is that it is not a compiler nor is it an assembler.

I hope that this clears up any doubts which prospective implementers may have.

Yours faithfully,
Jeremy Waine Ruston.

4 Hornton Place,
London W8 4LX.

Dear Sir,

We liked the 'Stockmarket' program in your December issue, especially after we had removed some bugs!

The two mains snags were in stock dealing, starting at line 270;

a. NN is set up at line 1340 for each commodity in turn, and is finally left at the value for Lead. At line 1570, NN is used to check that the number of shares to be bought is within permitted limits, and that means a different value of NN for each commodity. We solved this by making NN an array, with subscript X at 1340-1360, and subscript C at 1570.

b. In line 1790, it appears that S(X) should be S(M).

We were also a little suspicious of the multiplication by unity in line 740. Should this be .1? It hasn't proved vital so far, as prices never seem to rise high enough to invoke the dividend option, so at line 530 CD(X) never reaches five. Perhaps line 230 needs a change; as it stands, it seems a trifle odd . . .

A point arising from the printouts is that it would be helpful if the intended display style for a program could be mentioned — in this case the reference to scrolling implies a screen display, but some combinations would need a very big screen! (Should TF in line 490 and line 2690 be the same as the TF used elsewhere? It is the main reason for excessive output text length.)

'Cells and Serpents' is also running on our Sorcerer, but as one of us is an established 'Dungeons and Dragons'® expert it has to compete with a full Adventure-type version that is steadily growing to full maturity — in machine code without the aid of an Assembler! Sheer masochism.

Finally, may we suggest that the number of Sorcerers in use is no longer negligible and, despite numerous criticisms, the Sorcerer BASIC is commendably standard so conversion from Sorcerer BASIC programs is relatively easy. It is sad that Exidy fail to document all the available facilities, which we have to discover for ourselves, but that's part of the fun! Something relevant to this particular machine now and then would be encouraging.

On behalf of Sorcerer users in the Harrow area;

Yours faithfully,
Don Thomasson.

16 High Worple,
Rayners Lane,
Harrow HA2 9SU,
Middx.

(* Any offerings for our pages? Ed. *)

Dear Sir,

May I congratulate Computing Today December issue for the very high quality of the programs and the documentation for both 'Cells and Serpents' and 'Stockmarket'! I experienced very little difficulty at all in transcribing both of these listings to run on Apple II. The notes accompanying both these games were most explicit.

There does, however, appear to be a fundamental flaw in the 'Stockmarket' listing which prevents proper share dealing and prints up "fraud" on the display. I have traced this to line 1570. Firstly, I suspect the line should have read:

```
1570 IF A$ = "B" AND N>NN THEN 1640
```

Even so, the variable NN has not been redefined. According to the listing published, NN was last used during the share dealing display in lines 1270 to 1380. NN, therefore, will always refer to the number of lead shares available where X=4 in line 1340. If you have bought all 1000 lead shares, you will have problems trying to buy anything else!. I suggest the following line alterations :

```
1340 NN(X) = INT(BB/P(X))
1350 IF NN(X) > M(X)-S(X) THEN NN(X)=
     M(X)-S(X)
1360 PRINT TAB(18);NN(X);
1570 IF A$= "B" AND N >NN(C) THEN
     1640
```

Incidentally, for anyone who has Apple Pascal, but does not have a word processing package, have you considered the possibilities of the Pascal Editor? If you type out your letters etc. using the normal editor facilities, the following will give you hard copy :

```
F(ILER)
T(RANSFER)
TRANSFER WHAT? APPLE1:SYSTEM.WRK.
TEXT
TO WHERE? PRINTER:
```

Many thanks for a most enjoyable magazine.

Yours faithfully,
Alan Robinson.

23 Wendsley Rd.,
Harlescott Grange,
Shrewsbury SY1 3PE,
Shropshire.

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There are also other Nascom 2 products defined that we will quickly engineer and produce in the next few months.

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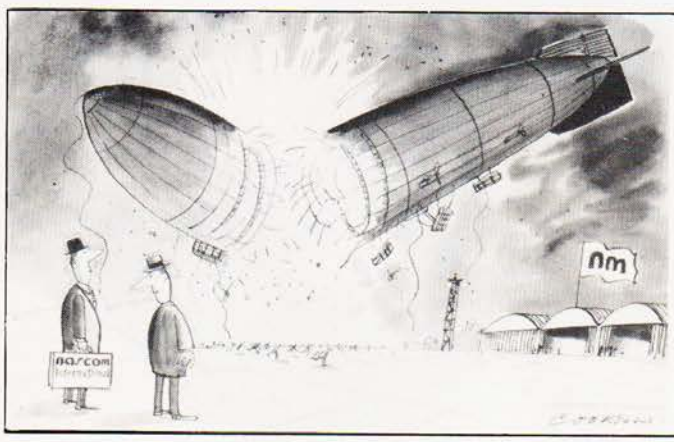
Peter Mathews Chairman



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Col:- —
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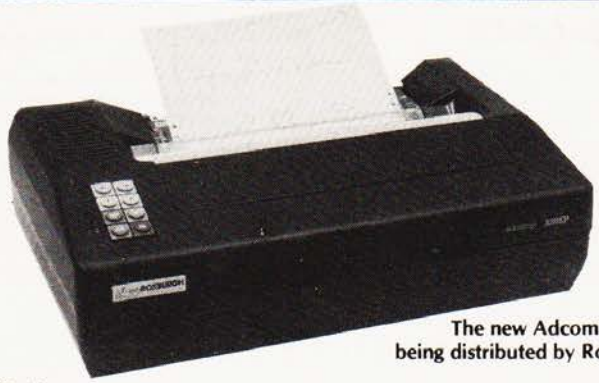
Graphics Option:- Yes
Price:- £995



The new Adcomp X80 SP being distributed by Roxburgh.

Options:-
Notes:- Extended carriage version of 9500 with higher density plotting.

ANDERSON JACOBSON

AJ 860
Manuf:- Anderson Jacobson
752 Deal Avenue,
Slough, Berkshire SL1 4SJ
Slough 25172

Also Manchester office

Face:- Dot
Interface:- RS232
Feed:- Tractor
Head Size:- 9x5
Baud Rates:- 110-1200
Print Speed:- 120cps
Col:- 132
Type Sizes:- 2
Graphics Option:- Yes
Price:- £

Options:-
Notes:- The descender matrix printer that gives both graphics and full APL character set.

AJ 832
Manuf:- As AJ 860

Face:- Daisy
Interface:- RS232
Feed:- Friction
Head Size:- N/A
Baud Rates:- 110-300
Print Speed:- 30cps
Col:- 132/156
Type Sizes:- Various
Graphics Option:- Yes
Price:- £2,560

Options:- Tractor option, 45cps printing option.
Notes:- Daisy wheel printer capable of both graphics plotting and APL printing. IBM 2741 compatible option.

AJ 880
Manuf:- As AJ 860

Face:- Dot
Interface:- RS232
Feed:- Friction
Head Size:- 7x9
Baud Rates:- 110-9600
Print Speed:- 30cps
Col:- 132/216
Type Sizes:- —
Graphics Option:- —
Price:- £899

Options:- Tractor feed.
Notes:- Low cost APL terminal.

BASE 2

Z-800
Dist:- Zero One Electronics
36 Oaklands Avenue,
Thornton Heath, Surrey CR4 7PH
01-689 7924

Also Intelligent Artefacts

Face:- Dot
Interface:- RS232/20mA Centronics/IEEE
Feed:- Tractor/Friction
Head Size:- 5x7
Baud Rates:- 75-9600
Print Speed:- 100cps
Col:- 64/132
Type Sizes:- 2
Graphics Option:- Yes
Price:- £375

Options:- User definable font.
Notes:- Supplier also runs a service and repair centre and supplies ribbons and paper.

CENTRONICS

MICROPRINTER P1
Manuf:- Centronics Data Computer (UK) Ltd.,
Victoria Way, Burgess Hill
Sussex RH15 9NU
04446-45011
All prices are one off OEM. Wide UK distribution network including Sintrom, Bytech, Datac, Hamilton Rentals, Rair, Comma, Dacoll and MIBF.

Face:- Dot Electrostatic
Interface:- Centronics
Feed:- Friction
Head Size:- 5x8
Baud Rates:- —
Print Speed:- 150 lpm
Col:- 132
Type Sizes:- 3
Graphics Option:- —
Price:- £190

Options:- Teletex/Prestel interface @ £375
Notes:- Software selectable line and type sizes.

MODEL 700
Manuf:- As Model P1

Face:- Dot
Interface:- Centronics
Feed:- Tractor
Head Size:- 5x7
Baud Rates:- —
Print Speed:- 60cps
Col:- 132
Type Sizes:- 2
Graphics Option:- —
Price:- £890

Options:-
Notes:- Conventional low speed matrix printer.

MODEL 701
Manuf:- As Model P1

Face:- Dot
Interface:- Centronics
Feed:- Tractor
Head Size:- 5x7
Baud Rates:- —
Print Speed:- 60cps
Col:- 132
Type Sizes:- 2
Graphics Option:- —
Price:- £980

Options:-
Notes:- Bi-directional version of Model 700.

MODEL 702
Manuf:- As Model P1

Face:- Dot
Interface:- Centronics
Feed:- Tractor
Head Size:- 7x7
Baud Rates:- —
Print Speed:- 120 cps
Col:- 132
Type Sizes:- 2
Graphics Option:- —
Price:- £1,210

Options:-
Notes:- Faster version of 701 with extra form controls.

MODEL 703
Manuf:- As Model P1

Face:- Dot
Interface:- Centronics
Feed:- Tractor
Head Size:- 7x7
Baud Rates:- —
Print Speed:- 150cps
Col:- 132
Type Sizes:- 2
Graphics Option:- Yes
Price:- £1,360

Options:- Graphics plotting option.
Notes:-

MODEL 704
Manuf:- As Model P1

Face:- Dot
Interface:- RS232
Feed:- Tractor
Head Size:- choice
Baud Rates:- 110-9600
Print Speed:- 150cps
Col:- 132
Type Sizes:- 2
Graphics Option:- —
Price:- £1,360

Options:- Stand, Buffer, "hush" kit.
Notes:- Large carriage high quality matrix printer.

730 MINIPRINTER
Manuf:- As Model P1

Face:- Dot
Interface:- Centronics
Feed:- Tractor/Friction
Head Size:- 7x7
Baud Rates:- —
Print Speed:- 100cps
Col:- 80
Type Sizes:- 2
Graphics Option:- —
Price:- £375
End user

Options:- Serial interface (730-4).
Notes:-

737 MINIPRINTER
Manuf:- As Model P1

Face:- Dot
Interface:- Centronics
Feed:- Tractor/Friction
Head Size:- Nx9 or 7x8
Baud Rates:- —
Print Speed:- 50 or 80cps
Col:- 80
Type Sizes:- 2
Graphics Option:- —
Price:- £425
End user

Options:- Serial interface version (737-4)
Notes:- Unit capable of proportional spacing and justification under micro control.

MODEL 753
Manuf:- As Model P1

Face:- Dot
Interface:- Centronics
Feed:- Tractor
Head Size:- Nx9
Baud Rates:- —
Print Speed:- 100-150cps
Col:- 132
Type Sizes:- 2
Graphics Option:- —
Price:- £1,360

Options:- Stand, Various electronic options.
Notes:- Correspondence printer with proportional spacing.

MODEL 779
Manuf:- As Model P1

Face:- Dot
Interface:- Centronics
Feed:- Friction
Head Size:- 5x7
Baud Rates:- —
Print Speed:- 60cps
Col:- 80/132
Type Sizes:- 2
Graphics Option:- —
Price:- £370

Options:- Tractor feed.
Notes:- The original micro printer as supplied by Tandy.

MODEL 780
Manuf:- As Model P1

Face:- Dot
Interface:- Centronics
Feed:- Friction
Head Size:- 9x7
Baud Rates:- —
Print Speed:- 60cps
Col:- 80/132
Type Sizes:- 2
Graphics Option:- No
Price:- £830

Options:-
Notes:- Upmarket version of 779 with better quality head.

MODEL 781
Manuf:- As Model P1

Face:- Dot
Interface:- Centronics
Feed:- Friction
Head Size:- 9x7
Baud Rates:- —
Print Speed:- 60cps
Col:- 80/132
Type Sizes:- 2
Graphics Option:- No
Price:- £930

Options:-
Notes:- Bi-directional version of 780.

COMPRINT

COMPRINT 912
Dist:- Transam,
12 Chapel Street,
London NW1 5DH
01-402 8137

Face:- Dot Electrostatic
Interface:- RS232/Parallel
Feed:- Friction
Head Size:- 9x12
Baud Rates:- —
Print Speed:- 225cps
Col:- 80
Type Sizes:- —
Graphics Option:- —
Price:- £370 - £385

Options:-
Notes:- Electrostatic printer with full page width printing.

DATAROYAL

DATAROYAL IPS 5000
Dist:- Facit Data Products Ltd.
Maidstone Road,
Rochester, Kent.
0634-401721

Face:- Dot
Interface:- RS232/
Centronics
Feed:- Tractor
Head Size:- 9x9
Baud Rates:- 110-9600
Print Speed:- 125cps
Col:- 80/136
Type Sizes:- 2
Graphics Option:- —
Price:- £774 - 910

Options:- Large 136 column platten, 2K buffer, 20mA interface.
Notes:- Slightly less enhanced versions of FACIT 4525/6.

DIGITRONIX

DIGITRONIX MINI PRINTER
Manuf:- Digitronix Ltd,
10 Burners Lane,
Kiln Farm Industrial Estate,
Milton Keynes.
0908-566888

Face:- Electrostatic
Interface:- RS232/20mA
Feed:- Friction
Head Size:- —
Baud Rates:- 110-4800
Print Speed:- 64cps
Col:- 32
Type Sizes:- 2
Graphics Option:- Yes
Price:- £195

Options:- Different font or graphics set
Notes:- Electrosensitive paper printer for data logging etc.

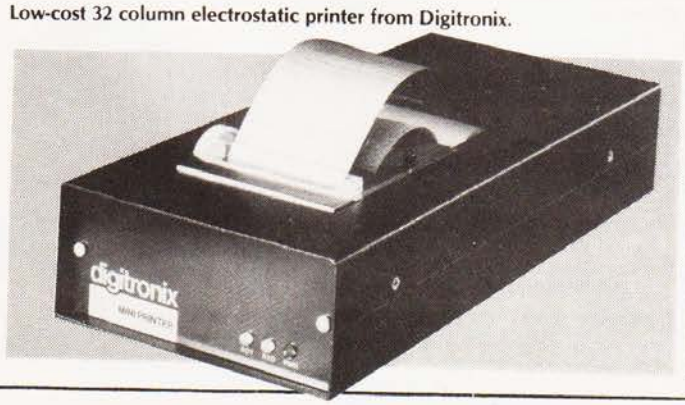
EPSON

EPSON TX 80
Dist:- Westrex
Bilton Fairway Estate
Long Drive,
Greenford, Middx
01-578 0957

Face:- Dot
Interface:- Centronics
Feed:- Tractor/Friction
Head Size:- 5x7 or 6x7
Baud Rates:- —
Print Speed:- 125cps
Col:- —
Type Sizes:- 2
Graphics Option:- Yes
Price:- £395

Options:- Grafcom graphics, various interfaces, feed option.
Notes:- PET graphics compatible matrix printer.

Low-cost 32 column electrostatic printer from Digitronix.



FACIT

FACIT 4520/1
Dist:- Facit Data Products
Maidstone Road,
Rochester, Kent
0634-401721

Face:- Dot
Interface:- RS232/
Centronics
Feed:- Friction
Head Size:- 9x7
Baud Rates:- —
Print Speed:- 80cps
Col:- 80/132
Type Sizes:- —
Graphics Option:- —
Price:- £583

Options:- Tractor feed (4521).
Notes:- Intelligent, bi-directional matrix printer.

FACIT 4525/6
Manuf:- As 4520

Face:- Dot
Interface:- RS232
Centronics
Feed:- Tractor
Head Size:- 9x9
Baud Rates:- —
Print Speed:- 150cps
Col:- 80/132
Type Sizes:- —
Graphics Option:- —
Price:- £890-1046

Options:- 132 column version (4526)
Notes:- Bi-directional printer, can be equipped with most European fonts.

FACIT 4530
Manuf:- As 4520

Face:- Dot
Interface:- RS232/
Centronics/20mA
Feed:- Tractor
Head Size:- 5x7 or 9x7
Baud Rates:- —
Print Speed:- 200cps
Col:- 132/198
Type Sizes:- Various
Graphics Option:- —
Price:- £1,628

Options:-
Notes:- Microcontrolled printer, capable of bar code printing.

FACIT 4540
Manuf:- As 4520

Face:- Dot
Interface:-RS232/Parallel/
Centronics/IEEE/20mA
Feed:- Tractor
Head Size:- 7x9 or 9x9
Baud Rates:- —
Print Speed:- 250cps
Col:- 155
Type Sizes:- —
Graphics Option:- —
Price:- £2,764-3,040

Options:- Keyboard unit (4610), Graphics (4542).
Notes:-

GENERAL ELECTRIC (USA)

TERMINET 200
Dist:- International General Electric
of New York,
111 Park Road,
London NW8 7JL
01-402 4100
Distributors include Zygal & Middlectron.

Face:- Dot
Interface:- RS232
Feed:- Tractor
Head Size:- 7x9
Baud Rates:- 110-1200
Print Speed:- 200cps
Col:- 136/224
Type Sizes:- —
Graphics Option:- Yes
Price:-

Options:-
Notes:- Available as ASR, KSR or forms access printer with wide range of print formats.

TERMINET 2000
Dist:- As TERMINET 200

Face:- Dot
Interface:- RS232
Feed:- Friction
Head Size:- 7x9
Baud Rates:- –
Print Speed:- –
Col:-
Type Sizes:- –
Graphics Option:- –
Price:-

Options:- Tractor feed, character buffer, modem.
Notes:- KSR terminal unit offering three-part form handling and various print formats.

HEATH ELECTRONICS

H14
Dist:- Heath Electronics
Bristol Road, Gloucester GL2 6EE
0452-29451

+ London shop - 01-636 7349

Face:- Dot
Interface:- RS232/20mA
Feed:- Tractor
Head Size:- 5x7
Baud Rates:- 110-4800
Print Speed:- 135cps
Col:- 80/132
Type Sizes:- 3
Graphics Option:- –
Price:- £413(kit)-£592(built)

Options:-
Notes:- High quality reliable printer with no frills.

HEWLETT PACKARD

HP 2631B
Dist:- Hewlett Packard Ltd.
308-314 Kings Road,
Reading, Berkshire RG1 4ES
0734-61022

Face:- Dot
Interface:- RS232/20mA
Centronics/IEEE
Feed:- Tractor
Head Size:- 7x9
Baud Rates:- 110-2400
Print Speed:- 180cps
Col:- 132
Type Sizes:- 2
Graphics Option:- –
Price:- £2,110

Options:- Graphics copy option.
Notes:- Software selectable print densities and form sizes.

HP 2635B
Dist:- As HP 2631B

Face:- Dot
Interface:- RS232/20mA
Centronics/IEEE
Feed:- Tractor
Head Size:- 7x9
Baud Rates:- 110-2400
Print Speed:- 180cps
Col:- 132
Type Sizes:- 2
Graphics Option:- –
Price:- £2,315

Options:-
Notes:- KSR version of 2631 with same facilities.

One of the recently introduced Honeywell matrix printers, this is the 132 column S30.

HONEYWELL

HONEYWELL S10
Dist:- MBS Terminals
Aldwych House, Madeira Road,
West Byfleet, Surrey KT14 6BA
09323-53151

Face:- Dot
Interface:- RS232
Feed:- Friction/Sprocket/Tractor
Head Size:- 7x7
Baud Rates:- –
Print Speed:- 80cps (bi-directional)
Col:- 80
Type Sizes:- –
Graphics Option:- –
Price:- £510

Options:-
Notes:-

HONEYWELL S30
Dist:- As HONEYWELL S10

Face:- Dot
Interface:- RS232/Centronics
Feed:- Friction/Sprocket Tractor
Head Size:- 7x7
Baud Rates:- –
Print Speed:- 80cps (bi-directional)
Col:- 132
Type Sizes:- –
Graphics Option:- –
Price:- £690

Options:-
Notes:-

LEAR SIEGLER

BALLISTIC 300
Dist:- Penny & Giles Recorders Ltd.
Mudeford, Christchurch,
Dorset BH23 4AT
04252-71511

Face:- Dot
Interface:-RS232/20mA
Feed:- Tractor
Head Size:- 9x7
Baud Rates:- 75-9600
Print Speed:- 180cps
Col:- 136
Type Sizes:- –
Graphics Option:- –
Price:- –

Options:- Foreign character sets, 9x9 or 9x12 heads.
Notes:- Micro controlled 'smart' printer with powerful forms control.

LOGABAX

LOGABAX 100
Dist:- Brospa Data
87 Castle Street,
Reading, Berkshire RG1 7ST
0734-589393

Face:- Dot
Interface:- RS232/Parallel/Centronics/IEEE/20mA
Feed:- Tractor
Head Size:- Various
Baud Rates:- 110-9600
Print Speed:- 100cps
Col:-
Type Sizes:- 2
Graphics Option:- No
Price:- £1,152

Options:- Stand and paper handling trays.
Notes:-

LOGABAX 200
Dist:- As LOGABAX 100

Face:- Dot
Interface:- RS232/Parallel/Centronics/IEEE/20mA
Feed:- Tractor
Head Size:- 7x9 or 9x9
Baud Rates:- 110-9600
Print Speed:- 180cps
Col:-
Type Sizes:- 2
Graphics Option:- Yes
Price:- £1,590

Options:- Stand and paper handling trays.
Notes:- Bi-directional matrix printer with expanded and compressed type facility.

LOGABAX LXI200
Dist:- As LOGABAX 100

Face:- Dot
Interface:- RS232/20mA/Centronics
Feed:- Friction/Sprocket/Tractor
Head Size:- 9xn
Baud Rates:- 110-9600
Print Speed:- 180cps (bi-directional)
Col:- —
Type Sizes:- Selectable (various)
Graphics Option:- Yes
Price:- £2,031

Options:- Stand and paper holder
Notes:- Full software controlled matrix printer offering WP quality and facilities.

MASTERPRINT

MASTERPRINT 165
Dist:- MBS Terminals,
Aldwych House, Madeira Road,
West Byfleet, Surrey KT14 6BA.
09323-53151

Face:- Dot
Interface:- RS232/Centronics
Feed:- Tractor
Head Size:- 10x9
Baud Rates:- —
Print Speed:- 90/165cps (bi-directional)
Col:- —
Type Sizes:- 2
Graphics Option:- Yes
Price:- £1,450

Options:- Apple and S100 interfaces, special character sets, high resolution graphics
Notes:- High quality drafting printer with 18 by 9 matrix print capability.

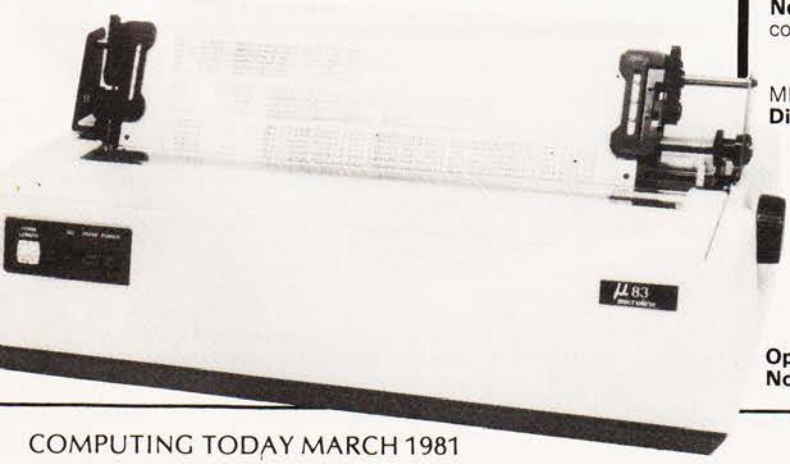
MICROTEK

MICROTEK MT 80P
Dist:- HAL Computers
133 Woodham Lane,
New Haw, Weybridge
Surrey KT15 3NJ
Weybridge 48346

Face:- Dot
Interface:- RS232/IEEE Centronics
Feed:- Tractor
Head Size:- 9x7
Baud Rates:- to 9600
Print Speed:- 125cps
Col:- 80/120
Type Sizes:- 2
Graphics Option:- No
Price:- £495 - £550

Options:- Various interfaces, character buffer.
Notes:- 80 or 120 column matrix printer.

OKI's top of the range MICROLINE 83.



NASCOM

IMP
Dist:- Currently available from many local outlets.

Face:- Dot
Interface:- RS232
Feed:- Friction
Head Size:- 7x7
Baud Rates:- 110-9600
Print Speed:- 60 lpm
Col:- 80
Type Sizes:- —
Graphics Option:- Yes
Price:- £325

Options:- Tractor feed, programmable character set.
Notes:- First of a new generation of matrix printers, like the BASE 2 and EPSON.

NEWBURY LABS

8300 RM
Dist:- Newbear Computing Store
40 Bartholomew Street
Newbury, Berkshire
0635-30505

Face:- Dot
Interface:- RS232
Feed:- Tractor
Head Size:- 7x9
Baud Rates:- 110-9600
Print Speed:- 125cps
Col:-
Type Sizes:- 2
Graphics Option:- No
Price:- £525

Options:- Choice of character per line and buffer sizes.
Notes:- General purpose dot matrix printer.

OKI

MICROLINE 80
Dist:- Rohan Computing
52 Coventry Street,
Southam,
Warcs CV 0EP
092681-4045

Face:- Dot
Interface:- Centronics
Feed:- Friction
Head Size:- 9x7
Baud Rates:- —
Print Speed:- 80cps
Col:- 80
Type Sizes:- 3
Graphics Option:- Yes
Price:- £399

Options:- Tractor feed, RS232 1200 baud interface
Notes:- One of the new generation of micro printers for small business and personal use.

MICROLINE 82
Dist:- As MICROLINE 80

Face:- Dot
Interface:- RS232/Centronics
Feed:- Friction/Sprocket
Head Size:- 9x7
Baud Rates:- 1200
Print Speed:- 80cps (bi-directional)
Col:- 80/132
Type Sizes:- 3
Graphics Option:- Yes
Price:- £550

Options:-
Notes:- Bi-directional version of the MICROLINE 80 with form controls.

MICROLINE 83
Dist:- As MICROLINE 80

Face:- Dot
Interface:- RS232/Centronics
Feed:- Friction/Sprocket
Head Size:- 9x7
Baud Rates:- 1200
Print Speed:- 120cps (bi-directional)
Col:- 132/136
Type Sizes:- 3
Graphics Option:- Yes
Price:- £799

Options:-
Notes:- Full width version of MICROLINE range.

Pertec's daisy printer, the Stylist 360.

OLIVETTI

DY 311
Dist:- Dealership currently under negotiation.

Face:- Daisy
Interface:- RS232/ IEEE
Feed:- Tractor/Friction
Head Size:- N/A
Baud Rates:- 110-9600
Print Speed:- 32cps
Col:-
Type Sizes:- Various
Graphics Option:- —
Price:- £1,300

Options:- Sheet feeder, 20mA interface
Notes:- High quality daisy system with full proportional spacing and tabbing.

TH 240
Dist:- As DY 311

Face:- Dot/Thermal
Interface:- RS232
Feed:- Tractor/Friction
Head Size:- 7 pin
Baud Rates:- 110-9600
Print Speed:- 320cps
Col:-
Type Sizes:- —
Graphics Option:- Yes
Price:- £860

Options:- High speed plot, paper handling accessories.
Notes:- Thermal printer capable of producing eight ISO alphabets.

PAPER TIGER

PAPER TIGER
Dist:- Microsense
Finway Road
Hemel Hempstead, Herts HP2 7PS
0442-48151
+ regional outlets inc.
Teleprinter Equipment

Face:- Dot
Interface:- RS232 Centronics
Feed:- Tractor/Friction
Head Size:- 7x7
Baud Rates:- 110-1200
Print Speed:- 95cps
Col:- 132
Type Sizes:- 4
Graphics Option:- Yes
Price:- £598

Options:-
Notes:- Very versatile printer with various built-in options for line length, etc.

PAPER TIGER 560
Dist:- Teleprinter Equipment,
Akeman Street,
Tring, Herts
HP23 6AJ
044282-4011

Face:- Dot
Interface:- RS232/ Centronics
Feed:- Sprocket
Head Size:- —
Baud Rates:- —
Print Speed:- 160cps (bi-directional)
Col:- 132
Type Sizes:- 8
Graphics Option:- —
Price:- —

Options:-
Notes:- Full width version of popular matrix printer.

PERTEC

STYLIST 360
Manuf:- Pertec International,
10 Portman Road,
Reading, Berkshire
Berkshire RG3 1DU
0734-582115
Local dealers include Adler Business Systems, Computer Instrumentation, Computer Services Ltd. (RSA)

Face:- Daisy
Interface:- Centronics
Feed:- Friction
Head Size:- —
Baud Rates:- —
Print Speed:- 17cps
Col:- 132/198
Type Sizes:- Various
Graphics Option:- No
Price:- £666

Options:-
Notes:-

PERTEC P80
Manuf:- As STYLIST 360

Face:- Dot
Interface:- Centronics
Feed:- Friction/Sprocket
Head Size:- 7x9
Baud Rates:- 110-9600
Print Speed:- 80cps (bi-directional)
Col:- 80/120
Type Sizes:- 2
Graphics Option:- No
Price:- £478

Options:- RS232 or 20mA interfaces.

PERTEC P250
Manuf:- As STYLIST 360

Face:- Dot
Interface:- RS232
Feed:- Tractor
Head Size:- 7x9
Baud Rates:- 110-19,200
Print Speed:- 250cps (bi-directional)
Col:- 132/158/198
Type Sizes:- 3
Graphics Option:- Yes
Price:- £1,311

Options:- Centronics and 20mA interfaces.

QUME

SPRINT 5
Dist:- Facit Data Products Ltd.,
Maidstone Road,
Rochester, Kent.
0634-401721
Local distribution by: Access Data, Fortronics, Cytec, Wilkes, Rohan, Brospa etc.

Face:- Daisy
Interface:- RS232/20mA Parallel
Feed:- Tractor/Friction
Head Size:- N/A
Baud Rates:- 110-1200
Print Speed:- 45-55cps
Col:- 132/158
Type Sizes:- Various
Graphics Option:- Yes
Price:- From £1,625

Options:- RO or KSR terminals, single sheet feed
Notes:- High quality correspondence printer.

RICOH

RICOH RP1600
Dist:- Nexos (UK) Ltd.,
Metropolitan House, 1, Hagley Rd.,
Edgbaston, Birmingham B16 8TG
021-454 2235
Local dealers, Micropute, Small Systems, London Computer Store, Camden Electronics.

Face:- Daisy
Interface:- Centronics
Feed:- Friction
Head Size:- N/A
Baud Rates:- –
Print Speed:- 60cps
Col:- N/A
Type Sizes:- various
Graphics Option:- –
Price:- £1,290

Options:- Various interfaces.
Notes:- Fast commercial daisy wheel for WP and other office applications.

ROBETRON

ROBETRON 1152
Dist:- Kingston Computers Ltd.
Scarborough House,
Scarborough Road
Bridlington, Yorkshire.
0262-73036

Face:- Daisy
Interface:- Centronics
Feed:- Friction
Head Size:- N/A
Baud Rates:- –
Print Speed:- 45cps
Col:-
Type Sizes:- various
Graphics Option:- No
Price:- under £1,000

Options:- Interfaces, tractor feed.
Notes:- East German RO daisy printer for high quality type.

SEIKO

SEIKOSHA GP-80
Dist:- Mitecrest Ltd.,
61, New Market Square, Basingstoke,
Hants RG21 1HW
0256-56468

Face:- Dot
Interface:- Centronics
Feed:- Tractor/Friction
Head Size:- 'unihammer'
Baud Rates:- –
Print Speed:- 30cps
Col:- 80
Type Sizes:- –
Graphics Option:- Yes
Price:- £199

Options:- Various interfaces.
Notes:- Amazingly low cost single needle printer capable of reasonable print and graphics quality.

SIGMA

MODEL 801
Dist:- Sigma UK
Unit 2, 106-120 Garrat Lane,
Wandsworth, London SW18
01-870 4524

Face:- Dot
Interface:- RS232/20mA Centronics
Feed:- Tractor/Friction
Head Size:- 7x7
Baud Rates:- 110-1200
Print Speed:- 132cps
Col:-
Type Sizes:- –
Graphics Option:- –
Price:- £695

Options:-
Notes:-

TELETYPE

TELETYPE 43
Dist:- Peripheral Hardware Ltd.
Armfield Close,
West Molesey, Surrey
01-941 4806
+ various regional outlets

Face:- Dot
Interface:- RS232/20mA
Feed:- Tractor/Friction
Head Size:- 7x9
Baud Rates:- –
Print Speed:- 10 or 30cps
Col:- 132
Type Sizes:- –
Graphics Option:- No
Price:-

Options:- IEEE interface, Buffer store, Stand, ASR.
Notes:- High quality matrix terminal available as KSR, ASR or RO. Portable and TTY compatible.

TEXAS INSTRUMENTS

TI 810
Dist:- Texas Instruments
Manton Lane,
Bedford
0234-67466

Face:- Dot
Interface:- RS232
Feed:- Tractor
Head Size:- 9x7
Baud Rates:- 110-9600
Print Speed:- 150cps
Col:- 132
Type Sizes:- 2
Graphics Option:- –
Price:- £1,450

Options:- Character sets, various interfaces, form handling.
Notes:-

TI 820
Dist:- As TI 810

Face:- Dot
Interface:- RS232
Feed:- Tractor
Head Size:- 9x7
Baud Rates:- 110-9600
Print Speed:- 150cps
Col:-
Type Sizes:- 2
Graphics Option:- –
Price:- £1,450 - £1,650

Options:-
Notes:- KSR bi-directional with RO option at reduced cost.

TI 825
Dist:- As TI 810

Face:- Dot
Interface:- RS232
Feed:- Tractor
Head Size:- 9x7
Baud Rates:- 110-600
Print Speed:- 75cps
Col:-
Type Sizes:- 2
Graphics Option:- –
Price:- £1,095 - £1,250

Options:-
Notes:- Slower RO or KSR matrix printer.

TI 743
Dist:- As TI 810

Face:- Dot Thermal
Interface:- RS232/20mA
Feed:- Friction
Head Size:- 5x7
Baud Rates:- 110-300
Print Speed:- 30cps
Col:-
Type Sizes:- –
Graphics Option:- –
Price:- £995 - £1,105

Options:-
Notes:- Thermal printer KSR terminal.

TI 745
Dist:- As TI 810

Face:- Dot Thermal
Interface:- RS232
Feed:- Friction
Head Size:- 5x7
Baud Rates:- 110-300
Print Speed:- 30cps
Col:-
Type Sizes:- –
Graphics Option:- –
Price:- £1,250

Options:-
Notes:- Integral modem in portable terminal.

TI 763
Dist:- As TI 810

Face:- Dot Thermal
Interface:- RS232/20mA
Feed:- Friction
Head Size:- 5x7
Baud Rates:- 110-9600
Print Speed:- 30cps
Col:-
Type Sizes:- –
Graphics Option:- –
Price:- £2,195

Options:- Expanded character store.
Notes:- Bubble memory based terminal with 20K internal storage.

TRENDCOM

TCM 100
Dist:- Personal Computers Ltd.
194-200 Bishopsgate,
London EC2M 4NR
01-626 8121

Face:- Dot Thermal
Interface:- Parallel
Feed:- Friction
Head Size:- 5x7
Baud Rates:- —
Print Speed:- 40cps
Col:- 40
Type Sizes:- —
Graphics Option:- Yes
Price:- £240

Options:- Interfaces for various machines.
Notes:- 40 column thermal printer capable of graphics plotting.

TCM 200
Dist:- As TCM 100

Face:- Dot Thermal
Interface:- Parallel
Feed:- Friction
Head Size:- 5x7
Baud Rates:- —
Print Speed:- 40cps
Col:- 80
Type Sizes:- —
Graphics Option:- Yes
Price:- £340

Options:- Interfaces for various machines.
Notes:- 80 column version of TCM 100.

SILENTYPE
Dist:- Microsense
Finway Road
Hemel Hempstead, Herts HP2 7PS
0442-48151
+ regional outlets

Face:- Dot Thermal
Interface:- Apple
Feed:- Friction
Head Size:- 5x7
Baud Rates:- —
Print Speed:- 40cps
Col:- 80
Type Sizes:- —
Graphics Option:- Yes
Price:- £349

Options:-
Notes:- Custom interfaced TRENDCOM printer for Apple capable of high density graphics.

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DOLPHIN BD-80P
Manuf:- Walters Microsystems
1 Blenheim Road,
High Wycombe, Bucks
0494-445172

+ many regional outlets

Face:- Dot
Interface:- RS232/20mA Centronics/IEEE
Feed:- Tractor/Friction
Head Size:- 7x9
Baud Rates:- 50-19,200
Print Speed:- 125cps
Col:- 80/132
Type Sizes:- 2
Graphics Option:- Yes
Price:- £525

Options:- Stand, Buffer, Coms interface.
Notes:- A standard matrix printer with excellent reliability reputation.

Weyfringe Century in RO mode.

DOLPHIN BD-136
Manuf:- As DOLPHIN BD-80P

Face:- Dot
Interface:- RS232/Parallel /Centronics/IEEE/20mA
Feed:- Friction/Sprocket/ Tractor
Head Size:- 9x9
Baud Rates:- —
Print Speed:- 240cps (bi-directional)
Col:- 136
Type Sizes:- —
Graphics Option:- Yes
Price:- £1,200

Options:-
Notes:- Flexible, intelligent matrix printer capable of a wide formatting range.

WEYFRINGE

MODEL 480
Dist:- Weyfringe
Longbeck Road
Marske, Redcar
Cleveland TS11 6HQ
0642-470121

Face:- Dot
Interface:- RS232/20mA Centronics
Feed:- Friction
Head Size:- 5x7
Baud Rates:- 110-9600
Print Speed:- 110cps
Col:- 40
Type Sizes:- 2
Graphics Option:- —
Price:- £475

Options:- Choice of indicated interfaces.
Notes:- Tally roll printer for logging applications.

CENTURY
Dist:- As MODEL 480

Face:- Dot
Interface:- RS232/20mA Centronics
Feed:- Tractor/Friction
Head Size:- 7x9
Baud Rates:- 110-9600
Print Speed:- 110cps
Col:- 96/132
Type Sizes:- 4
Graphics Option:- —
Price:- £945

Options:- Optional PET interface, alternate character set.
Notes:- General purpose machine with form handling facilities, Now available with keyboard.

WHYMARK

WHYMARK 201
Dist:- Whymark Instruments
6 Holmesdale Road,
Reigate, Surrey RH2 0BQ
07372-21753

Face:- Dot
Interface:- RS232/20mA Centronics/IEEE/Parallel
Feed:- Friction
Head Size:- 7x7
Baud Rates:- 110-4800
Print Speed:- 1 lps
Col:- 40
Type Sizes:- 4
Graphics Option:-
Price:- £410 - £490

Options:- Label printer, rack mounted, interfaces to order.
Notes:- Tally roll printer with 40 character line.

WHYMARK 801
Dist:- As WHYMARK 201

Face:- Dot
Interface:- RS232 Centronics/IEEE
Feed:- Tractor
Head Size:- nx7
Baud Rates:- 75-9600
Print Speed:- 140cps
Col:- 120
Type Sizes:- 2
Graphics Option:- Yes
Price:- £750

Options:- User definable character set, stand.
Notes:- Intelligent printer with proportional control and absolute alignment.

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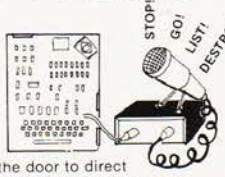

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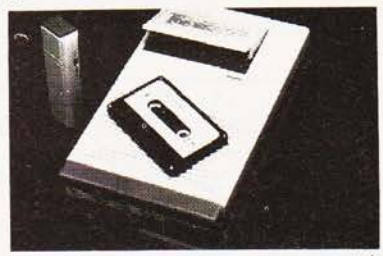

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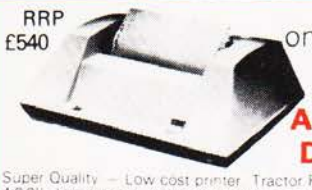

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