Practical Computing

50p

An ECC Publication. Volume 2 Issue 3 March 1979

Ready-made computer systems for stock control

We review single-board computers

Tandy Forum & Pet Corner

School computer project

Build your own frequency meter

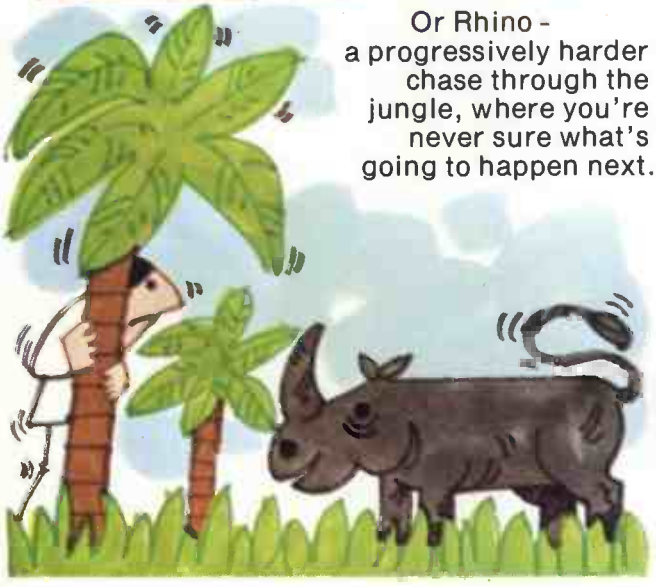
After you've been chased by rhinos and have met the hangman, it's time to learn a thing or two...

One lesson you'll have to learn on your own - how to tear yourself away from your computer in the early hours. Infoguide provides you with a new concept in recreational, educational and business software.

You'll probably start in the Playgroup.

Insert your Compusette, and there's the Hangman to challenge.

Or Rhino - a progressively harder chase through the jungle, where you're never sure what's going to happen next.



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Middle School
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Or Go!

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sees you and your computer working on statistical programmes. Conversion. Financial management. Forecasting. These - and many other functional programs - are on Compusette.

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why not simulate an enzyme reaction? Change any one (or more) of six parameters and see what happens? Maybe discover, when playing chess, that your computer is a Grand Master? A Compusette will supply each of the necessary programs.
An interesting variety of Compusettes are being made available for PET, Apple II and TRS 80. Each is accompanied by a fully detailed booklet with listings of the programs - there are up to three on each tape.
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120 El Camino Drive, Suite 108, Beverley Hills, Cal 90212 USA

* Based on three programs on an £8.00 Compusette.

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Practical Computing

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Contents

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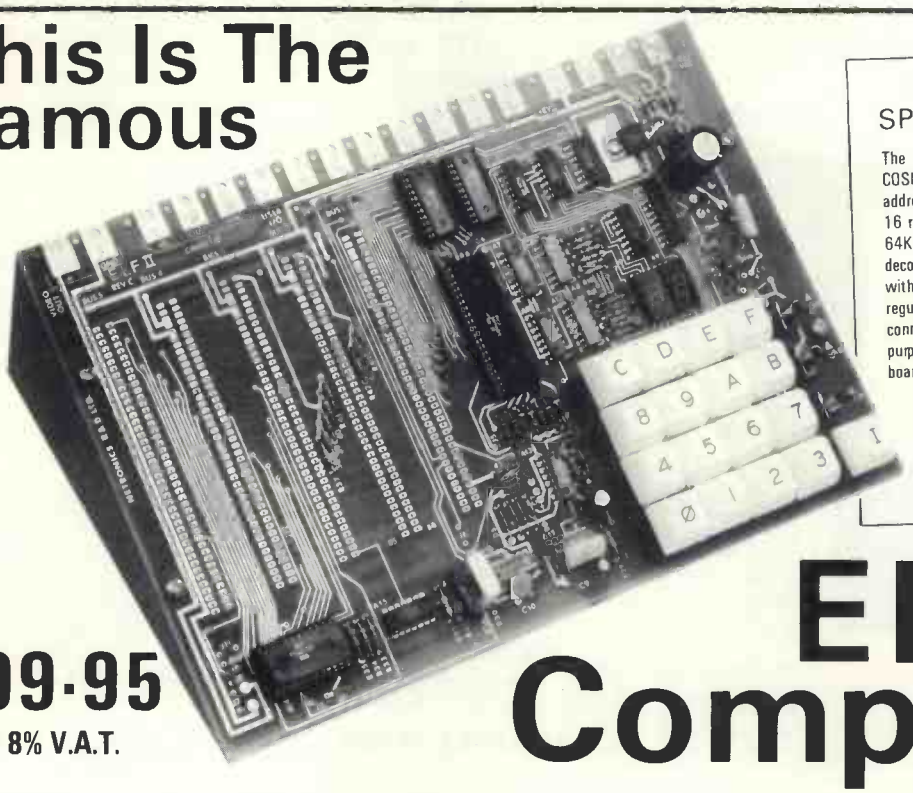

SPECIFICATIONS

The £99.95 ELF II computer features an RCA COSMAC COS/MOS 1802 8-bit microprocessor addressable to 64K bytes with DMA, interrupt, 16 registers, ALU, 256 byte RAM expandable to 64K bytes, professional hex keyboard fully decoded so there's no need to waste memory with keyboard scanning circuits, built-in power regulator, 5 slot plug-in expansion bus (less connectors), stable crystal clock for timing purposes and a double-sided, plated-through pc board plus RCA® 1861 video IC to display any segment of memory on a video monitor or TV screen along with all the logic and support circuitry you need to learn every one of the RCA 1802's capabilities.

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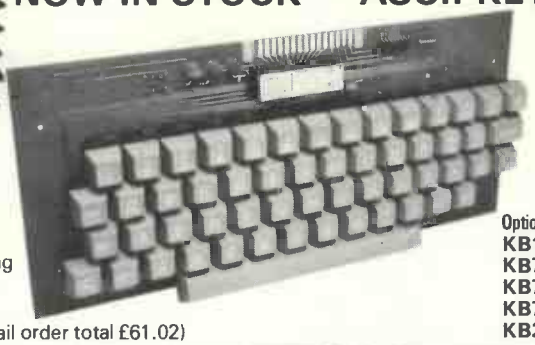

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16K — Uses 2114's (low power)

Assembled & Tested:

RAM 16 (250ns)	$168.75
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16K with memory management

Assembled and Tested:

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Assembled & Tested:

250ns	$993.75
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★ STATIC RAM SPECIALS ★

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IF YOU CAN'T BEAT THEM :-

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£350

PR2 12K PROM/RAM card holds a comprehensive monitor program for system testing and configuration. Normal operation is in conjunction with a serial terminal via I/O card.

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FLASHWRITER, memory mapped VDU with graphics, allows a system to be built without a terminal or I/O card. Specify version EV of monitor program.

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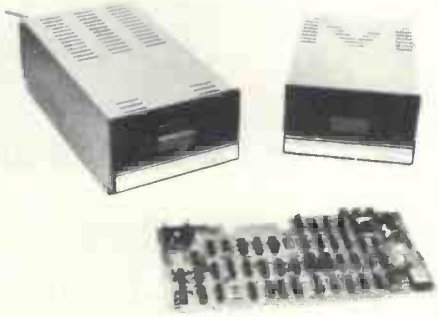
8K Computer System £895

MICROPOLIS



Micropolis disk drives employ higher standards of engineering to pack either 143K or 315K bytes per diskette, formatted, Supplied complete with controller card, cables, manual and software they plug directly into the S100 bus; 8080 or Z80.

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Applications Software for the VECTOR MZ now in preperation will perform a wide variety of business functions; stock control, invoicing, ledger and mailing lists. Further applications exist as a microcomputer development system, and low cost replacement for minicomputer control and instrumentation.

VECTOR MZ configuration includes:

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Tel: 041-634 3860

U Microcomputers
PO Box 24 Northwich
Cheshire CW8 1RS
Tel: 0606-75627

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Publisher's Letter

THE micro revolution will give Britain's entrepreneurs the same tremendous opportunity the industrial revolution did in the past. It appears that the Government has recognised the opportunity and is ready to encourage free enterprise to grasp it to the full. Over recent months very large amounts of taxpayers' money have been committed in that direction.

The announcements to date already total nearly £250 million—yes, £250,000,000. That includes an initial £55 million for the Microprocessor Application Project (MAP), and £60 million for schemes to make Britain more aware of the possibilities, and for education and training.

The money will be spent over three years at the most and industry is expected at least to match the Government contribution; thus the very lowest estimate of the sums available over the coming years avarages in excess of £15 million per month.

The Government is busily commissioning studies on what to spend the money. We know there are many readers of *Practical Computing* who have really *practical* ideas on applications which would be well worthwhile funding.

Well, the money is there and the right time is now. Has your company yet taken the trouble to find out the details of MAP? The Secretary of State for Industry has stated that under MAP: "Assistance will be available both for application of microprocessors in end-products and for their use in production processes". Why not invest 7p in a stamp and write to:

Miss M. S. Rae
Room 309
Department of Industry
Dean Bradley House
52 Horseferry Road
London SW1P 2HE

Good luck.

The Publisher

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

Extender boards

I WOULD like to point out a possible source of confusion in your glossary definition of Extender Board.

In my limited hardware experience, 'Extender Board' is a hardware diagnostic tool and is a simple board comprising a PC plug on one edge and a mating PC socket on the opposite edge. Plug and socket are connected, pin to equivalent pin, by straight PC tracks.

The purpose of the board is to extend a PC socket inside a framework to the outside of the framework so that the original PC board the extender replaces may then be plugged into the outer socket of the extender. The original PC board is then in an accessible position for scoping or whatever.

Extender Board would appear to be the more standard definition of the hardware you describe.

If Extender Boards to my definition were advertised and purchased by someone using your definition, then that purchaser will not be very pleased nor any more able to expand.

N. D. Canton
St. Albans, Herts.

Fascination

HAVING just purchased a copy of *Practical Computing* may I say it has greatly increased my fascination with computers?

I have for some time toyed with the idea of buying a personal computer but must confess to knowing next to nothing about them. Your magazine obviously must aim at a section of the community whose minimum knowledge must be a smattering of jargon and an ability to press the right key somewhere along the line. Therein lies the dilemma for myself. To get to the point, it would be infinitely easier if I had a computer, but how do I choose a computer without this basic knowledge?

My interest in computers is purely games. Even the most advanced TV computer games tend to need special skill and quick reactions at the expense of intellect. I am looking for a cheap—perhaps second-hand?—computer programmable for a wide number of games where tactics and strategies depend on forethought rather than wrist agility.

If you could advise, or put me in touch with any group which could advise me on such a choice so I may become one of the enviable bunch of home computer operators, I would be extremely grateful, and am sure *Practical Computing* would become a necessity rather than a present curio.

Philip A. Rylett
Brighton.

● **Yes, there is a problem in bridging the gap between ignorant interest and positive enthusiam; and it is true that personal computers offer some really excellent programmable games, so it seems a pity you should miss out on any of it.**

One starting-point might be to contact a local computer club. We know of several, and here is the address of one relatively near you—P. Guile/N Latcham, *23* Silverdale Road, Hove, Sussex.

Help offered

I BOUGHT your first issue at the DIY Exhibition in Summer, 1978 and took a year's subscription shortly afterwards.

In June, 1978 I also purchased a Synertek Vim-1, probably among the first to be released. I had no previous experience of computers or microprocessors, other than the general knowedge acquired as a physics teacher over the last 27 years.

During the last three months I have put in several hundred hours on the Vim-1, working solely from the two printed handbooks supplied with it. They consist of 370 pages of text, 50 pages of component data sheets, and 55 pages of listing. Unfortunately most of the intermediate and all of the advanced material is contained in about 10 pages of (important) tables and flowcharts, with only six pages of explanation.

This has to cover vector points, monitor calls, interrupts, trace routines, monitor extensions, user-defined functions, mixed I/O configurations, and so on.

There is a rich library of Kim-1 programs, with more than one in *Practical Computing* recently. But the compatibility of Vim's 4K monitor with Kim's 2K equivalent is only superficially dealt with in a brief one-page appendix to my documentation, making it almost impossible for me to utilise all these Kim programs.

This is most frustrating. The Vim-1 performs excellently and I am sure with only a few more clues I could obtain considerably more versatility.

I would be grateful for the opportunity to exchange information, assistance or ideas with any other Vim-1 (or Sym-1) owner.

In return, I can offer correction of

(*continued on page 21*)

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(*continued from page 19*)
several errors and misconceptions in the handbook texts and personal experience about the most suitable, and cheapest, cassette recorder, and the most reliable tapes. I have much to say on the general reliability of the keypad and the transfer of the oscilloscope routine and character generator—it works very well on my very cheap and rudimentary 'scope'. I also have a few display, delay and clocking gimmicks.

Finally, I am very interested in the November article *How to play Mastermind*. I am particularly keen to get it into my Vim monitor and would welcome any advice, especially on how to produce an 'aesthetic' display with the minimum pressing of keys and Hex codes between moves, segment patterns, and so on.

The Vim manual lists the equivalents of GETKEY & AK but not the other monitor calls; and there are various other functional differences.

Len Green,
15 Jotan Street,
Achuga, Haifa,
Israel.

Malaysia bound

I AM hoping to buy a computer in England, perhaps next year, and to take it to Malaysia with me in the summer. In my mind now I have three computers to choose from —Pet, Exidy Sorcerer and the new contender Superboard II. Can you please give a review about the second and the latter?

From the above three computers, can you please help me to choose which one suits me best from the following guides:

To use it as a personal computer; to teach my sisters and brothers more about Basic; to play some games for the family; ability to add other manufacturers' plug-in memory; low power consumption; portable.

I am also most concerned about the servicing of the computer as there are no service facilities near me. If you have any extra advice, please reply and I would be grateful. In particular, if you know of any company with some link with a company in Malaysia, I would be most interested.

Lastly, can you please give me the address of Ohio Scientific because I want to give some extra ideas to the Superboard II.

A. G. Adam,
Worksop, Notts.

● **We have discussed both the Exidy and the Ohio microcomputers, though we have not done a full-scale review on either. You may, however, be aware that delivery on the Ohio Superboard is delayed. Contact Abacus Computers (tel. no. 01-637 0777) for the latest news.**

In any case, from your list of requirements only the Pet looks an obvious choice. In particular, there is now a very wide range of add-on hardware options, including floppy discs and printers, and ready-to-go software from independent suppliers and from Commodore. Pet has a fine Basic, it is portable, it seems reliable, and it has built a good body of knowledge around it.

We asked Commodore about your nearest Pet agent and the only address produced is: Commodore Japan Ltd, Paisei-Benshi Building, 8-14 Ikue 1-choee Asahy-Ku, Osaka 535.

Buss exchange

THE REVIEW of "Heath's Kit" in your November issue was most interesting. I edit *Buss: The Independent Newsletter of Heath Co. Computers*, to which the article referred. One of the four pages of the September issue of *Buss* was devoted to a letter from a fellow who took an H11 into England by rather unconventional means.

I would be willing to offer *Buss* to anyone mentioning *Practical Computing* at the modest discount of $10 for 14 issues by airmail. At the subscriber's option this could start with either the current issue or available back issues.

Charles Floto,
***Buss*,**
325 Pennsylvania Ave, S.E.
Washington DC 20003

Users' club

WE ARE in the process of forming a National Association for all those working with the 6502 microprocessor (Kim-1, Sym-1, Aim-65, Superboard II, Pet, Apple II, and the like.

We see the objectives of the association as providing a medium for the sharing of information which will benefit both the new user and people with more experience in this field. If you are interested, please contact me.

W. R. Wallenborn,
21, Argyle Avenue,
Luton, Beds LU3 1EG.

● **6502 enthusiasts, including Pet and Apple owners, should also note the existence of the 6502 Program Exchange, an excellent organisation in the States whose stated aim is "to provide a means of exchanging tested software for 6502 systems at reasonable prices".**

Much of it is from user groups and is charged at a bargain price, equivalent to 50 cents per page of assembly code, $3.50 per page for code in Tiny Basic, or a Focal implementation is also available from the exchange. The Tiny Basic, incidentally, costs $7.50, as a hex dump, hex format buff tape, or on Kim hypertape.

Other goodies from the Exchange newsletter are a Kim-to-S100 bus adapter for $165. The address is 2920 Moana, Reno, NV 89509, U.S.

Prize offer

AFTER READING your excellent article in the November issue of *Practical Computing* concerning the future of personal computing in schools, I noticed a footnote concerning your willingness to correspond with people either developing subject courseware or with those requiring more information about microcomputers and education.

I am a newcomer to the field of computers and computing and I have been trying to absorb the largest possible amount of information concerning microprocessors, programming and other related subjects.

I have recently been practicing on the local university computer terminal Basic and Fortran and with these two languages I have taught myself Cobol, all with the aid of books only. I am still a member of the country's education system and I have been writing, and I might add enthusiastically, programs for my maths and physics. I have found that by dissolving the mathematical principles and re-constructing them stage by stage into a computer program, it makes clear to me the more fundamental principles concerned.

I have also recently been to a lecture about microelectronics and data transmission systems. Since this lecture and your article concerning the use of Pets in the classroom, I have researched more deeply into job possibilities in this field and have decided that with my love of maths and physics and electronics computers are to be my career.

I wondered if you could possibly increase my knowledge upon the subject of how education might differ in about 20 years, from what it is like at present.

R. J. R. Morris,
Caerphilly
Glam.

● **We could write pages on what computers will be like in five years, let alone 20. Anyone with an idea on how a computer will perform in five years' time, however, can write to us and we will give a prize for the most original thoughts.**

Tandy printers

I OWN a Tandy TRS-80 system and I am interested in including a printer. I note that a printer is made by Anadex Ltd. and perhaps you will kindly let me know if this will couple and work from a TRS-80 expansion interface.

T. R. Martin,
London SW9

● **As far as we know the Anadex printer will not work directly from Tandy TRS-80 interface, but for about $80 Tandy will sell you an RS-232 interface conversion. This will allow you to attach the Anadex, and indeed other printers.**

Nascom club is formed

THE INTERNATIONAL Nascom Microcomputer Club is not least a formal recognition of the impressive success of the Nascom-1 micro. The club is organised by Nascom. The supplier says its prime objective is "the exchange of programs and ideas for developing the Nascom-1" and that must be entirely commendable.

Membership is open to anyone for £5 a year. The principal benefit is *INMC News*, issue one of which appeared in December. It consists largely of messages from Nascom, a few apologies for unsatisfactory hardware items and delivery delays, tips for tweaking systems and getting around operational inefficiencies and a handful of job advertisements. Nascom obviously expects more user feedback in successive issues.

Incidentally, if there's any demand from *Practical Computing* readers, we will be pleased to start a Nascom-1 page along the lines of the Pet and TRS-80 pages. Let us know what you think—much of the input will have to come from you.

Zilog package for MCZ and ZDS

ZILOG MCZ and ZDS users will be glad to learn that the company is now marketing a Z8 Software Development Package, an assembler and simulator, which allows you to write and debug Z8 software without having Z8 hardware.

The package will run on any MCZ or ZDS system with 60K bytes of memory. The two major components of the package are the assembler for the Z8 PLZ/ASM structured assembly language and the Z8 Simulator.

Special features

The assembler lets you generate re-locatable and absolute object code and special features include conditional statements, CASE statements, a DO . . . OD looping construct and procedures. Data structures include bytes, words, arrays and records. Data and instructions can be mapped into any of the three Z8 address spaces—register, data and program.

The simulator enables you to set and display simulated memory, set breakpoints, and access simulated external memory. A special shadow memory feature permits you to know whether a particular memory location has been read, written or executed.

The Software Development Package is a diskette with software and documentation including a technical manual, a Z8 assembler users' guide, a PLZ/ASM programming manual, a simulator manual, sample programs and sample simulator sessions.

Detailed pricing and ordering information is available from your local Zilog dealer. The package is available with 30 days' delivery.

Micro course at Reading

CELDIS MICROSYSTEMS of Reading runs a three-day micro course which looks comprehensive.

It presumes a certain amount of knowledge on your part, so if you are a beginner, it is not for you. Celdis expects you to know about binary, octal, BCD and hexadecimal numbering systems, signed and unsigned arithmetic, Boolean logic and TTL family.

The workshops are run once every month and will cost £140 per person, plus VAT. That includes lunches and full documentation but not accommodation.

More information from Julie Lea on Reading (0734) 598848.

Impressive guide

IF YOU have £5 to spare, you could do worse than to spend it on "the most comprehensive sources of microcomputer software ever published". That modest title is claimed by *The SSI Microcomputer Software Guide* and though we don't really like subscribing to such over-enthusiasm, we are forced to concede that the 2,000 or so programs referenced in this 124-page paperback constitute an impressive list.

They are all American, of course, but all authors and suppliers are noted. For each program entry the Guide may or may not give enough information to specify exactly the system on which it can run; some programs are named without any further explanation—that usually means they are in a Basic—while others include notes on exactly which implementation of which language on which particular micro, the medium on which the code is supplied, and the host operating system required.

There are 236 separate classifications, including 20 pages under Games. Pet and TRS-80 are separate categories, two pages for the Tandy, three for Pet.

It's a good guide, especially if you're looking for software, Why doesn't someone sell it here? In the meantime, you can order it (cash with order, we're told) from SSI at 4327 E Grove St, Phoeniz, AZ 85040, U.S. If you have any difficulty, we will probably be able to obtain it for you.

ACTRESS Joanna Lumley, who played 'Purdie' in The New Avengers TV series, presenting the robot prize to Fiona Mackay (12), of Rickmansworth, who won first prize in the Altergo painting competition. The presentation was made at the British Computer Society Young Computing Funfair.

PCNET is method to link personal computers

SOMEONE told us about PCNET, so we sought more information. It sounded interesting—people looking at ways to hook together personal computers.

Eventually we reached Dave Caulkins, who is 'co-ordinator' of the PCNET Committee. He says that PCNET is a loosely-organised group of volunteers in California, plus a mailing list of about 500 names—"but we are starting to make progress". That consists of some experiments to try the PCNET software in practice.

The goal of the PCNET organisation is the provision of "a reliable, low-cost means of transferring messages or files between personal computers", using ordinary voice-grade dial-up telephone lines.

PCNET is aiming at unattended operation—with one computer transmitting automatically and initiating receive mode automatically at another—to take advantage of cheap-rate late-night connections.

Great potential

The prospect of this is obvious and its potential is enormous—instant communication between enthusiasts; instant transfer of programs and data; instant updates to existing software.

It could even be the start of a small but important social change, with increased dissemination of ideas and information which could lead eventually—here comes the starry-eyed visionary bit—to a reduced need for urban conglomerations.

Returning briefly to earth, you can't create an interlinked network of Pets and TRS-80s and Nascoms like that. You have to develop standardised forms of communication all participating computers will understand, and which they will all be able to use. That is what a communications protocol is, and developing protocols is the principal activity if the PCNET Committee.

From here it becomes a trifle esoteric, so we'll be brief. The PCNET 'protocol working group' has produced a five-level protocol which covers everything from the way a computer plugs into a telephone line—in the States they use modems—right to the kind of electronic mail programs you'll need to switch around messages between participating computers.

The first problem is the fact that the telephone line works on analogue signals and your computer works with digital information. A modem is a black box which converts digital to analogue, so you can transfer computer data to the phone line and send it, and vice versa, so that it can be re-converted at the other end.

In the States the telephone companies are fairly sanguine about what you attach to their lines; they have to approve the modems, but several modems are available and approved—PCNET has found three it regards as particularly suitable. Two are S100-compatible, one likes the Pet, and prices range from $280 to $395.

In Britain, the Post Office is much less accommodating. You take either its modems for your dial-up link, and pay the price, which isn't anything like $395; or you rent your own line, which is clearly out of the question.

There is, of course, the acoustic coupler. This is a kind of modem—it does the analogue-digital conversion—and it doesn't have to be cable-connected to the telephone lines. It is connected to your computer and it has a padded receptacle on it into which you place the handset of an ordinary telephone receiver. So you disconnect nothing and you don't tamper with the Post Office lines.

Distortion

Because you are employing the telephone handset the chances for electrical noise are much increased, and this can distort the data you are trying to send or receive. The Post Office might not like it very much, and even an acoustic coupler will cost £300 or more.

Still, the chances are there. We would be most interested to hear any news and views on the interconnection of personal computers in Britain.

Meanwhile, we'll keep you posted with PCNET. Last year it demonstrated several inter-computer connections successfully. Two PCNET members have set up an interesting Community Bulletin Board System in California which can be called to read or leave a message. How about that for a U.K. project?

Selling Triton in parts

IF YOU can't afford to pay hundreds of pounds to buy your own computer, Transam Components may have just what you're looking for.

It has decided to sell its Triton single-board computer in individual component parts as well as in kit form, so that instead of buying everything at once, you can take your time about it, without upsetting your bank manager.

The Triton has resident Basic in EPROM, graphics, memory mapping, and a modem-controlled data-handling feature. The single board holds 8K of memory, full power supply, and will interface to standard audio cassette and domestic TV. It is complete with 56-key ASCII keyboard, a custom-designed case and a fully-comprehensive manual.

Transam says that it is easy to construct and versatile to use. It has fully-buffered outputs for up to 64K memory, 256 input/output ports, and eight levels of interrupt.

Programs run in Basic and machine code, and the total price of the model is £286 plus VAT. All resident hardware is in EPROM and Transam offers an EPROM programming service for Triton users who want to "burn-in" their own resident hardware.

Transam is developing an expansion motherboard and 8K RAM, 8K ROM and serial interface boards. They are expected to be released shortly.

The Triton is available from Transam Components at 12, Chapel Street, London, NW1. Telephone 01-402 8137.

NASCOM 1 AT MICRODIGITAL

The Microcomputer only shop providing a complete service from a single chip to a commercial data processing installation. Well worth a visit for a look around and a chat.

NASCOM I..... £178.20
From 10th February 1979.
Includes VAT and carriage.

The Nascom I was exceptional value for money at the old price, now it is unbeatable.
The Nascom I is the best possible introduction to the world of personal computing, yet it has the power and flexibility to be expanded into a full data processing system.
The specification includes powerful Z80 processor, parallel I/0 controller with two 8 bit ports. UART driving cassette interface or most serial peripherals, video output to plug in the ariel socket of your T.V., 2K bytes of RAM (IK user and IK video), proven IK byte monitor program in EPROM and a spare EPROM socket.
The kit is complete, all that is required is a power supply a domestic T.V. and a domestic cassette recorder.

POWER SUPPLIES
There are two power supplies available, a 3 amp supply which will power the basic kit and some expansion and an 8 amp supply with toroidal transformer which will power a very large system. Both supplies can be mounted in the vero frame.

3 amp P.S.U. kit..... £26.46
8 amp P.S.U. kit..... £64.80

EXPANSION
Nascom I is expanded by connection to a buffer board which creates a 77 way bus structure "NASBUS" into which expansion boards plug directly. The bus structure is carried along a motherboard which allows future boards to be added and to keep your computer neat the Nascom I, power supply, buffer board, mother board and expansion boards can all be mounted in a vero frame.

Buffer Board..... £27.00
Mother board..... £10.26
Mini Motherboard..... £3.13
Vero frame..... £31.86

NASBUS
The 77 way Nasbus has the following advantages:—
1. Uses standard Veroboard as a motherboard and Standard 0.1" single sided edge connectors for expansion cards. These components are readily and cheaply available.
2. The bus structure leaves 8 spare data lines and 4 spare address lines for future use of 16 bit processors.
3. The power lines are regulated, on board regulators are therefore not needed which obviates the necessity for fan assisted cooling.
4. All cards use lower power, low noise shottky buffering which means the bus is quiet and does not need sophistications like active termination or interleaved ground planes.
5. Expansion boards are standard 8" x 8" vero DIP boards which are economic and give a good useable area.

MEMORY
The memory expansion board can carry 16 dynamic RAM chips, these can be either 4K bit or 16K bit chips and the board is offered with8,16 or 32K bytes of RAM. The 16K board can be expanded to 32K by plugging in 8 more 4116 chips.
The memory expansion board also has room for 4 2708 UVEPROMS each of IK bytes and a lot of pre-programmed systems software is available to fit these sockets.

8K RAM board kit..... £91.80
16K RAM board kit..... £151.20
32K RAM board kit..... £216.00
Set 8 x 4116..... £75.60
Additional 2708..... 11.34

INPUT/OUTPUT
For people wanting to use more peripherals than the standard kit allows for, Nascom are producing an I/O board which can carry a counter timer chip and a number of PIO's and UARTS. This will be available in March.

I/O board..... £37.80
CTC..... £8.64
UART..... £5.94
PIO..... £8.64

BASIC
To allow high level language programming Nascom have produced a 2K Tiny basic and a 3K Super Tiny Basic in 2 or 3 2708 EPROMS respectively. Also available is an 8K Microsoft precision floating point basic in 8 2708's which will be available in April on a single 64K bit ROM to fit the EPROM board.

Tiny Basic..... £27.00
Super Tiny Basic..... £37.80
8K Basic (8 x 2708)..... £108.00
8K Basic (ROM)..... £43.20

EPROM BOARD
Available in March this board will carry 8 x 2708 UVEPROMS and the 64K bit ROM containing basic. The board can also be used for burning in 2708 UVEPROMS.

EPROM BOARD..... £43.20

GRAPHIC BOARD
Allows high resolution graphics on your Nascom I. Contains 4K of RAM.

Graphics board..... £102.60

MONITOR
Nascom have written a new monitor, T4 the most powerful yet available for this machine it contains many desirable features not found on any other monitor. T4 comes in 2 x 2708 to plug into the main Nascom I board.

Nasbug T4..... £27.00

FIRMWARE
A powerful editor assembler zeap 15 available to run under Nasbug in 3 x 2708 or on tape. ICL Dataskill have produced a letter Editor available in 2 x 2708.

Zeap (tape)..... £32.40
Zeap (Eprom)..... £48.60
Letter Editor..... £75.60

THE FUTURE
In the near future a mini-floppy disk system will be available with either single or double drive. These will probably offer in excess of ½ a megabyte and 1 megabyte respectively at prices that will allow even the hobbyist to have a large data base. To take full advantage of the business and scientific uses opened up by disks Nascom intend to release several high level languages. Looking further forwards Nascom is a developing product, and the fact that many thousands are now in use will ensure that the latest in computer technology will be available at a competitive price.

OPENING HOURS: *9-5.30 Monday to Saturday. Friendly, expert staff always on hand!*

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or complete this order form

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MICRODIGITAL LTD. 25 BRUNSWICK STREET LIVERPOOL L2 0BJ Tel: 051-236 0707

● **Circle No. 129**

Sailing along with your programming skills

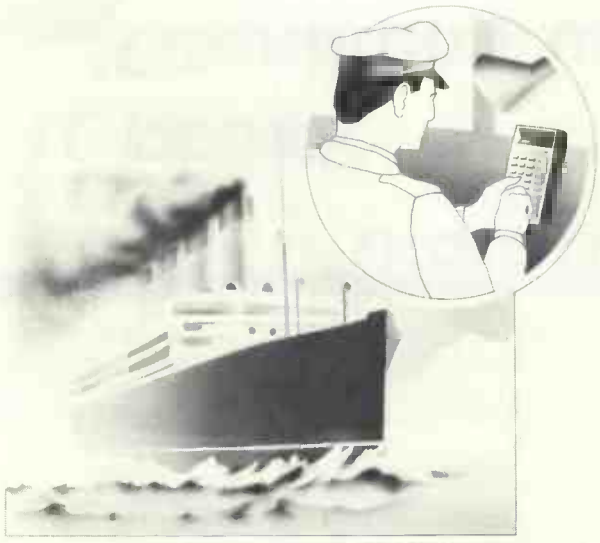
IF YOU want to combine your programming with your sailing skills, then Texas Instruments latest product is for you. It is a complete electronic navigation package, tailored specifically to the needs of small boat users, especially those who are all at sea when it comes to finding their way home.

The system is called Navigatronic, and is made up of a TI-58 programmable calculator with up to 480 program steps, a marine navigation solid-state software program library and a 12-24V dc adapter/charger. This is mounted in a luxurious brass-handled, mahogany case which would give a touch of class to even the humblest vessel.

The case houses a label cards holder, marine navigation quick-reference guide, and a block notepad and pencil. There is also a 220V ac adapter charger for shore use.

Texas says the package is designed to meet all navigational needs, from racing to cruising or ocean-crossing navigation. There is a comprehensive library of 30 programs, including coastal navigation to compute relative or absolute position; speed made good and true course; time, speed and distance equations; distance to horizons; even star identification and planet location—in fact, everything you could need to reach your destination.

The dc adapter/charger includes automatic voltage selection, is protected against radio frequency interference, and operates with either polarity. The package retails at £149·95, including VAT.



Micros in kitchen

PRESTIGE, the household equipment firm, is organising a competition for suggestions on the use of microprocessors in the kitchen.

All you have to do is design a piece of kitchen equipment which uses a micro. If Prestige thinks it's good enough to sell commercially, it will give you the option of selling it the design at the end of the competition.

The rules are very simple. The product should be designed to sell at £100 or less and the design must be something to do with food or recipes. No washing-machine applications—it's all been done before.

Two first prizes of £1,250 will be offered. If you're interested, we have the address to which your entries should be sent.

Better support for Kim

THE recent fall in price of the Commodore Kim 1 has allowed GR Electronics to put together a package which includes the Kim, a power supply, and an 8K RAM and 8K erasable PROM extension board for less than £300.

The Kim 1 was reduced to £99 plus VAT in December and its increasing popularity has led to better support for the machine. GR Electronics of Newport has been appointed sole U.K. distributor for the range of hardware and software produced by Computerist, of Chelmsford, Massachusetts, for the Kim and other 6502-based systems. GR has appointed other dealers in several areas over the last few weeks.

The available software offers several business applications, including editor, mailing list and information retrieval packages, as well as chess and other games programs.

Assembler for calculators

HELPING you build a bridge between assembler and calculator operation is SIA Computer Services, with its new technical language, ASSIST.

The langauge was designed specifically for Motorola 6800s for those who find difficulty with software but can operate programmable calculators successfully. It has straightforward verbs such as load, store, add and subtract, and more complicated ones like log, sin, cos, tan and square root.

The package can be controlled via an executive/operating system block which can handle up to 16 programs running at the same time.

You can provide up to 256 external routines which interface directly to ASSIST programs, which means that functions best performed in assembler can be controlled by you. the system designer.

Subroutines can be stored to any depth, and the subroutine address library is a LIFO stack. Real-time functions include programs being able to run any other programs, calling for any other to be revived, and dropping itself from the system—becoming idle or suspended pending a transaction completion. A time-slice version of the package is available but it makes more extravagant use of memory than the normal multiprogramming ASSIST.

There are 256 storage areas available to the user but they need not all be put to work. Many ASSIST solutions use only a few areas, thus saving on RAM space. The package is available in ROM form or as an Exorcizer-compatible card with RAM and I/O ports.

As yet, there is no price on the system as SIA says it is still adding enhancements.

Roadrunner board aid

ROADRUNNER may sound like something from a Warner Brothers cartoon, but it is, in fact, the latest prototype wiring system for circuit boards from TJB Associates.

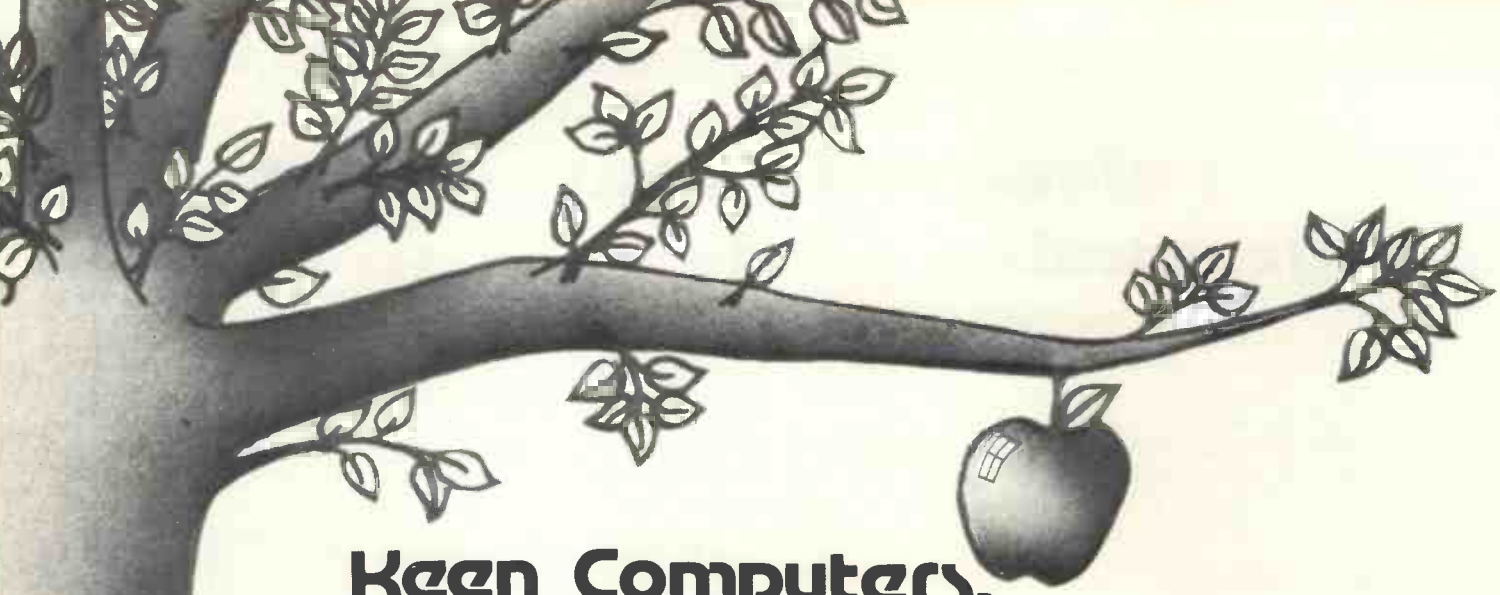
It is a cost-effective device, giving a fast, accurate means of producing pre-production circuit boards of any type, size or integrated circuit packing density.

The key to the system is a new "pencil", a wiring instrument which feeds the quick-soldering enamelled wire from interchangeable bobbins. Special features include the simple threading system which allows fast change of the bobbin and the device provided for adjusting the wire tension.

The distribution strips used in the system are low-profile, press- or glue-fix and have the capacity for retaining a large number of wires securely in position without affecting the low profile of finished boards.

TJB will supply Roadrunner in kits which include a circuit board, wiring instrument, distribution strips and spare bobbins of wire in four colours. A typical kit costs £8·50. and individual components are available separately.

More information from TJB, Haslemere (0428) 52511.



Keen Computers, Spread Their Wings

Hardware

You've heard about the new attaché—we stock it. We are the Midlands distributors of the sophisticated attaché business computer from America: This is a purpose designed business computer supplied complete with monitor, dual 8" floppy disks and printer. We also stock the **Apple II**—the best micro for its price available in the U.K.

Attache	£5,895	Disk & controller	£425	Decwriter II	£1,050
Apple II 16K	£ 985	Applesoft ROM	£110	Centronics 779	£ 850
16K Memory	£ 160	Printer card	£110	Axiom micro printer	£ 350
		Communications card	£110	Axiom printer/ plotter	£ 699

Software

We have a full range of software for the Apple II, available on disk or cassette:

- Incomplete Records Accounting
- Addressing & Mailing program
- Word Processor
- Chequebook
- Shape-create
- Variance
- Data Testing
- Matrix Inversion
- Information Retrieval
- Co-resident assembler
- Regression
- Standard deviation
- Correlation
- Distribution

Personal Software MICROCHESS for the Apple II computer, Tandy, and the Pet.

Keen Computers Ltd,
5 The Poultry, (off Market Sq)
Nottingham
Tele: Nottm
583254/5/6

● Circle No. 130

Wide choice available but no accepted standard

This month *Practical Computing* looks at single-board computers. Starting at £50, they are ideal for training, developing systems or just for playing around.

As a descriptive definition, the term single-board computers is somewhat restrictive, because there is no universally-accepted board size, and no accepted standard as to what components ought to be included on the board to constitute a computer.

Therefore on the one extreme, the Rockwell AIM 65 is an all-singing, all-dancing board complete with dedicated QWERTY keyboard, 20-character LED display, 20-character hard-copy, roll printer and single-chip CPU.

At the other extreme is the 'half-card' LSI-11/2 from Digital Equipment Corporation with multi-chip CPU and no memory or interfaces. For all but bottom-end applications, though, one will need additional boards for almost any single-board computers.

Single-board computers are essentially designed as replacement modules for discrete logic and even for discrete component electronics. Many have little by way of real software other than elementary firmware monitors to control LEDs, set breakpoints, debug and edit hex programs.

That is particularly true of training systems/courses which are not really applications-orientated. They are more orientated to the component level and their manuals determine whether they are good or bad.

For applications-orientated systems, software is essential. This may be in a variety of forms, such as an extra-cost Basic interpreter and/or operating system burned into ROM, or loaded to RAM from cassette or floppy disc storage.

Alternatively, applications may be developed on special-purpose development systems, or even off-board on a minicomputer for compatible boards such as the Digital LSI-11, Data General MicroNOVA or General Automation GA-16/110 & 220.

Every board has its strengths and weaknesses; a really cheap one will have limited use and the very expensive one will probably be under-utilised. One may have better computational capability than another, but poor video graphics facilities. You would be well advised to define your requirements as accurately as possible before dipping into your pocket.

Some boards may be more easily obtainable than others and suppliers to the wholesale (known as OEM) market may feel some self-righteous revulsion to hobbyists.

Manufacturer	Model	Price
Advanced Microcomputer	AMC 95/4000	Not available
American Microsystems Inc	EVK Series	Not available
Brutech Electronics	BEM-CPU I	£116
Commodore	Kim I	£99·95
Computer Automation	LSI 4/10	£387
Data General	MicroNOVA	£505
Digital Equipment Corp	LSI-11	£650
EMM Sesco	SECS 80/10A	Not available
General Automation	GA-16/110 & 220	Not available
Heathkit	Training Course	£248·70
Intel	iSBC 80/10A	£303
Intel	iSBC 86/12	£1,399
Integrated Computer Systems	Training System	£349
Mostek	OEM 80E	Not available
Mostek	MD Series	Not available
Nasco Sales	Nascom	£167
National Semiconductor	BLC 80/10	Not available
Newbear	7768	£50 approx.
Ohio Scientific	Superboard II	£284·95
Plessey Microsystems	Miproc	£500
Pronto Electronics	Z80 Eurocard (3 off)	£265
RCA Service Div.	Cosmac Eurocard	Not available
Real Time Controls	RTC 5100	Not available
Rockwell	AIM 65	£249·50
Texas Instruments	"Micro 99"	£350 approx.
Zilog	Z80 MCB	£329

Advanced Microcomputers

THE AMC 95/4000 MonoBoard Computer (MBC) from Advanced Microcomputers, an affiliate of Siemens in Europe, is fully bus-compatible with Intel SBC 80 products.

AMC popularity, however, stems from its AMD Am 9511 Arithmetic Processor Unit. Arithmetic computations are performed by this special-purpose processor to realise a throughput up to 100 times faster than comparable software approaches.

This unit is contained on the AMC 95/6011 board to provide 32-bit floating point arithmetic, 16- and 32-bit fixed-point arithmetic, and data format operators for fixed-point and floating-point conversions.

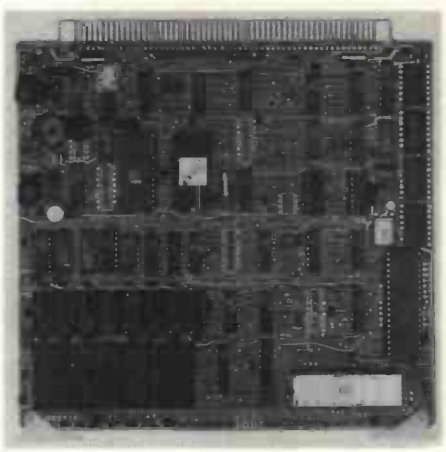
There are 4K bytes of RAM and sockets for up to 12K bytes ROM on the AMC 95/4000 board. By replacing a single address decoder PROM, the entire 16K bytes of address space can be re-organised, thereby permitting memory selection to external boards.

The communications port is fully-programmable and supports synchronous or asynchronous communications with full duplex capability.

An auto-initialisation feature allows repetitive DMA operations such as VDU refresh or memory buffer transfers without the need for re-programming of the DMA channel. Four DMA channels are incorporated on the board.

Memec Ltd.
Thame Park Industrial Estate,
Thame, Oxon
Tel: (084421) 3146

Memec



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American Microsystems Inc.

AMERICAN Microsystems Inc (AMI) has based its EVK Series Board on the Motorola 6800 MPU. The EVK 300 is a fully-assembled and tested board, while the EVK 200, and EVK 100 and EVK 99 are in kit form. All kits are fully-expandable to EVK 300 capabilities.

One of its main features is the ability to program S6834 EPROMs (512 bytes) on-board from any memory location, RAM, ROM or EPROM.

The standard system clock is adjustable from 300kHz to 1MHz and an on-board interval timer gives 1ms and 100ns timing marks for EPROM programming and general use. Three types of DMA operation are possible—halt processor, cycle steal or multiplexing.

All memory and I/O on board may be disabled externally by an edge connector line called 'memory disable', leaving the MPU free to operate a totally external memory.

A prototype Operating Library (Proto) and a ROM Subroutine Library (Rs) comprising the system monitor are contained in S6830 ROMs and require 256 bytes of RAM. An optional assembler/disassembler (M/AD) S6831 ROM is available to operate with Proto.

A 20 mA current loop and an RS232C interface are both available on the board. Three S6820 PIAs allow up to 58 I/O lines.

American Microsystems Inc.
108A Commercial Rd.,
Swindon, Wilts
Tel: (0793) 31345

Brutech BEM-CPU 1

BRUTECH Electronics is a Dutch company and a relative newcomer on the scene with its BEM CPU 1 central processor card.

The card is based on the 6502 CPU and except for a small 32-byte PROM is not supplied with memory or other addressable devices. The PROM may be switched off, enabling the user to have full access to any memory location under DMA control.

Therefore it has to be used in combination with other cards to create a working system and these are offered, too, including 2, 4, and 8K RAM, EPROMs and Interfaces.

No manuals are provided and for a detailed description of the 6502 CPU, Brutech recommends the hardware and applications manuals of MOS Technology, Rockwell and Synertek.

Data Precision Equipment Ltd.
81 Goldsworth Road, Woking,
Surrey GU21 1LJ.
Tel: Woking (04862) 64444

Kim 1

WHEN Commodore decided to buy its own semiconductor manufacturing company, MOS Technology, it inherited the Kim 1 microprocessor system based on the 6502 CPU, the MOS Technology version of what the Motorola 6800 should look like.

Kim 1 is assembled on a PC board with 2K bytes of ROM, 1K bytes of RAM, hex keyboard and six-digit LED display. Three manuals accompany the system—user, hardware and software.

Memory may be expanded by 4K and 8K RAM using Kim 2 & 3 boards, and a cassette and Teletype interface is already on-board.

Software available includes an assembler/disassembler/editor package, an information retrieval package and a mailing list program, according to Commodore claims. They are loaded from cassette and prices start at £12. A chess game is also available.

Kim is marketed in the U.K. by an electronics chain, Marshalls, and by GR Electronics of Newport, Gwent. The latter offers a pocket terminal for £240 for the input of ASCII characters from 40 keys, and a video board for attachment to a domestic TV set for £150.

If the prices are disconcerting, the price of the Kim should help you change your mind—£99·95.

Commodore, 360 Euston Rd.,
London W1
Tel: (01) 388 1358

Kim 1

Computer Automation

THE Computer Automation LSI 4/10 features a high-speed processor with a powerful instruction set, up to 4K RAM and four distributed I/O channels.

An optional configuration includes a processor and I/O-only version, plus various RAM PROM combinations. The distributed channel technique utilises the CA microcoded, Picoprocessor-controlled intelligent cables.

Each I/O distributor accommodates up to four or eight intelligent cables. For high data-rate applications, a four-channel DMA version is available. Also available are I/O controllers for floppy medium- and high-capacity disc drives, and a full range of peripheral devices.

Core memories are offered in 4K- to 16K-word cards, semiconductor RAMs up to 32K words with cycle times as fast as 550ns, and RAM/ROM/PROM combinations up to 2K-word RAM and 8K-word ROM. All semiconductor memories have provision for battery back-up.

The Naked Mini 4 Operating System supports a macro-assembler, Fortran IV, Basic and Pascal, and editors, file and data management routines, utilities and handlers for I/O and communications.

Computer Automation
Hertford House,
Denham Way,
Maple Cross, Rickmansworth, Herts.
Tel: (87) 71211

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Data General

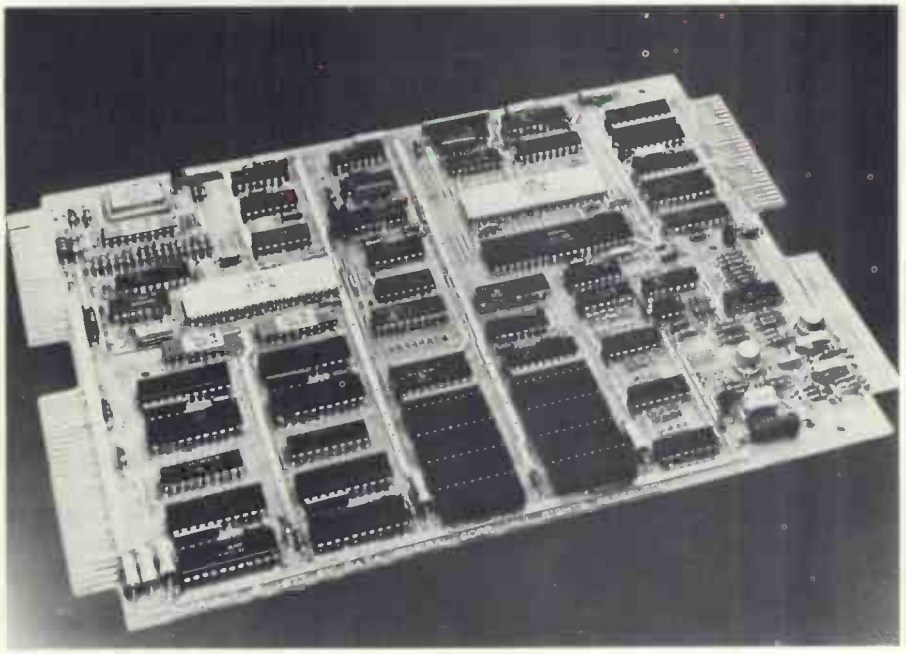
DATA GENERAL'S MBC/1 is bound to become a serious challenger to the Digital LSI-11 single-board computer. The MBC/1 comprises a 16-bit MicroNOVA CPU, 2K bytes static RAM, sockets for 4K bytes of PROM, an asynchronous communications interface, and a 32-line digital I/O port on a single 7½ × 9½ in. board.

This type of board is at the top of the league as far as hobbyists are concerned. A multi-tasking software support package (MBC/M) provides an emulator for other Data General systems which allows MBC/1 users to develop programs under the Data General Advanced Operating System (AOS), Disc Operating System (DOS), and Real-time Disc Operating System (RDOS) and a monitor for program execution on the board.

An optional on-board ROM console debug and self-test diagnostic chip is also available. The MBC/1 is compatible electrically and mechanically with the entire MicroNOVA family.

Applications may be developed using Fortran IV, single- or multi-user basic, in addition to the standard utilities in DOS which include a macro-assembler, command line interpreter, library file editor, text editor, re-locatable loader and Symbolic debugger.

The end-user distributor is Celdis.



Data General MBC/1

Data General,
Hounslow House,
London Rd.,
Hounslow, Middx.
Tel: (01) 572 7455

Digital Equipment Corporation

DIGITAL Equipment Corporation's LSI-11 was reviewed in depth in our sister magazine, WHICH COMPUTER? in July, 1978 and we reproduce the following extracts:

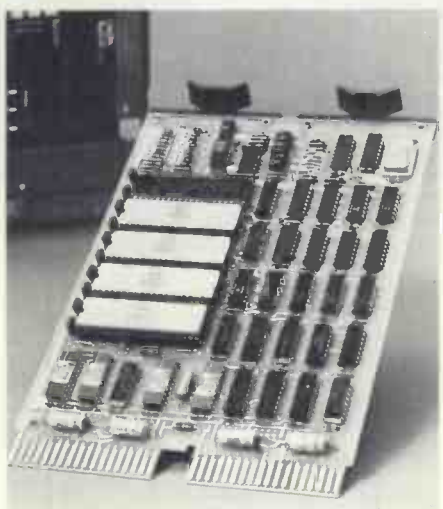
"The LSI-11 chip set was developed originally to Digital specifications by a West Coast semiconductor company, Western Digital, for a 16-bit microprocessor which would relate to the best-selling PDP-11 line.

"Many of its U.K. sales have been made through distributors like Dicoll, Rapid Recall and Midlectron. The LSI-11 is a single-card PCB which includes the CPU —basically four NMOS chips, two of which implement the PDP-11 instruction set and an on-line diagnostic routine, with a fifth chip supplied optionally at extra cost for extended arithmetic, including floating-point instructions.

"Also on-board are the input/output control, real-time clock, power fail/auto re-start, and a basic 4K words of semiconductor RAM.

"System software includes RT-11, a small real-time disc operating system in single- or multi-user versions, but not time-sharing. RT-11 is designed for on-line program development and interactive applications.

"RSX-11S is an execute-only version of a more powerful operating system. Up to four Basic programs can run in foreground, with background batch work on the multi-user RT-11".



LSI 11/2

Digital Equipment Corporation
Fountain House,
The Butts Centre,
Reading, Berks.
Tel: (0734) 583 555

EMM Sesco

SECS 80/10A is a severe environment equivalent of the Intel iSBC 80/10A supplied by EMM Sesco with 8080 CPU, 1K bytes of RAM and sockets for 8K bytes of ROM.

As it is designed for airborne, shipboard or land-based applications primarily for the military market; it might be of little value to the hobbyist and difficult to obtain.

The SECS 80/10A contains 48 programmable parallel I/O lines implemented with the use of two Intel 8255 Programmable Peripheral Interfaces, and a programmable communications interface using the Intel 8251 Universal Synchronous/Asynchronous Receiver/Transmitter (USART).

The USART may be programmed by the system software to select the desired serial data transmission technique including IBM Binary Synchronous Control (BSC).

EMM Sesco
12 Redford Way,
Uxbridge, Middx.
Tel: (89) 38421

(*continued on page 31*)

(*continued from page 29*)

General Automation

THE General Automation GA-16/110 and 220 microcomputers are configured around a microprogrammed 16-bit CPU emulating the instruction set of the larger GA minis.

The GA-16/110 is designed as a 'load-and-go' computer for dedicated applications, without software development or sophisticated disc-based operating system.

The GA-16/220, on the other hand, has the full hardware configuration needed for program generation and for running all GA operating systems and software, except the Control IV memory management operating system for large GA-16/440 minis. In fact, it comprises two GA-16/110s attached back-to-back.

Small GA-16/110 and GA-16/220 systems are configured with one of two types of 'piggyback' memory modules; static RAM with 1K or 2K words, plus positions for 64 words of initial program load (IPL) PROM for simple applications, or 3K words of EPROM, plus 1K words of RAM working storage.

For larger systems, memory is expanded with plug-in, automatically-refreshed dynamic RAM modules of 4K or 8K words, available in 16-bit or 18-bit byte parity versions.

Programmed I/O takes place under CPU control for 16-bit parallel transfers at rates up to 120K words per second. Interleaved DMA and serial I/O is available only on the GA-16/220.

All programs are re-entrant and recursive, I/O device-independent and relocatable. Fortran, Commercial Fortran, and Cobol modules may be linked with assembly language subroutines to form a single program if required.

Other program generation tools include CAP-16 Macro assembler, Basic, Core Load Overlay Builder, Dynamic debug, Text editor, Utilities, and hardware diagnostics.

General Automation,
Victoria Road,
Burgess Hill, Sussex.
Tel: (04446)-43421.

Heathkit

IN our November issue we looked at what Heathkit has to offer in terms of packaged systems. Also available is a microprocessor course and trainer based on the Motorola 6800 MPU.

The hardware comprises a microprocessor board with six-digit LEDs, hex keypad, 1K ROM monitor, and 256 bytes of RAM which is assembled from a kit of 62 components. The course covers microprocessor basics, computer arithmetic, programming and interfacing.

This kit however, is not for the beginner, a fact which few suppliers of training kits care to admit. Heath can afford to because it has a beginners' course called Digital Techniques, a lower-level course more orientated towards electronics and logic design.

There is, however, a catch. Heath recommends the use of its IM-5284 multimeter (£40·18) and an oscilloscope such as its IO-4541 (£164·32) with this course.

The manuals must be the best-selling point for Heathkit and are among the best we have seen. Microprocessor training course costs £248·70 and Digital Techniques course £63·46.

Heath (Goucester) Ltd,
Gloucester GL2 6EE.
Tel: (0452)-29451

Intel

INTEL is almost synonymous with single-board computers. The iSBC is second-sourced by numerous semiconductor manufacturers and is a *de facto* standard in industry.

Intel also makes single-board computers based in its 8085 and 8086 microprocessors. The new iSBC 86/12 is claimed as 'the most powerful microcomputer board to be announced to date'.

It comprises 16-bit CPU, up to 48K bytes memory, parallel I/O and serial communication ports on-board. Intel claims that with a 5MHz 8086 CPU it exceeds the Digital PDP-11/34 in performance. The 8MHz version will be available 'shortly'.

The iSBC 86/12 plugs into the standard Intel Multibus for expansion, using cards available from Intel and more than 100 other manufacturers supporting Multibus.

With its announcement Intel revealed the purpose of several lines on the Multibus which were not needed by 8-bit microcomputer systems; eight additional data lines, four more address lines, increasing the number to 20 to cater for the iSBC 86/12 one-megabyte addressing capacity, and a byte-control line which allows 8- and 16-bit CPUs to be used on the same Multibus in a multi-processor system.

The 8086 instruction set includes multiply and divide in binary, BCD or ASCII. On-board memory on the 86/12 includes 32K bytes of RAM and sockets for up to 16K bytes of ROM. A dual-port feature allows the RAM to be accessed by both the 8086 CPU and any other bus master sharing the Multibus.

There is no shortage of software support for iSBC products, particularly the 80/10A, which, in addition to Intel development systems, may have applications developed on independently-supplied cross-assemblers and intermediate-code Cobol compilers such as those offered by CAP microSoft and Micro-Focus.

Intel Corporation (U.K.) Ltd.,
4 Between Towns Road,
Cowley, Oxford OX4 3NB.
Tel: (0865)-771431

Mostek

THE Mostek OEM-80E is a single-board microcomputer designed around the Z-80 microprocessor with 4K bytes of RAM expandable on board to 16K bytes, sockets for up to 10K bytes of ROM, serial port and 40 buffered I/O lines.

It is full-expandable with a wide range of Mostek SD Series boards. RAM-80E provides up to 64K bytes of MK 4116 dynamic RAM. FLP-80E will interface the board with up to four single- or double-sided floppy disc drives.

For connection to a video display, the VDI-S/P provides the interface for 80 × 24 upper- and lower-case characters and ASCII keyboard.

The SD Series also includes backplane cards, extender cards, and wire-wrap cards for easy systems construction.

Software support includes an operating system; FLP-80DOS, Basic, Fortran, Macro, and cross-assemblers.

Also available from Mostek are two other single-board computers .The MDX-CPU1 comprises Z-80 CPU, 4K bytes PROM and 256 bytes RAM on a compact 4·5 × 6·5 in. card. The MD-SBC1 has the same measurements but contains CPU, 8K bytes EPROM, 2K bytes RAM, two 8-bit input ports, and three 8-bit output ports.

The Mostek SYS-80F dual floppy disc development system features 32K bytes memory, Z80 CPU card with 3K bytes dedicated PROM, serial I/O port, four parallel I/O ports, with additional memory up to 56K bytes.

Mostek U.K. Ltd.,
Masons House,
1 Valley Drive,
Kingsbury Rd.,
London NW9
Tel: (01) 204 9322

(*continued on page 33*)

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London E8 4AE
01-254 3293

Dams Office Equipment Limited
30–36 Dale Street
Liverpool L2 5SF
(051) 227 3301

H.B. Computers Limited
22 Newland Street
Kettering
Northants
(0536) 83922/520910

Holdene Limited
10 Blenheim Terrace
Leeds LS2 9HX
(0532) 459459

Medical & Scientific Computer Services Limited
Altona Road
Lisburn, County Down
Northern Ireland
(084) 62 77533

Rockcliffe Brothers Limited
2 Derby House
Rumford Street
Liverpool L2 8SZ
(051) 236 6773

Sigma Systems Limited
54 Park Place
Cardiff
(0222) 21515

Torbus Business Systems Limited
500 Chesham House
150 Regent Street
London W1R 5PA
01-734 5351

● **Circle No. 133**

(*continued from page 31*)

Newbear

THE Newbear 7768 was designed as a rudimentary CPU board which could be bought at around £50 and expanded upon as time and pocket permitted.

The board is based on the Motorola 6800 MPU, 256 bytes of RAM, miscellaneous control logic and 'halt', 're-set', and 'load' switches, and is constructed from a kit.

Once this kit is assembled it will not be long for the 'expandability' bug to set in. A 4K byte RAM is available with straps which allow it to be set to any 4K block within the 64K-byte address block.

A monitor allows for the attachment of a cassette or paper tape drive and terminal comprising two UARTs with output buffers to interface with TTL or 20mA current loop or RS232C terminals, 1K byte of memory and provision for a 32- or 64-byte bootstrap loader in PROM to load a monitor from cassette or paper tape into the 1K RAM via one of the serial input ports.

(With acknowledgment to the Amateur Computer Club)

Newbear Computing Store
7 Bone Lane,
Newbury, Berks.
Tel: (0635) 49223

Nascom

THE Nascom 1 will need little introduction to most U.K. hobbyists because it has been promoted very aggressively.

Sold through Lynx Electronics of London, the Nascom is based on the Z-80 CPU and supplied in kit form complete with full QWERTY keyboard.

The kit comprises a 12 × 8 in. card, five LSI MOS chips (six with second EPROM option), 16 1K MOS chips (2K bytes) and 33 TTL chips, all packaged, of course.

Some of the so-called options are clearly necessary to get a going system, such as an extra 2K bytes of RAM, cassette modem or Teletype, CPU clock and video modulator.

A monitor allows for setting breakpoints, single-stepping and tabulating on screen.

Nascom Sales Ltd.,
92 Broad Street,
Chesham, Bucks.
Tel: (02405) 75151

Nascom 1

National Semiconductor

NATIONAL SEMICONDUCTOR has four single-board computer in its Series/80 microcomputer systems.

The BLC-80/10 is a self-contained board-level computer based on second-source 8080A CPU with 1K RAM and sockets for 4K RLM, 48 programmable I/O lines, and RS232C or 20mA current loop interfaces.

The BLC-80/11, 80/12 and 80/14 microcomputers provide greater on-board RAM capacity up to 4K bytes and jumper-selectable transmit/receive reverse for RS232C interface.

Software may be developed on the Starplex SPX-80/40 development system, a general-purpose, user-orientated hardware and software system based on the 8080 family processor with 64K bytes of RAM.

The Starplex system comprises keyboard/VDU, floppy disc storage up to one megabyte, 50 cps thermal printer, and PROM programming option.

System software includes operating system, macro-assembler, text editor, linker, debugger, Basic interpreter/compiler, and Fortran compiler.

Most of these products are plug-for-plug, second-source replacements for existing Intel SBC products but National claims to offer significant improvements, such as greater reliability, more convenient user options and cleaner design.

National Semiconductor U.K. Ltd.,
301 Harper Lane, Bedford
Tel: (0234) 211262

Ohio Scientific

THE Superboard II from Ohio Scientific provides a 6502 microprocessor, 8K Microsoft Basic in ROM, 4K bytes RAM, and full QWERTY keyboard with upper- and lower-case characters.

An optional expander board adds 24K bytes of extra RAM and interfaces for printer and mini-floppies. Otherwise the board supports Kansas City standard audio cassette interface.

Features include I/O utilities in ROM and direct-access video display with 1K of dedicated memory (beside user 4K memory), and upper- and lower-case characters, graphics, and gaming characters from a normal TV set.

An optional assembler/editor and extended machine code monitor is available.

Lotus Sound,
4 Morgan Street,
London E3 A5B.
Tel: (01)-981 3993

Plessey Micro Systems

PLESSEY Micro Systems offers a wide range of semiconductor memory systems compatible with all the popular microprocessors. They are designed to provide low-cost, versatile modules for both OEM and end-user. In addition, it offers the System 80 range of single-board computer products based on the 8080A and 8085. These modules enable powerful micro-

(*continued on page 35*)

At the Bloomsbury Centre Hotel, London
5–7 July '79

A three day exhibition, with seminars, developed from the highly successful 1978 DIY Computer Show. This year greater emphasis will be given to the rapidly expanding area of Personal Computers in Business.

Exhibitors will be able to sell their goods direct from the stands; creating an ideal market place for the ever growing number of personal computer retail outlets.

BOOK NOW – SAVE 20%

A discount of 20% is offered on all exhibition space for which full payment is received before 28 February 1979.

Seminars

Thursday, 5 JULY Microprocessors in Light Industry
Friday, 6 JULY Personal Computers in Business
Saturday, 7 JULY Personal Computers in the Home

Speakers will include:

Portia Isaacson (USA), Adam Osborne (USA), Howard Kornstein (Intel), Keith Baker (University of Sussex), John Coll (Oundle School), Mike Gurr (BOC), Guy Kewney (Computing).

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(continued from page 33)
computers to be built at competitive costs.

The key products in the range are the PMS 80/10, a self-contained, single-board computer including the 8080A CPU, system clock, RAM and ROM I/O lines, serial communications interface, bus logic and drivers. The PMS 8201 single-board disc controller supports two standard or mini-sized floppy disc drives and has on-card error-checking and logic for soft-sectored formatting.

The PSM 4463I memory boards with up to 64K-bytes capacity use dynamic RAMs to provide low cost and contain the board, the control and timing logic to provide transparent refresh.

Plessey Micro Systems
Water Lane,
Towcester,
Northants.
Tel: (0327) 50312

Pronto

AT Compec '78, a newcomer, Pronto Electronic Systems, launched a range of Z-80-based Eurocards and a graphics package consisting of four single Eurocards complete with software.

A three-card set provides a complete microprocessor system with Z80 CPU, 1K byte of RAM, sockets for 8K bytes of PROM, and PIO (programmable I/O) card for £265.

Pronto Electronics is a U.K. OEM supplier and consultancy and will write applications programs for users. Otherwise there is no user software support.

Pronto Electronic Systems Ltd.,
645-647 High Road,
Seven Kings, Essex 1G3 8RA
Tel: (01) 599 3041.

RCA Cosmac

A SWEDISH firm, Bhiab Electronics, has developed a single-board personal computer system based on the RCA Cosmac CDP 1802 with powerful video graphics facilities.

SPC 1800, has a simple 64-character 'light touch' keyboard as well as a ready-to-use cassette with some 40 programs. The board comprises the CPU, 4K bytes of RAM expandable externally to 32KB, graphic video display interface, sound circuits, 512 bytes ROM operating system, and documentation.

It features CHIP-8, an interpretative programming language consisting of 31 instructions. By the use of single instruction, one may generate a random byte, read-in a hex keyboard digit, display a pattern on the video screen, sound a tone, increment a variable, or set a real-time clock.

Sixteen one-byte variables are provided and subroutine nesting and machine language inserts are permitted.

The optional CRT screen is probably advisable for the system. With it, RAM may be extended by another 8K, and it provides 16 lines × 64 characters per line.

RCA Service Division,
Lincoln Way,
Sunbury-on-Thames,
Middlesex TW16 7HW
Tel: (09327) 85511

Real Time Controls

REAL TIME Controls Ltd offers a Z-80-based microprocessor incorporating a fully-buffered busbar channel for memory, I/O and peripheral controller expansion called the RTC 5100.

It incorporates a Z80 CPU, 4K bytes of RAM expandable to 16K bytes and two parallel I/O ports. A printed circuit backplane is available for mounting the board with five extra slots for expansion.

The company claims that the RTC 5100 is supported with an extensive range of software including a real-time operating system.

Real Time Controls Ltd,
Kebbell House, Carpenders Park,
Watford, Herts WD1 5BE
Tel: (01) 428 0088

AIM 65

IT TOOK Rockwell long enough to get a product on the market but those who waited will not be disappointed with the AIM 65.

The AIM 65 is fully-built and tested with full QWERTY keyboard, 20-character display, and 20-column printer configured around a 6502 CPU second-sourced from MOS Technology.

The printer uses thernal roll paper and produces characters formed in a 5 × 7 dot matrix operating at 120 lines per minute. On the display, the characters are formed by 16-segment-font monolithic LEDs.

AIM 65 has a 4K ROM monitor and spare sockets for additional ROMs, including those containing Rockwell's assembler, text editor, and Basic interpreter plug-in options.

RAM may be expanded off-board, and a cassette and Teletype may be attached directly via on board interfaces.

Pelco Electronics Ltd,
Enterprise House, 83-85 Western Road,
Hove, Sussex BN3 1JB.
Tel: Brighton (0273) 722155.

Texas Instruments

THE TMS9900 must be one of the most powerful commercially-available microprocessors on the market. It is unconventional in that the CPU has no accumulators but instead uses 16 consecutive 16-bit words of memory, known as a 'workspace', which are addressed via a pointer in the CPU, which may be software driven—the only restriction on the number of workspaces is memory size.

A ready-built 'Micro-99' board may be bought comprising CPU, 256 words of RAM, 16 I/O lines (parallel) and a 20mA current loop and RS232C interface, along with the 1K Tibug ROM monitor.

The CPU has 69 instructions compatible with the upper range of TI minis and including 16-bit multiply and divide. There are 16 external and 16 software interrupts, all separately vectored.

For software development, Texas supplies an Advanced Microprocessor Prototyping Library, a floppy-disc-based minicomputer for generating software or debugging hardware. High-level languages include a Fortran IV and Coral-66 compiler.

Texas Instruments Ltd.,
Manton Lane
Bedford MK41 7PA
Tel: (0234) 67466

Zilog

IN DESIGNING its Z-80 microprocessor, Zilog made it completely compatible with the Intel 8080 instruction set but used an enhanced second-generation MOS fabrication process to add a few instructions of its own and to put the instruction set on a mirror image, thereby providing more than double the amount of instructions of the 8080.

In spite of this, the majority of applications utilising the Z-80 treat it as an emulation of the 8080. Nevertheless, it will provide a fascinating device with which the hobbyist can experiment.

The Z-80 microcomputer board comprises the Z-80 CPU, up to 16K bytes of dynamic RAM, provision for up to 4K bytes of ROM, and parallel and serial ports. The parallel port is implemented with the Z-80–P10 ,and the serial port with an 8251 USART.

Two versions of monitor software (1K and 3K bytes) are available in bi-polar PROMs for insertion into four 24-pin PROM sockets, allowing for software debugging and terminal interface.

Memec Systems Ltd,
Thame Park Industrial Estate,
Thame, Oxon OX9 3RS.
Tel: Thame (084421) 5471.

New slant on an ancient game

OUR GAME this month is Nim, an ancient game in which two players take turns to remove matches from a pile in a group of piles.

Only one pile may be accessed at any one time but any amount (at least one) can be removed from that pile.

You will be given the option of setting the piles, and how many there are in each pile. If you do not wish to do this, the computer will do it randomly. The winner is the player who forces his opponent to remove the last match.

The program was written by 15-year-old schoolboy David Hartnell from Birmingham, and has been tested by Practical Computing.

```
Ready

LIST
NIM     02:00 PM        16-Jan-79
10 PRINT "A GAME OF NIM IS READY.DO YOU WANT INSTRUCTIONS?";
20 INPUT Z$
30 IF Z$="N" THEN 120
40 PRINT "THE GAME OF NIM IS AN OLD GAME IN WHICH TWO PLAYERS TAKE"
50 PRINT "TURNS TO REMOVE MATCHES FROM A PILE IN A GROUP OF PILES."
60 PRINT "ONLY ONE PILE MAY BE ACCESSED AT ANY ONE TIME BUT ANY"
70 PRINT "AMOUNT CAN BE REMOVED FROM THAT PILE.(AT LEAST ONE)"
80 PRINT "YOU WILL BE GIVEN THE OPTION OF SETTING THE PILES,AND HOW"
90 PRINT "MANY THERE IN EACH PILE.IF YOU DO NOT WISH TO DO THIS THE"
100 PRINT "COMPUTER WILL DO IT RANDOMLY.THE WINNER IS THE PLAYER WHO"
110 PRINT "FORCES HIS OPPONENT TO REMOVE THE LAST MATCH."
120 PRINT
130 PRINT "WHO WILL SET THE PILES?TYPE 1 FOR PLAYER OR 0 FOR COMPUTER;"
140 INPUT M
150 IF M=0 THEN 220
160 IF M=1 THEN 270
170 GOTO 120
200 REM:COMPUTER SETS PILES
220 LET A=INT(RND(-1)*8)+1
230 IF A<3 THEN 220
240 GOTO 380

270 REM:PLAYER SETS PILES
280 PRINT
300 PRINT "HOW MANY PILES ARE THERE?(AT LEAST 3,NO MORE THAN 8).";
310 INPUT B
320 IF B=INT(B) AND B>2 AND B<9 THEN 350
330 PRINT "ERROR:PLEASE TYPE AN INTEGER BETWEEN 2 AND 9".
340 GOTO 300
350 LET A=B
380 DIM P(25)
390 IF M=1 THEN 530
420 REM:COMPUTER CHOOSES HOW MANY IN EACH PILE
440 FOR C=1 TO A
450 LET P(C)=INT(RND(-1)*7)+1
470 NEXT C
480GOTO 650
510 REM PLAYER CHOOSES HOW MANY IN EACH PILE
530 FOR C=1 TO A
540 PRINT "HOW MANY MATCHES IN PILE";C;"?(AT LEAST 1,NO MORE THAN7)".
550 INPUT K
560 IF K=INT(K) AND K>0 AND K<8 THEN 590
570 PRINT "ERROR:PLEASE TYPE AN INTEGER BETWEEN 0 AND 8."
580 GOTO 540
590 LET P(C)=K
600 NEXT C
650 DIM D(3),F(3)
700 GOSUB 1240
730 REM:DECIDE WHO STARTS
750 PRINT "WHO WILL START?TYPE 0 FOR COMPUTER,1 FOR PLAYER";
760 INPUT N
770 IF N=1 THEN 840
780 IF N=0 THEN 1440
790 GOTO 750
820 REM:PLAYER'S TURN
840 PRINT
850 PRINT "WHICH PILE WILL YOU ALTER?";
860 INPUT G
870 IF G=INT(G) AND G<=A AND G>0 THEN 900
880 PRINT "ERROR:PLEASE TYPE AN INTEGER BETWEEN 0 AND";A+1
890 GOTO 840
900 IF P(G)>0 THEN 930
910 PRINT "SORRY,THIS PILE HAS NO MATCHES IN IT-TRY AGAIN!!!"
920 GOTO 840
930 PRINT "HOW MANY MATCHES WILL YOU TAKE FROM THIS PILE?";
940 INPUT H
950 IF H=INT(H) AND P(G)-H>=0 AND H>0 THEN 960
960 PRINT "SORRY,THAT NUMBER CAN'T BE ACCEPTED-TRY AGAIN!!!"
970 GOTO 930
980 LET P(G)=P(G)-H
```

```
1010 REM:PRINT GAME SO FAR AND TEST FOR A WIN
1030 GOSUB 1240
1040 GOSUB 1350
1050 IF Y=0 THEN 1120
1060 IF Y=1 THEN 1120
1070 GOTO 1440
1100 REM:A WIN FOR PLAYER-PLAY AGAIN?";
1150INPUT A$
1160 IF A$="YES" THEN 120
1170 PRINT
1180 PRINT "OK THEN,GOODBYE."
1190 STOP
1220 REM:SUBROUTINE TO PRINT GAME SO FAR.
1240 PRINT
1250 PRINT "PILE","MATCHES"
1260 FOR C=1 TO A
1270 PRINT C,P(C)
1280 NEXT C
1290 PRINT
1300 RETURN
1330 REM:SUBROUTINE TO TEST FOR A WIN.
1350 LET Y=P(1)
1360 FOR C=2 TO A
1370 LET Y=Y+P(C)
1380 NEXT C
1390 RETURN
1420 REM:COMPUTER'S TURN
1440 PRINT
1450 PRINT "MY TURN"
1460 LET E=1
1470 LET D(E)=0
1480 IF E=3 THEN 1510
1490 LET E=E+1
1500 GOTO 1470
1510 FOR C=1 TO A
1520 IF P(C)>=4 THEN 1560
1530 IF P(C)>=2 THEN1600
1540 IF P(C)>0 THEN 1650
1550 GOTO 1660
1560 LET D(3)=D(3)+1
1570 LET X=P(C)-4
1580 IF X>2 THEN 1610
1581 IF X=2 THEN 1610
1600 LET X=P(C)
1610 LET D(2)=D(2)+1
1620 LET X=X-2
1630 IF X>0 THEN 1650
1640 GOTO1660
1650 LET D(1)=D(1)+1
1660 NEXT C
1710 IF D(3)<2 THEN 1730
1720 GOTO 2020
1730 IF D(2)<2 THEN 1750
1740 GOTO 2020
1750 LET J=0
1760 IF D(1)-J=0 THEN 1800
1770 IF D(1)-J=1 THEN 1820
1780 LET J=J+2
1790 GOTO 1760
1800 LET V=0
1810 GOTO 1830
1820 LET V=1
1830 IF D(3)=1 THEN 1880
1840 IF D(3)=1 THEN 1860
1850 GOTO 2210
1860 IF V=0 THEN 2420
1900 GOTO 2360
1910 FOR C=1 TO A
1920 IF P(C)<>7 THEN 1950
1930 IF V=0 THEN 3170
1940 GOTO 3200
1950 IF P(C)<>6 THEN 1980
1960 IF V=0 THEN 3170
1970 GOTO 3200
1980 NEXT C
2020 LET E=1
2030 LET J=0
2040 LET W=D(E)
2050 IF W-J<>0 THEN2100
2060 LET F(E)=0
2070 IF E=3 THEN 2150
2080 LET E=E+1
2090 GOTO 2030
2100 IF W-J<>1 THEN 2130
2110 LET F(E) =1
2120 GOTO 2070
2130 LET J=J+2
2140 GOTO 2040
2150 IF F(3)<>0 THEN2250
2160 IF F(2)=0 THEN 2190
2170 IF F(1)=0 THEN 2680
2180 GOTO 2740
2190 IF F(1)=0 THEN 2210
2200 GOTO 2490
2210 LET C=1
2220 IF P(C)>0 THEN 3050
2230 LET C=C+1
2240 GOTO 2220
2250 IF F(2) <0 THEN 2280
2251 IF F(2) >0 THEN 2280
2270 GOTO 2810
2280 IF F(1)=0 THEN 2970
2290 GOTO 2880
2360 LET C=1
2370 IF P(C)=4 THEN 3140
2371 IF P(C)>4 THEN 3140
2390 GOTO 2370
2420 LET C=1
2430 IF P(C)=5 THEN 3170
2440 IF P(C)=4 THEN 3110
2450 LET C=C+1
2460 GOTO 2430
2490 LET C=1
2500 IF P(C)=7 OR P(C)=5 OR P(C)=3 OR P(C)=1 THEN 3050
2510 LET C=C+1
2560 IF P(C)=3 OR P(C)=2 THEN3080
2570 LET C=C+1
2580 GOTO 2560
2610 LET C=1
2620 IF P(C)=3 THEN 3110
2630 IF P(C)=2 THEN 3050
2640 LET C=C+1
2650 GOTO 2620
2680 LET C=1
2690 IF P(C)=6 OR P(C)=3 OR P(C)=2 THEN 3080
2700 LET C=C+1
2710 GOTO 2690
2740 LET C=1
2750 IF P(C)=7 OR P(C)=3 THEN3110
2760 IF P(C)=6 OR P(C)=2 THEN 3050
2770 LET C=C+1
2780 GOTO 2750
2810 LET C=1
2820 IF P(C)=7 OR P(C)=5 THEN 3170
2830 IF P(C)=6 OR P(C)=4 THEN 3110
2840 LET C=C+1
2850 GOTO 2820
2880 LET C=1
2890 IF P(C)=7 THEN 3230
2900 IF P(C)=6 THEN 3170
2910 IF P(C)=5 THEN 3110
2920 IF P(C)=4 THEN 3050
2930 LET C=C+1
2940 GOTO 2890
2970 LET C=1
2980 IF P(C)>=6 THEN 3200
2990 IF P(C)>=4 THEN 3080
3000 LET C=C+1
3010 GOTO 2980
3050 LET K=1
3060 GOTO 3270
3080 LET K=2
3090 GOTO 3270
3110 LET K=3
3120 GOTO 3170
3140 LET K=4
3150 GOTO 3270
3170 LET K=5
3180 GOTO 3270
3200 LET K=6
3210 GOTO 3270
3230 LET K=7
3250 REM:REMOVE MATCHES FROM PILE.
3270 LET P(C)=P(C)-K
3280 PRINT
3290 PRINT "I AM TAKING";K;"MATCHES FROM PILE";C
3300 PRINT
3330 REM:PRINT GAME SO FAR AND TEST FOR A WIN.
3350 GOSUB 1240
3360 GOSUB 1350
3370 IF Y<>1 THEN 840
3400 REM:COMPUTER WINS
3420 PRINT
3430 PRINT "HARD LUCK,I HAVE BEATEN YOU."
3440 PRINT
3470 REM: ANOTHER GAME?
3490 GOTO 1130
3500 END
```

School's miracle effort for £250 with FREACK

Setting-up an entire school computer department can be a headache. Doing it successfully on £250 is little short of a miracle. "We haven't had to sell matches, but it's almost been like that", says Tony Compton, the brain behind the project at Fearnhill School, Letchworth, Herts.

by

KAY FLOYD

Compton is head of the physics department. Starting with nothing—no experience, no equipment and very little money—he built FREACK, the Fearnhill Resource and Educational Applications Computer Kit.

The system comprises a Nascom 1 kit, a Ferguson black and white portable television set, and an ordinary cassette tape recorder. The system is already proving an invaluable aid to teaching in physics, biology and astronomy.

The idea of a school computer began in the Autumn of 1977, after Compton read articles in an electronics constructors' magazine. He realised that a computer was no longer an impossible luxury; one could be built on a very limited budget.

Training ground

"I felt the need for a computer in the school, in the first place mainly because I think a school should be a model of the outside world," he says, "It's the outside world they'll be going into, and there is so much computing going on out there that I really felt there ought to be something in the school. Now the pupils can get an idea of a computer, what it can do and what it can't, as well as being a training ground for those people who might enter into computing, or at least, might do a lot of computing".

It soon became apparent that the school was not convinced of the educational advantages of having a computer, compared to all the other items on which it wished to spend its meagre resources.

So finance was one of the major factors which influenced Compton's choice of machinery. "The alternatives were either to get a terminal in the school, which would have cost around £800, or we could have had what the county council wanted us to buy—that would have cost around £1,000."

In spite of opposition from his colleagues, Compton took a chance. He "mortgaged" the physics department and ordered one of the then unproven Nascom 1 kits. It arrived last June and in the next three to four weeks Compton built the system. The case which houses it was obtained separately, the power supply was designed at the school and built from components supplied through the years by local firms which have used the school as a "dustbin" for obsolete equipment. The television set was given by one of the school cleaners.

No experience

Plans were made at the time of ordering the kit for sixth-year pupils to begin a course and help develop programming methods for the system. All programs were written in Z-80 machine code, about which Compton and his pupils knew nothing.

"We learned together", he says. "We simply had to learn the principles of

(continued on next page)

Pupils with their system.

Tony Compton using FREACK.

(*continued from previous page*)

machine-code programming. I was learning from scratch. It was a case of sitting down together, swapping ideas and telling each other what we'd learned".

In addition to having no programming experience, Compton had no technical computing experience. "I was very interested in the idea of computing at university, and I just missed it since it was two years before they began using computers in university courses and I've always felt the lack of it in myself.

"I felt if I didn't do something about it, not only was I going to be missing-out but I was missing an opportunity for the school".

The great switch-on day for FREACK was four weeks after the kit was delivered. It almost worked, except for two faults which were soon corrected by Comptons group of "experts".

Ecology programs

The computer has by now attracted a sizeable following. Almost every day Compton finds a new pupil using the 'teach-yourself' worksheet which he devised. All sorts and conditions of pupils have been seen during lunch-times trying the games the senior students have developed.

So far, a library of 16 programs has been written, ranging from games like Mastermind to ecology programs and a stars program for the astrology class. The programs have been conceived during the one-hour-a-week programming lessons. The games programs, apart from being fun to play, were developed for the school fair and parents and visitors were asked to pay a nominal fee to play them.

At present, the system has only 1K of memory and it takes about two minutes to call-up each program. Long programs have to be dumped on to an audio-cassette, as FREACK forgets everything when it is switched off, apart from its built-in monitor program.

For educational use in the classroom there are statistics programs, graph plotting, oscillations, and a small-scale model of a 'bad business computer', complete with faults like sending out invoices for £0·00.

Sparking

Plans include a moving night sky, chemical equilibrium and an illustration of how sparks occur. Some help to the school timetablers is not outside the realm of possibility, although it would be limited. Compton reckons that the system will have benefitted about half of the 760 students by the time it has been installed for a year.

Now that he has the system working, he will not sit back and rest. He is hoping for an extra £240 from "various sources" shortly, so that he can implement a 2K version of Tiny Basic on to the system. An expansion to 8K memory is scheduled for next year.

"The advantage of doing it this way is that you can do it gradually and you don't have to spend all the money at once", he says. He also hopes to improve the graphics facilities.

"The other big problem is that you have 48 characters in a line, and you have 16 lines, so to try to make molecules go flying across the screen is not very easy. We hope to have better graphics by the end of the school year". Hard-copy facilities are expected in two or three years.

Fun to build

Compton is also developing an interface of his own design, with two analogue-to-digital converters which allow bit inputs and analogue input and output. It will mean that he can extract TV signals to synchronise television video recorders. He hopes that will lead to stage lighting control and a system for teaching people how to use a telephone switchboard without disconnecting callers.

The system has limited capabilities as it stands but Compton maintains that it has been "fun building it". "Obviously I would have been happier with a larger thing, to be able to use Basic at once. It would also be better from the point of view of teaching.

"At the moment this looks like an expert's machine, and to a large extent it is. In fact, the only way it's not an expert's machine, is if we, the small group of experts, can develop programs which the staff can use, just as an audio-visual aid like a television. That is the only way non-experts can use it, because machine-code programming is fairly sophisticated. It's tedious, but it's good training".

Hunt-and-find service cuts time and distance

THERE are days when you can look across the Firth of Clyde from the Ayrshire coast to the Isle of Arran and appreciate quickly that the 14-miles sea crossing will be either a feat of endurance or an impossibility. So how, then, is it possible for Ardrossan, mainland base for the ferry boats, sometimes to appear closer to far-off California—strictly in computer terms?

The man who can provide the answer is 30-year-old Mike Parry. Joint director of Airamco Ltd., along with 34-year-old Malcolm Cardill, Parry, as one of the sidelines to the business of selling computer equipment, operates a Hunt-and-find service for equipment which is in short supply and urgently needed.

From his base in appropriately-named Witches Linn, Parry might be expected to use a besom but instead employs the simple expedient of the telephone, contacting all the possible known sources of supply—provided that the customer is prepared to pay for the cost of the calls.

Yet how is it easier to get goods to this Scottish outpost quicker than it might be to obtain them, say, in London?

Same-day clearance

"Easy", says Parry. "Prestwick is just down the road and whereas equipment might lie at London Airport for a week or two, I can always get clearance at Prestwick in a day.

"It certainly doesn't make it any more difficult when I tell you that the head of Customs at the airport lives at the end of my road."

Parry and Cardill started the company in 1976. Parry, after service in the Royal Navy, worked for four and a half years as an instrument commissioning engineer for Honeywell and, like his fellow director, first made his acquaintance with Scotland's west coast at Hunterston B Power Station, down the road from Ardrossan towards Largs.

"After being on 24-hour call, I decided it might be better to go freelance", he says, "and then decided the next step was to form a company."

"Since then, from watching micros scratching the surface, I have seen them come on in a big way. I certainly never thought when we started that it would go so well, or that the biggest problem would not be selling equipment, but getting deliveries.

"Our business has expanded so much that that is probably our biggest problem. The large pending order file is what we are continually trying to reduce.

"We have a policy of making sure that no customers' cheques are cashed until they get delivery. The cheques just lie there with the orders until the equipment is available. There is no way we are ever going to trade with other people's money.

"Because of that, we are always anxious to move things as quickly as possible, and so the customer must benefit in the long run. After all, we are anxious to use that money, because we've reached the stage, after looking on £500 to £600 as a big order six months ago, where we are often thinking instead now of £5,000–£6,000.

"We don't set ourselves up as being able to provide all the answers. People ask for equipment and we provide it. Of course, if someone is trying to put together something which is not likely to work we should tell him right away. But we don't say what we don't know, and we don't make false promises.

"The biggest criticisms we have had have been from people who have suggested we are slow in delivery on occasions, but there are times when people have to wait to buy at our prices.

"I think some of our prices are the cheapest in the U.K. I try to give a fair pricing, an economic pricing, and in those circumstances the play-off is sometimes extended delivery. From our point of view it means finding out who are the ropey suppliers and staying away from them.

"If people want super-fast deliveries, they can always go to people who charge twice as much as we do", he adds.

Scottish clannishness, Parry agrees, helps in obtaining orders from people who wish to shop with suppliers in their own country—even though he's a Welshman from Colwyn Bay, he's sufficiently integrated to be chairman of the Glasgow group of the Scottish Amateur Computer Society, which has some 25 members after an existence of only four months.

by

HAROLD MAYES

Home buyers

"Orders come from universities, schools and teaching colleges", he says, "but a lot of local enthusiasts like to buy in Scotland, which helps".

Parry has one other observation to make pertinent to the industry. He regards *Practical Computing* as the best magazine available. "And that", he says, "is not just because it produces more orders for me". So there.

MIKE PARRY doesn't often have his eyes closed to possibilities but that is how the camera caught him when Princess Margaret visited the Airamco stand at the TV and Microelectronics exhibition at Birmingham.

Applications for the small businessman

ONE MICRO manufacturer bemusedly said that his company, when enquiring in the marketplace for application software houses to write software for its new machine, had replies from more than 500 "companies"—he reckons there are thousands of them.

The vast majority are the ubiquitous "man-boy-dog-garage" and not a few are sizeable—10 or more programming staff.

The situation reflects conditions in the micro marketplace—a very wide range of equipment both U.K.-manufactured and imported, mostly from the U.S., at a wide range of prices.

The micros being pushed at the hobbyist and very small businessmen are easy to set-up and to program. Still, there is a big slice of that group which wants preprogrammed games, home applications, and business applications. So, scenting fair game, the entrepreneurial software genius is setting-up to provide them, either "one-offs", like a software consultancy, or packaged to sell by the thousand, they hope.

In this series we shall concentrate on applications for the small businessman, starting with stock recording and stock control—later on, we'll look at ledgers (sales, purchase, nominal), order processing and invoicing, financial and management accounting.

Functions

We start with what stock recording and stock control ought to be, and what we can find calling itself "stock ordering/stock control".

Let us look at the functions of stock recording and stock control. To start, stock control is impossible without good stock recording. Stock recording tracks the movement of goods in and out of the stock room and shows what stock is on hand. Stock recording should do five things:

1. Receive the goods into store and match the items and quantities shown on the incoming invoice;
2. See that the goods are identified properly and located easily;
3. Issue the goods;
4. Maintain records of receipts, issues, shortages and adjustments;
5. Make the stock room safe from pilferage.

At point 4, a properly-designed records system aids the businessman. This "records" system can either be manual, as many are, or computerised. How can it be computerised? First, the number of items to be tracked limits the design. If cassette, then about 200 items per cassette, depending on how much information about each item is kept; if floppy discs, then perhaps a factor of 20 and higher improvement in number of items recorded but also an increase of five to 10 times the cost.

Information

The kind of information a businessman in retail/wholesale and distribution trades may want to retain on a monthly basis includes:

1. The item description (and code number);
2. The month-to-date issues, receipts, and adjustments (this for damaged goods, returns, and the like);
3. a, Balance on hand;
   b, On order next month;
   c, Allocated (forward delivery dates) and back ordered;
   d, Balance available.

Those items are sometimes called "perpetual" stock (or inventory) recording. In addition, some businesses want values of stock and status by supplier.

The recorded data, updated daily, weekly or monthly, is then available for printed management reports on a periodic basis or, better still and in addition, as enquiry answers from a display screen.

So then the businessman knows what and how much is in stock. He can then proceed to stock control, i.e., how much should be ordered, when, and at what frequency? When a businessman can satisfy customer demand while keeping his level of stock of each item to a minimum, he increases his profit margins enormously. Here we come to a jungle of definitions and terminology about stock control. We will try to keep it simple, at the expense of completeness and clarity.

What more does a businessman have to know before he places an order on a supplier?

- Customer Service Level—there are two definitions: a, ratio of demand

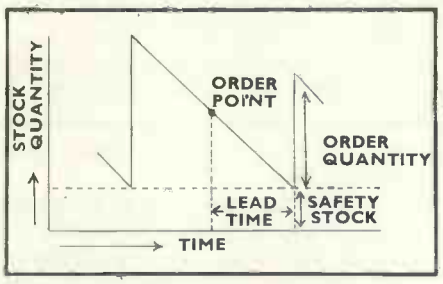
(*continued on next page*)

	When Available	Machine	Supplier	Cost (hardware and software; not incl. VAT)
PETSOFT Stock Control	Now	Pet	Petsoft, Newbury, Berks.	£712
COMPELEC Stock Control	Mar 79	Series I	Compelec, London	about £5,500
VIDEO-STOCK	early 79	Machine Independent	Video Software, Worcester	£1,000 to £5,000 (software only)
MICROINV	Now	Sorcerer	Comp Computer, Components, New Barnet, Herts.	about £2,300
COMPUCORP Stock Control and Invoicing	Now	Compucorp 625	Compucorp, Wembley	about £4,500
COMPUTER MART Stock Control System	Now	VDP–80	Computer Mart Ltd, Norwich	about £8,000
EQUINOX Inventory-I	Now	Horizon	Equinox Computer Systems Ltd, London	about £4,000

(*continued from previous page*)

quantity met from stock to total demand; b, ratio of value of orders filled to total order value received. "Normal" service levels are between 95 and 98 percent.

- Lead Time—this is the time between the businessman placing an order on his supplier and the actual delivery of the goods to his warehouse/shop.
- Safety Stock—stock required to minimise "stock-outs"—over and above stock required to cover what is forecast in demand for the period. It is calculated using statistical techniques (frequency distribution error).
- ABC Analysis—80 percent of stock value comes from 20 percent of the items.
- Economic Order Quantity (EOQ). This is determined by two factors—the cost of carrying the inventory and the cost of the order.
- Order Point—when stock issues bring down the level to this pre-determined point, an order is placed on the supplier.



Graphically, what the stock control system should do for the businessman is shown thus:

No businessman runs as orderly and precise an inventory system as our graph shows; what we are trying to indicate is that there is some logic behind inventory systems which can be handled easily by a computer.

Can you program a stock recording/stock control system on your micro by yourself? Most assuredly you can—if you are prepared to put in the effort. If you are a small businessman, you probably are not. To your rescue there are pre-programmed applications programs. We were given the specifications, or manuals, or demonstrations for seven systems which we now examine.

Petsoft Stock Control

Supplied by Petsoft, PO Box 9, Newbury, Berkshire.

To be run on the Pet computer, this is a very basic system which essentially does two things:

1. It builds and stores on cassette tape your stock items—by code, description, and supplier and address;
2. It allows instant access to the stock data on a tape (once properly recorded).

Other options include a "corrections" sequence (you use this option to update your tapes), a re-settable "low stock" warning on every item, and an item counter (important in this package because it is needed when updating your records).

You can store up to 150 items (and their data) on one tape—customers with extra memory can increase this to 255 items but without extra memory as many data tapes as you need can be built up with 150 items on each.

The system is aimed at the very small business; we believe that more than, say, 400 items (about three data tapes), the system will start to creak from slowness and inaccessibility of data. For the price of the software (£12) and the price of the PET (about £700), the system is good value.

Compelec Stock Control

Supplied by Compelec, 14-15 Berners Street, London W1.

The concept in this system is another level entirely from the Petsoft application. For one thing, the hardware is Compelec Series 1 with floppy disc input/output. The software costs about £1,000 and the hardware £4,000–£5,000. Although the stock ordering/stock control function can be implemented on its own, this application is part of a larger order processing/invoicing/stock control/accounting system. Because of the use of floppies, two advantages are gained in the stock control application:

1. More items can be recorded—no estimate is given but possibly 5,000 items per diskette;
2. Quicker access and display of the data.

In addition, the fact that this is one component of a larger application system means less difficulty when the additional modules are added.

The stock recording/stock control has these features:

1. Stock status enquiries;
2. Stock valuation on one of three costs—selling, replacement, or standard;
3. Calculation of recommended reorder quantities;
4. Incoming stock, issues, returned goods, damaged goods, transfers, automatically reduce or increment the files "On-order" and "In-stock".
5. Price list and suppliers' list.

Purchase orders are matched against incoming stock and maintain chains with the stock files.

The system is sophisticated and is for the small businessman with a turnover of £0·5 to £1 million a year.

Video-stock

Supplied by Video Software Ltd, Stone Lane, Kinver, Stourbridge, Worcester DY7 6EQ.

This software house is not concentrating on any particular machine but on the "executive" (or operating system) called VIDEO (Virtual Computer Using Decision Tables for On-line Processing). Designed initially for minis but being converted to micros, VIDEO supports a complete range of standard on-line application packages which are machine-independent. One of these applications is called VIDEO-STOCK. This application supports a stock control system for finished goods, raw materials, or work in progress stocks. Like the Compelec stock control package, VIDEO-STOCK can be part of a larger information system, embracing Invoicing and Ledgers.

VIDEO-STOCK is a further refinement of the stock control systems already mentioned. More options and functions are available. This is reflected in the price of the software alone, which can range from £1,000 to £5,000.

This is a very powerful and complicated system for controlling inventory and worth a look by the businessman whose annual turnover is in the range of £0·75 to £2 million.

Microinv

Supplied by COMP Computer Components, 14 Station Road, New Barnet, Herfordshire.

Of all the packages we have reviewed, this one is closest to the ideal. MICROINV provides a simplified sequence of steps, telling the user what is required at every step. Running on an Exidy Sorcerer with two floppy diskettes from Micropolis—each floppy with 630K bytes—the hardware costs about £2,000. The applications package is not yet priced but may be between £200 and £500.

The running of the program is simplicity itself. First, you choose which of six programs you want to enter:
1. Inventory data entry; 2. Inventory transactions; 3. File listing; 4. Inventory reports; 5. Job cost report – materials; 6. Economic order quantities.

The Master File holds 25 pieces of data on each item and about 5,000 items can be put on one diskette.

Because of its simplicity and relatively low cost, this looks like a super-buy for the small businessman. (*continued on next page*)

(continued from previous page)

Compucorp Stock Control and Invoicing

Supplied by Compucorp Ltd., 65-67 Wembley Hill Road, Wembley, Middlesex.

The stock control package we examined has a semi-automatic invoicing procedure which, although an integral part, will be investigated later. The stock package is designed to run on a Compucorp 625—prices start at about £4,000. The software is in the region of £500.

The 625 has a built-in floppy disc unit, so the number of items which can be held on one disc is about 5,000. Included in the functions are:

a, stock listing (either detailed or by supplier);

b, stock ordering which allows you to put items on order but does not physically update the stock;

c, sales across the counter, i.e, in a shop situation, automatically update the stock file. This routine also prints-out a stock reminder when stock falls below a pre-determined stock level.

Of course, adding, deleting, and amending of stock files are included.

Although the total system price is in excess of £4,500, the limited functions of the stock control software appear inadequate for the price; bear in mind, however, that an invoicing routine is included which none of the others we have reviewed possessed.

Stock Control System

Supplied by Computer Mart Ltd, 38 St. Faiths Lane, Norwich.

The stock control system runs on the VDP-80 Computer Mart distributes. With the software costing about £1,000 and the hardware and operating system about £6,900, the total system costs around £8,000.

In hardware there is a 32K RAM and standard dual floppies with 1·2MB disc storage and video monitor/keyboard. The stock control package handles about 6,000 items per disc. Its facilities are comprehensive, featuring a "menu" from which you choose your option.

The price of the total system almost takes it out of the micro market, (by *Practical Computing* definitions) and into the mini area where it appears to be good value in that arena.

Inventory—1

Supplied by Equinox Computer Systems Ltd, 32–35 Featherstone St, London EC1.

Inventory-1 runs on the Horizon where a minimum configuration of 32K and the software will cost around £4,000. Inventory-1 is part of the Horizon Business System which includes sales, purchase, and general ledgers and payroll—all, presumably, priced separately. The North Star minifloppy disc will hold up to 940 inventory items.

This is the only software we have encountered so far with upwards-compatible "brothers"—Inventory-2 and Inventory-3—which provide control of larger inventories and the added features of order entry and bill-of-materials processing. Inventory-1 features include:

1. On-line status enquiries.
2. Add, update, and edit of files.
3. Listing of all stock items (bought, sold, on-hand, sale value, stock value, suggested re-order).
4. Produces a form for stock-taking with a price list).
5. Individual item update by article name or record number (added on purchase or deleted or sale).

We think this system with its upwards-compatability and modularity represents the first trembling awakening of the business applications potentially inherent in the micros.

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COMPANY	SYSTEM	APPLICATION	PRICE RANGE
AIRAMCO LTD 30 Witches Linn, Ardrossan, Ayrshire KA22 8BR 0294 65530	**SDS 100.** Single unit containing 32K memory (expandable to 64K); up to 8K PROM; twin double-sided floppy disc drives of 500K bytes each; serial and parallel RS232 interfacing; keyboard; 12 in. video display; power supplies; SD monitor program: line printer available.	Software: CP/M, 8080 assembler, E Basic, Editor supplied with system; M Basic, Fortran, Cobol available for business use, industrial process monitoring and control (with additional hardware). All CP/M games and business packages available.	From £3,750 (basic machine) £890 (printer) £4,500 combined
CALDERBROOK TECHNICAL SERVICES (CTS) 1 Higher Calderbrook Littleborough, Lancs 0706 79332	**Ohio Superboard II** (computer on a board), Min. size: 6502 processor. 8K BASIC in ROM; 2K monitor in ROM; 4K RAM; Cassette I/F; full keyboard; 32 × 32 video I/F; controller for two floppies.	8K BASIC in ROM; Assembler/Editor; Games, personal, maths tutors, and business programs. American system aimed at hobbyist/small business.	£275–1,100
	Challenger II 4P (professional portable), similar to Superboard but supplied as two separate boards with open slots for expansion.	Similar to Superboard. Aimed at small business, education, research.	£595–1,500
	Challenger II 8P (personal computer), similar to 4P but expandable to include 2 × 8 floppies, multiple line printers, 74 MB hard disc, multiple terminals.	Similar to 4P but larger business/ commercial programs. Aimed at small business with requirement for large storage and multiple users. Also education and research.	£800–7,500
COMART PO Box 2, St Neots, Cambridgeshire 0480 215005	**Microbox,** Min. size: Chassis with three sockets. Max. size: Chassis with six sockets.	Aimed mainly at OEM industrial users and perhaps the serious hobbyist. Manufactured in Britain by Comart, it will take Cromemco, North Star and other processors and software.	£70–£195
	Cromemco System Two, Min size: Processor alone with six sockets in kit form. Max size: 21 sockets; 512K of memory; up to three mini-diskettes of 90K bytes each.	Software: Extended Basic; Fortran IV; Cobol; Macro-assembler; Word-processing, DBMS. American system suggested for systems development.	£395 to around £5,000
	Dynabyte, Memory board for any S100 bus system. Available in 16-32K units.		£275–695
	Cromemco System Three, Min size: 32K memory; terminal and printer interface; dual 250K-byte IBM-compatible floppy discs. Max size: 128K memory; two–three terminals.	Software: Same as System Two. Suitable for a wide range of commercial and scientific applications. Theoretical maximum of 512K of memory.	£4,174–£10,000-plus
	Horizon, Min size: 16K memory; serial interface; one mini-diskette drive with 90K bytes; power supply. Max size: 48K memory; three diskettes; hardware floating point board.	Software: Extended Basic; disc operating system; monitor; access to CP/M range. Manufactured by North Star Computers of the U.S. Aimed at educational and small business users.	£995–£3,500
	SOL 20/16, Min size: 16K memory; integral keyboard and monitor; serial and parallel interface; cassette unit. Max size: 64K memory; up to 1MB disc capacity.	Software: Extended Basic; Fortran; Focal; Assembler; Editor; Games. Another American system from Processor Technology Corp aimed at the small business and education markets.	£1,785–£5,000-plus
COMMODORE SYSTEMS DIVISION London NW1 01-388 5702	**PET,** Single unit containing screen, tape cassette and keyboard. Memory is expandable from 8–32K.	Software: Basic; Games; Business packages. The British subsidiary of Commodore Systems of the U.S. sells Pet for home, educational and small business applications.	From £695
	Kim 1, Min size: Processor (6502 chip); small calculator-type keyboard; LED six-digit display; built-in interfaces for audio-cassette and Teletype; 1K RAM; 2K ROM. Max size: Can add: Kim 4 motherboard; Kim 3B 8K RAM (up to 64K); Kim 5 resident assembler.	Software: None available yet, but it has three good manuals. An American import which gives Pet-type capabilities with a maximum configuration. For the hobbyist but used mainly as an evaluation board for the 6502 chip. There are two dealers, GR Electronics and J Marshall, which offer further facilities.	£129–£600 (+VAT)
COMP Computer Components 14 Station Road, New Barnet, Herts. 01-441 2922	**EXIDY Sorcerer** based on Z-80. Typical size: 12K ROM, 32K RAM; cartridge and cassette I/F; 79-key keyboard; 256 character set (128 graphics symbols); 12 in video monitor; expandable with Micropolis floppy discs.	Software: standard Basic Assembler and Editor Fortran and Cobol; word processor; games and other pre-packaged programs.	From £950
COMPELEC 14/15 Berners Street, London W1 01-580 6296	**Altair System 1300,** Min size: 32K memory; dual minifloppy discs, 71K bytes each formatted; serial interface. Max size: 64K memory; 4 serial ports.	Software: Basic (single and multi-user); Fortran; Cobol. The hardware for the Altair systems is from Pertec in the States, but the software is Anglo-Dutch.	£3,000–£5,500

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COMPANY	SYSTEM	APPLICATIONS	PRICE RANGE
COMPELEC (continued)	**Altair System 70,** Min size: 33K memory; dual floppy discs, 300K bytes each. Max size: 64K memory; provision for up to 8 VDUs.	Software: Single and multi-user Basic; Fortran; Cobol; APL. Aimed exclusively at business applications; packages are available for general and sales and purchase ledger, payroll, word processing, stock control, estate agency, hotel or small airline reservations, transport management and freight costing. A point-of-sale package will soon be ready.	£4,500 to £10,000-plus
	Altair System 300, Typical size: 64K memory; 10MB disc drive; turnkey processor; VDU; Qume daisywheel printer and disc unit.	Software: Single-user Basic; Fortran; Cobol. The same packages as for the System 70 are available for this top-end-of-the-market, business-orientated system. Compelec has its own office in Birmingham, but a full distributor network is being set up.	£10,000-plus
COMPUTERBITS LTD 40 Vincent Street, Yeovil, Somerset 0935 26522	**System 8,** Typical size: 64K memory; 1MB disc storage; serial I/O port for VDU; parallel port to printer; CP/M operating system.	Software: Basic; Pascal; Fortran. This British-manufactured microcomputer system is almost exclusively for business applications.	£3,000–£5,000
COMPUTER MART LTD 38 St Faiths Lane, Norwich. 0603 615089	**VDP-80,** Typical size: Single desk-top unit housing a 12 in. display, dual standard floppy disc drive, processor, power units, cooling system and fully-programmable keyboard containing 62 alphanumeric, 12 numeric and 12 cursor controls in separate keypads. Normally sold with 32K memory and 1.2M bytes of disc storage but may be expanded.	Software: Included in the price is a sophisticated operating system with Commercial Basic. A range of commercial application packages is available, including word processing if required.	£9,500
COMPUTER WORKSHOP 38 Dover Street, LondonW1 01-491 7507	**System 1,** Typical size: 40K memory; dual 8 in. floppy discs, total storage capacity 1·2MB; Ricoh daisywheel printer. **System 2,** Typical size: 24K memory; dual minifloppy discs of 80K bytes each; Centronics 779 dot matrix printer; VDU. **System 3,** 12K memory; cassette interface; 40-column dot matrix printer.	Software: Range of Editors, Assemblers, Basics and Games; Information retrieval package. These systems were designed and built in Peterborough and are suitable for educational, small business users and perhaps the more serious hobbyist. There is a large number of dealers around the country.	System 1—£5,000-plus; System 2—around £3,000; System 3—from £1,350
EQUINOX COMPUTER SYSTEMS LTD 32–35 Featherstone Street, London EC1Y 8QX 01-253 3781/9837	**Horizon,** Min size: 16K memory; Z80A processor; single minifloppy disc drive (180KB). Max size: 56K memory, four minifloppy disc drives (180KB), any acceptable S100 peripheral boards.	Software: Standard—Basic Interpreter (includes random and sequential access), disc operating system and monitor; Options—Basic Compiler, Fortran, Cobol, and Pilot. The system is suitable for commercial, educational and scientific applications. Application software for general commercial users.	£1,000–around £2,500
	Equinox 300, Min size: 48K memory; dual floppy discs giving 600K bytes of storage; 16-bit Western Digital m.p.u. Max size: Up to 256K memory; up to four 10MB hard discs.	Software: Basic, Lisp, Pascal, Macro Assembler, Text Editor and Processor. All software is bundled. The system is a multi-user, multi-tasking, time-sharing system for 2–12 users. Application software is available for general commercial users.	£5,000–£40,000-plus
MICRONICS 1 Station Road, Twickenham, Middlesex 01-892 7044	**Micros,** Typical size: 1K monitor; 47-key solid state keyboard; interfaces for video, cassette, printer and UHF TV; serial I/Os; dual parallel I/O ports; 2K RAM; power supply.	Software: Extended Basic; Pascal. A British-designed and manufactured system which is being enhanced rapidly. Already available are a 40-column impact printer using plain paper, at £360; what is claimed to be the cheapest data terminal around—a system with an acoustic coupler and VDU for £1,020. Prospective applications: small businesses, process controllers and hobbyists.	From £400, assembled
NASCOM MICROCOMPUTERS 92 Broad Street, Chesham, Buckinghamshire 02405 75151	**Nascom 1,** Min size: CPU; 2K memory parallel I/O; serial data interface; 1K monitor in EPROM. Max size: CPU; 64K memory; up to 16 parallel I/O ports.	Software: Mostly games, but a maths package is on its way. The British-manufactured system started as a hobbyists' package but has found an increasing number of industrial users. Printer and minifloppy interfaces are in preparation. There are about two dozen dealers around the country.	From £197·50
NEWBEAR COMPUTING STORE 7 Bone Lane, Newbury, Berkshire and 2 Gatley Road, Cheadle, Cheshire 0635 49223	**Sym 1,** Size: 6502 chip and keypad, with memory available in 4K blocks to 64K.	Software: Any Kim software. An American system meant to be the foundation for very small business and hobbyist users.	From £200
	7768, Size: CPU board; 4K memory; cassette and VDU interfaces.	Software: Range of Basics and Games. A British-manufactured system for hobbyists. Expandable to 64K memory, it is available only in kit form.	
	Cromemco Z2, Min size: Z2 chassis: power supply; motherboard; CPU; fan; sockets; byte saver board; 16K memory. Max size: 48–64K memory; dual 8 in. floppy discs.	Software: Basic, Fortran; Assembler; macro assembler. For small business and educational applications. These systems are also supplied to more than a dozen dealers. Same basic system as Comart.	£1,375 to £4,000

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COMPANY	SYSTEM	APPLICATIONS	PRICE RANGE
PERSONAL COMPUTERS LTD 194 Bishopsgate, London EC2 01-283 3391	**Apple II,** Min size: 16K memory; 8K ROM; keyboard; monitors; mini-assembler: colourgraphics; Powell card; RF modulator; Games; paddles and speaker; 4 demo cassettes. Max size: Expandable to 48K memory, and floppy discs and printers are now available.	Software: Basic; Assembler; Games; Business packages. An American system regarded as suitable for any kind of applications. There are 15 dealers throughout the country and maintenance contracts are offered.	£1,000–£2,000
RAIR 30–32 Neal Street, London WC2 01-836 4663	**RAIR Black Box,** Min size: 32K memory; dual minifloppy discs, 80K bytes each; two programmable serial I/O interfaces. Max size: 64K memory; 8 serial interfaces; 1MB disc storage (or 10MB hard disc); range of peripherals.	Software: Advanced Basic interpreter, Fortran IV compiler; Cobol compiler. Described by the makers as the only 'sensible' British-designed and manufactured microcomputer, its uses are small business and educational applications and in distributed processing networks. Hardware distributors are being signed and agreements made with software houses to add software. It is not for the hobbyists. A warranty and U.K.-wide on-site maintenance is given.	£2,300–£8,000
RESEARCH MACHINES LTD PO Box 75, 209 Cowley Road, Oxford 0865 49793	**Research Machines 380Z,** Min size: 4K memory; 380Z processor; keyboard. Max size: 48K memory. **280Z,** 4K board plus connecting cables, £398. 32K board—identical in performance to the 380Z: £722.	Software: Basic interpreter; 12K Basic; Assembler. A British system using CP/M software; delivery times are about 6 weeks at the moment. A minifloppy disc system is on trial. Sintel is the sole distributor.	From £830
SCIENCE OF CAMBRIDGE 6 Kings Parade, Cambridge 0223 312919	**MK 14,** Min size: 8060 SC/MP; ¼K user memory; ¼K PROM with monitor program; Hex keyboard and 8-digit, seven-segment display; interface circuitry; 5v regulator on board. To this can be added: ¼K RAM (£3·60); 16 I/O chip (£7·80); cassette interface kit (£5·95); cassette Interface and replacement monitor (£7·95); PROM programmer (£9·95).	Software: None provided, but a 100-page manual includes a number which will fit into 256 bytes covering monitors, maths, electronics systems, music and miscellaneous. Based on American National Semiconductor chips. Science will soon have a VDU interface and large manual on user programming. Half of sales are to hobbyists, half to engineers.	Basic price is £39·95. All prices are exclusive of VAT
STRUMECH ENGINEERING ELECTRONICS DIVISION (SEED) Portland Place, Coppice Side, Brownhills, Walsall, Staffordshire 05433 4321	**MSI 6800,** Min size: 6K memory; Act 1 terminal (keyboard); cassette interface. Max size: Three disc systems are offered: Minifloppy disc system with triple drives of 80 bytes each and 32K memory. Large floppy system with dual 312K-byte capacity disc and 32K of memory. Hard disc system with 10MB, five fixed, five removable, and 56K.	Software: Basic interpreter and compiler; super editor assembler; text processor on small disc system. This is an American-designed system which is being manufactured increasingly in U.K. A SEED survey of its sales showed 60% of the customers were educational establishments, a further 10% research institutes, 10% hobbyists and the rest commercial companies. A distributor network is being set up.	Basic system is £1,100 (£815 as kit); Minidisc—£2,500; large floppy disc £3,200; hard disc £8,000-plus
TANDY CORPORATION Bilston Road, Wednesbury, West Midlands 021-556 6101	**TRS-80,** Min size: Level 1 4K memory; video monitor; cassette; power supply. Max size: Level 2 16K memory; line printer, floppy disc system.	Software: Basic; some business packages. An American system from the 200-outlet Tandy chain—The Level 1 is aimed at the hobbyist and education market and Level 2 at small business applications.	Level 1—£499; Level 2—£2,434
U-MICROCOMPUTERS PO Box, 24, Northwich, Cheshire 0606 75627	**Challenger 1.** Min. size: 4K RAM, 8K Basic in ROM, keyboard, video and cassette I/F. Max size: 32K memory, printers, voice I/O, dual mini floppies, modem. Based on Ohio Superboard II.	Fast Basic in ROM with wide range of business, personal, games and educational software on cassette or mini-disc.	From £300. Single mini-floppy system about £1,400.
	Challenger 2. Min-size: (C2–4P) 4K RAM, 8K Basic in ROM, two slots for expansion (C2–8P has six slots for expansion). Max size: 36K RAM, mini-floppies, full-size floppies, hard disc (74MB), printers.	Similar to Challenger 1.	From £700.
	Challenger 3, Min. size: 32K RAM, dual mini-floppies, triple processor architecture (6502A, Z-80, 6800). Max size: 768K RAM, 74MB hard disc, multiple terminals, printers.	Can run virtually all 6502, 6800, 8080 and Z-80 code. With CP/M, languages Basic, Fortran, Cobol can be run. Full business software packages available including word processing and database management. Multi-programming available.	From £3,550 (C3 OEM) to £10,000 plus (C3 B with 74MB disc).

These pages represent an independent collection of news and views for owners of the Commodore Pet.

The principal focus is Mike Lake, of the Independent Pet Users' Group (IPUG).

If you wish to contact *Pet Corner*, write to him or send articles or ideas to us directly.

This month's offerings include information on new catalogues of interest to Pet users' independent American newsletters for Pet owners, some useful tips to avoid problems and program proposals on which your views are invited.

Catalogues

WE HAVE received the new catalogue from the London bookseller and program distributor MINI-MICRO. It features some Pet games we hadn't encountered, including a "very sophisticated" space game called *Galactic I*. Contact 01-889 7615 for more details.

Another interesting catalogue to come through the post arrived from Lotus Sound (01-981 3993). It includes a dual-drive minifloppy system for £916; it has a disc operating system—the well-respected DISKMON—which also supports Centronics printers and Axiom's clever, cheap printers but we don't know of a U.K. outlet for them yet.

Other DISKMON attractions include support for Fortran (about £60) and Intel's PL/M language (£40).

To run the floppy discs you will also need to spend at least £276 on an ExpandaPet expansion memory board. This is easy to install—it slots in above the main Pet circuit board—and it claims to have little adverse effect in terms of heat generation or power consumption. ExpandaPet is in 16KB or 32KB chunks; the biggest board costs £394.

Lotus Sound says it will despatch boards by registered mail, so you should have more memory a couple of weeks after your order.

Also in the Lotus catalogue is a £37·50 music synthesiser. It comprises the necessary software plus an integrated loudspeaker and amp which plugs into the I/O port; you can compose up to 90 'pages' of music, with up to 16 notes per page. Obviously you can store and edit music just like any other data. The Music Box also enables you to add sound effects to existing programs.

The third, and best, catalogue to arrive is the latest from Petsoft, 12 packed pages of programs. It is especially strong on business packages, including a new VAT system for £17·50, but is also good on other software. Programming aids in the catalogue include a data file handler for £12, which Petsoft claims "overcomes the problems often associated with Pet file handling capabilities".

Also new from Petsoft is the TIS series of *PET Workbooks*. They have been available previously only in the States but they have a fine reputation. Petsoft is charging £15 for the file and we have asked for review copies.

Petsoft has also tackled the problem of residual magnetisation of the heads on the cassette deck, to which Pets are prone. It is offering a battery-powered, solid-state de-magnetiser for £10·75; it emits a powerful pulse which instantly de-magnetises the heads without affecting other program cassettes, as mains-powered de-magnetisers are liable to do.

All prices in the new catalogue have been reduced by at least eight percent and are now inclusive of VAT. Copies are available free of charge; telephone 0635-201131.

Spanish problem

WE HAD a letter from a reader interested in buying a Pet for use in Spain. He was worried about voltage variations there, so we checked this.

It seems Pet is quite tolerant to voltage fluctuations within reason, but Iberian readers who are still uneasy might look for a small constant voltage transformer —a supplier in Madrid, Cierva Electro Optical, was recommended to us.

Petite

HB COMPUTERS of Kettering has contacted us to counter the claim of Torbus Ltd as the first distributor for the Plessey Petite add-on memory. HB says: "To our certain knowledge we are the only officially-appointed distributor for the Petite". More information from 0536 83922.

PET Gazette

THERE are three good independent American newsletters for Pet owners, and the one we're homing-in on is the *PET Gazette*. It is cyclo-styled, home-made, cheerful, friendly, packed, excellent, scruffy, and free—but more of that later.

It's a "news and resources handbook for Pet users". The first issue we saw is Volume 1 No. 5 for August-September, 1978. It is an A5 publication of 64 pages and a variety of typewriters. It is jam-packed with items for the U.S. user, much of which could also apply to British owners.

It had three pages of editor's ramblings and rumours, including some personal remarks about cassettes—Agfa he likes, Scotch and Microsette he'd heard bad things about; any U.K. experience to contribute? The booklet also contains some aggressive readers' letters, an excellent piece on Pet standards which we want to re-print, several tips and many programs, reviews of proprietary cassettes and hardware add-ons, and many lists about what you can get where. That last category includes the newsletter's own *PET Cassette Exchange*, for which you pay a $1 copying and handling fee.

The quality of the information is good, and we would like to re-print some of it from time to time.

We can recommend this publication. Which brings us to the fact that it's free but the publisher, Len Lindsey, asks for contributions. U.S. postage by air to Britain costs $1·02, so we reckon it wouldn't be unreasonable to send him £1 or so if you want a copy. We'll act as a clearing house; send us £1 and we'll pass it on, along with your name.

PET tips

- Many of you will be familiar with this message—PRESS PLAY & RECORD ON TAPE 1. If you want to avoid it, you can – simply press STOP then type in CONT (from *PET Gazette*).
- It probably goes without saying but when you turn it on the Pet is always in graphics mode. To get into lower-case you can type POKE 59468, 14. To return to graphics without switching off, type POKE 59468, 12.
- Here are a couple of line-remembering programs for you to try. In the second, 'NS' is the next line number.

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```
***RENUMBER***
59900  REM LIST THIS PROGRAM, LOAD
       TARGET PROGRAM, "RETURN"
       60000-, RUN 60000
60000  INPUT "RENUMBER OLD LINE
       NUMBERS FROM ";L1: INPUT
       "THROUGH";L2
60010  INPUT "AS NEW LINE NUMBERS
       FROM" ;L: INPUT "IN STEPS OF" ;D
60020  K=1025: B=256
60030  N=PEEK (K+2) + G*PEEK (K+3)
60040  IF N=O OR M>L2 GOTO 60000
60050  IF N>L1 THEN PRINT N,L: POKE
       K+2, L-INT(L/G)=G: POKE K+3,
       INT(L/G): L=L+D
60060  K=PEEK(K)+G*PEEK(K+1): GOTO
       60030
       READY
  ***AUTO LINE NUMBERER***
3 NS= 100
4 PRINT"3";NS;
5 GET KS:IF KS="" GOTO 5
6 PRINTKS;:IF ASC(KS)<> 13 GOTO £
7 NS=NS+10:PRINT" 3NS=" ;NS:PRINT"
  RUN 3"
8 POKE 525, 4:FOR 1=1TO 4:POKE525+1,
  13:NEXT:END
READY
```

- Another from *The PET Paper*. From time to time you may get the message.

```
PRESS PLAY AND RECORD ON TAPE 1
```

You can avoid this if you wish. Press STOP, then type in "CONT".

This we also took from *The PET Paper*.

- Replacing input statements.

It's a chore to teach a newcomer always to press the RETURN key after entering something. We might realise that the RETURN key signifies the end of input to the Pet. But that's not natural to the layman.

Many times the naive user will press RETURN by mistake, causing the program to end. Then you have to step in and type "CONT". That mystifies and alienates the newcomer.

Wouldn't it be better if the computer wouldn't quit when we just typed RETURN? And wouldn't it be pleasant if we could control what happens when the user makes a mistake, like enter a letter in a numeric INPUT—instead of the cryptic "?REDO FROM START" error message? But how can we put these things under program control?

- The form of the GET statement is:

```
GET V$ (V$ is any string variable)
```

You've all seen lines in programs like this:

```
10 PRINT"PRESS ANY KEY TO CONTINUE"
20 GET A$:IF A$="" GOTO 20
```

The GET A$ statement will place the character being pressed on the keyboard into variable A$. If no key is being pressed, A$ will be set to a null string (" "). Thus, line 20 GETs A$. If A$=" " (no key pressed) then line 20 will GOTO line 20. If a key is pressed, the program continues. A$ will equal the character you pressed. Add the following line:

```
30 PRINT A$:GOTO 10
```

Then run the program. Note that if you press the A key, A$ will equal "A". But how do we stop the program? Press the STOP key.

- Many times a program will ask a yes or no question (such as "DO YOU WANT INSTRUCTIONS?"). These are sometimes asked via INPUT statements. But then you have to type "YES" (or "Y") followed by the RETURN key for instructions.

But can't we use a GET statement instead? Try this program:

```
10 PRINT" IS YOUR NAME JON"
20 GET AS: IF A$="" GOTO 20
30 IF A$="N" GOTO 100
40 IF A$="Y" GOTO *00
50 PRINT" PLEASE ANSWER Y OR N"
60 GOTO 10
100 PRINT" YOUR NAME ISN'T JON!!!"
110 END
120 PRINT" HELLO JON"
130 END
```

Notice that if the user accidentally presses just RETURN, the program won't die. Even the layperson can understand the error message.

PET standards

THERE'S an argument against standards—they enforce rigidity, sometimes for its own sake—but if you want to be able to exchange programs and listings which are fully-compatible and easily-understood, you do need to follow some conventions and guidelines.

The PET Paper offers the following proposals for programs. We would like your opinion of them.

- Start your program with line 100.

Starting with line 100 serves two purposes. It allows 100 free lines for identification and useful routines: it will also allow a user provide an easy way to return in case you jump out of the program accidentally. If you hit RETURN with no data for an input statement, for example, you could simply type in GOTO 100 to get back into the program.

- Identify the program

Use lines 10–19 for identification purposes. A suggested format is:

```
10 PRINT "PROGRAM NAME"
12 PRINT "AUTHOR - DATE"
14 PRINT "LIST THE BOOK OR MAGAZINE
   TAKEN FROM, IF ANY/OR COPYRIGHT
   INFO"
16 PRINT "MEMORY NEEDED OK"
```

- Include instructions as part of the program.

Instructions on paper are fine, but you may lose your way. Best to have both but make sure enough instructions are part of the program so that it will be useful without the written instructions.

- Allow the user to read your identification/instructions.

Include a routine like the following:

```
40 PRINT "HIT ANY KEY TO CONTINUE"
42 GET AS:IF A$="" THEN GOTO 42
```

As soon as any key is pressed the program will continue.

- Clear the screen before starting.

Use a line such as:

```
60 PRINT" (CLR) " : REM CLEAR SCREEN
```

- Include documentation within your program.

Include plenty of REMarks in your program. It will help the next person understand what is going on—and you will be surprised how much it will help you with your own programs.

- Use lower-case whenever you have much text to display.
- Label each subroutine or main section of the program.

To make it easy to spot the beginning of each section of your program begin with a line with a lot of asterisks —for instance:

```
430 REM ************PRINT THE HUGE
    LETTER********
```

- Use line numbers increasing by 10 each new line.

By leaving nine lines between two program lines you obviously allow for future additions.

- Indent each FOR,NEXT loop.

This is a good programming technique. Remember that the Pet erases extra spaces between the line number and the beginning of your statement. To be able to indent simply use colons. For example:

```
560 REM*******SHOW ADDITION WITH
    THE SUM********
570 FOR A=1 TO 4:REM Loop for the first
    number
580 :FOR B=1 TO 6:REM Loop for the second
    number
590 : :PRINT A; "PLUS";B; "EQUALS" ; A+B
600 : :PRINT : REM print one blank line
610 :NEXT B:REM Next second number
620 NEXT A:REM Next first number
```

By indenting, you can see if you end every loop, and in the correct order.

The awkward part, of course, is coping with control and graphics keys. *Practical Computing* and *The PET Paper* both like the conventions proposed a year or so ago for key identification in a U.S. magazine, *Peoples' Computing*, which, incidentally, is about to turn into *Recreational Computing*.

- Use key cap identifiers if possible.

By using the letter/letters printed on the key there is nothing to memorise.

- Use capital letters and enclose them in square brackets.

This method allows each to be typed/with any typewriter or printer. Use ordinary parentheses if square brackets are not available.

- Use a number before an item to tell. how many times it should be repeated.

This saves a good deal of typing. Keep the number inside the brackets also.

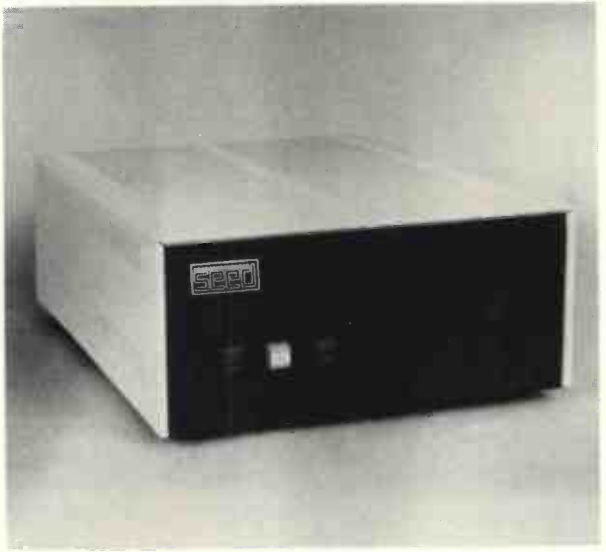
- Enclose consecutive special keys within the same brackets separated by commas.

This is much easier to read and eliminates the need to type brackets all the time.

- For graphics use the letter on the key enclosed in brackets.

If you see a letter inside brackets it means shift and hit that key. (S) means 'shift and hit s' which gives you a heart.

NEW FROM SEED



The 'System One':

A complete system based upon the highly successful MSI 6800 processor and including single or dual Shugart SA400 minifloppy drives all assembled in a single chassis.

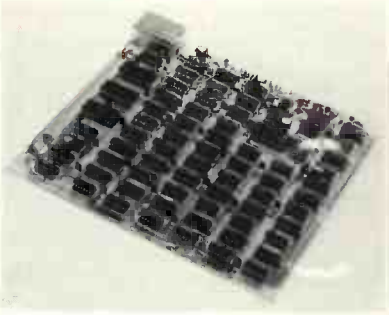
'System One' is expandable to 56K bytes of memory and will support up to eight I/O devices of serial or parallel types. The system is supplied with a disk operating system. The system includes a basic interpreter.

Further information from Strumech Engineering.

Strumech Engineering
Electronics Division Ltd.
Portland House
Coppice Side
Brownhills

Tel: Brownhills 4321

TANGERINE



NEW!
Ready built modules now available in 7 days Kits from
STOCK!

A fully-compatible terminal when used with any keyboard and domestic TV (or monitor) that can replace *any* serial terminal for a fraction of the cost.

Apart from the regular features that most VDUs have, the 1648 can perform the following:

1) Fully-controllable cursor.
2) Generates 16 lines of 44/48 characters (selectable) in both upper- and lower-case with any keyboard, even those *without* an 'alpha' facility.
3) Break and Repeat also provided.
4) RS232 and full current loop I/O provided.
5) *Full* control character decoding—selectable by the user to perform cursor movements, bell, page clear, and for switching any other peripherals with suitable interfacing.
6) 10 switchable Baud rates.

All VDUs are supplied with an A4-sized ring-binder containing 50 pages of comprehensive manual with large A3 fold-out Circuit Diagram and Component Layout. Details of graphics, and other applications are also included.

COMING SOON!

We shall be announcing soon the details of our Professional keyboard available in both kit and ready-built versions, with a numeric pad option.

Reed-keys are used exclusively, and it is therefore exceptionally reliable and robust!

Other products to be announced are:

- Z80 based single-board µcomputer.
- 6800 based single-board µcomputer.
- CRT Controller, an economy VDU module using software to control its functions. Also Teletext-compatible, with full graphics.
- Add-on Graphics Module for the 1648.
- Add-on Hex Keypad, for machine coding.
- Add-on µmodem for cassette interfacing.
- Prom Programmer.
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( ) Further information.
( ) 1648 VDU KIT @ £129·50 inc. pp + VAT £10·36
( ) 1648 VDU Built and tested @ £154·50 inc. pp + VAT £12·36

NAME: .....

ADDRESS: .....

.....

.....

Business telephone: ..... Home telephone: .....

DATE: / /79

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£..... INCLUDING VAT.

Signature: .....

Overseas customers should send a bank draft drawn on a London Bank, and include sufficient postage for surface/air mail for 1,3 kg.

● Circle No. 148

Tandy users, like any other micro enthusiasts, have their difficulties as well as their successes—information they would clearly like to share with others. Now *Practical Computing* offers them their own monthly forum to share their news and air their views.

Troubles

WE HAD a letter from Nigel Dibben wondering whether the other 199,999 TRS-80 users have had as much trouble as he has.

Nigel has had a collection of hardware faults on his 16K Level II machine. His first system arrived with some, was returned to Tandy, was repaired and failed completely within half an hour of being re-started. The replacement refuses intermittently to LIST or CLOAD, the cassette relay is jammed, and is unable to compute some mathematical functions correctly.

He reckons that the faults on the second system are caused by over-heating. He reports that "a blast of cold air into the back reduced errors and overflows from 50 percent probability to zero within about five minutes. Switching-off the cooling causes errors within one minute, deteriotating to 50 percent again after about 10 minutes.

He also suggests that buyers should be warned that the video is sensitive to any operating TV within about two metres; the effect is a severe horizontal wobble on the picture. This could be what our reviewer suffered.

There is another problem he found. The Editor/Assembler software works well enough but the documentation is below standard, apparently being assembled hastily from poorly-edited material. For example, there are references to sections of text which do not exist; and the Opcode listings are re-printed computer output with two out of four columns irrelevant. Incidentally, they were run off at 10:20:50 am and 10:22:47 am on July 9, 1976—it's all there.

More seriously, there is a dearth of information about subroutines already available in the resident ROM and there is not even a reference in the contents list to the few (such as *keyboard scan*) which are listed.

All about the TRS-80

WE HEARD pleasant things about the *Guide to TRS-80 Information* and recently tracked down a copy. We saw the second edition, which appeared in mid-1978.

Modestly subtitled 'All about the world's fastest-selling microcomputer', the guide declares that it "permanentises in one place a large number of exciting references to or about the TRS-80 and the broad field or hard/software designed for it."

It appears that permanentises in one place means 'contains'; and you can be your own judge of what constitutes an 'exciting' reference.

So what is it? For a start, it's an A5 booklet of 36 pages organised into seven sections, plus an introduction:

- *General TRS-80 Information.* Articles, letters, editorials, advertisements, newsletters of interest to users and potential users. Mostly culled from U.S. magazines.
- *TRS-80 Software Articles and Information.* Articles, reviews and sources.
- *A special TRS-80 Software List.* Annotated entries and location of authors of selected software, many people wanting a SAE.
- *Other TRS-80 Software Sources.* Authors and addresses, mostly small companies.
- *TRS-80 Hardware Articles and Information.* References to hardware articles and reviews.
- *A special TRS-80 Hardware List.* Annotated references to some hardware sources.
- *TRS-80 and General Programming Information.* Selected references to articles and books on programming; not many, but good quality.
- *TRS-80 User and Special Interest Group Information.* Who and where they are—there are 13 of them and, of course, they are all in the U.S.
- *Bugs, Ideas and Tips.* Brief but helpful information reported by or prepared for users, including some things about which you might ask your TRS-80 supplier.

What did we think of the guide? It's excellent value if you have access to U.S. magazines, and perhaps U.S. people. The 'tape tips' alone are worth several pence of anyone's computer budget, in any case.

There are some 400 references. Since it costs only $2·80 (plus $1·50 shipping plus 20 percent for air mail, which we work out at a total of $5·16) you should be able to get something from it.

The address is PO Box 37206, Oak Park, Mi 48237, U.S. If you have any difficulty obtaining it, contact us.

Colour blindness

EVERY TIME the editor assembles his TRS-80, he has to refer to the *Handbook* to make sure which jack plug goes into which socket—he's funny that way. The instant solution, as now practised by many TRS-80 owners, is to colour-code the jacks and sockets; he is using coloured insulating tape.

Cursor curse

HERE'S a thought from a U.S. seminar participant—don't leave your cursor for too long in the middle of the screen. It may get 'locked' in that position.

Square cut

WRITING programs to draw squares and rectangles can be tricky. This effort is from Freddie Nicholls of Optronics in Twickenham.

```
 1 CLS
 5 PRINT"ENTER START & FINISH OF
   HORIZONTAL LINES (0 TO 127):INPUTA,B
 6 PRINT"ENTER START & FINISH OF VERTICAL
   LINES (0 TO 47): INPUTC,D
 8 Y=C
10 FORX=ATOB:SET(X,Y): NEXTX: Z=Z+1:
   IFX=BGOT020: GOTO10
20 Y=D:IFZ=2GOTO40
30 GOTO10
40 X=A
50 FORY=CTOD:SET(X,Y) :NEXTY: IFY =
   DGOTO60:GOTO50
60 X=B:GOTO50
70 END
```

Does anyone have a routine to draw circles?

Optronics options

INCIDENTALLY, Optronics will be marketing three American goodies in this country. Pride of place must go to Michael Shrayer's Electronic Pencil software, available on several S100 micros already but now implemented on Tandy's little giant, as we mentioned in our U.S. report in the January issue. We'll be asking for a review copy of the software.

Optronics is also fixing a distributorship for *The BASIC Handbook*. This we have reviewed enthusiastically; we like it so much we might even sell it ourselves.

Optronics is also arranging to sell *TRS Computing* here. This is the best of the TRS-80 specialist magazines, even if it is only a few months old. Optronics let us see a copy but insisted we return it, so the continuity of supply might be in some doubt. Still, if you have a chance it is worth subscribing to—we get ours direct from the States for $18. Goodies from issue one—much the best so far—include:

- A $6 kit to get Level I and Level II on the same machine.
- How to get at the lower-case characters every TRS-80 has within it.

Getting taped

J & J Electronics is a new name to us, but it's keen to become better known. We've just received the company's mailing sheet and there are some real goodies on it, including a do-it-yourself 16K upgrade kit for $149. J & J promises that this takes only half an hour to install and it certainly beats the Tandy price.

This supplier also has good-quality Racal tapes at discount prices—10 for £4·50. The bulk of the lists comprise programs, 23 of them ranging from a £5·95 submarine chase game to £19·95 for an accounts-receivable package. More programs are promised, especially for business.

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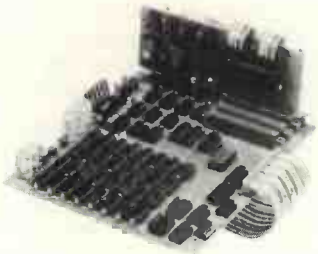

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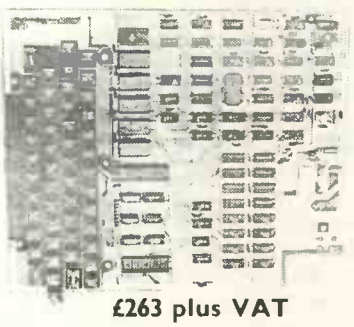

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Similar considerations for input conversion

by ROLAND PERRY

In two previous articles we discussed the use of an IBM Selectric I/O writer as a printer, describing a hardware interface and giving suitable software routines to drive it. The IBM machine is capable of input; indeed the output can even be verified as it proceeds.

SIMILAR considerations apply to the input conversions as were detailed for output conversion. For example, it is easier to re-wire the contacts than to trace the existing wiring, Again, the input may be derived from an operational cycle or from a golf-ball character. Some of the circuitry of the original output conversion, and the look-up table of the software, are used, with the addition of a little extra electronics and a driver program.

The C1 contact, as yet unused, signals that the character selection contacts are ready to be sampled, and the combination C2 and the like signals that the operational contacts are ready to be sampled.

In fact, for character inputs both C2 and C1 are used and it is this combination which will allow the computer to differentiate between operations and characters.

Sampling takes place when the Normally Open (N/O) contact closes, which for the C2 and the like combination is already detected in the interface as one of the constituent parts of the BUSY signal. To detect the N/O closure of C1, an extra pair of NAND gates are used to form a bi-stable, de-bouncing the switching action.

A new set of seven wires connects the contacts to the computer. The contacts are wired in pairs, one character and one operational, using the same relationship as for the paired output magnets—note the inverted sense of R-5 and wire accordingly. It is unlikely that the terminal will have spare contacts for the shift operations and they are dealt with as a special case.

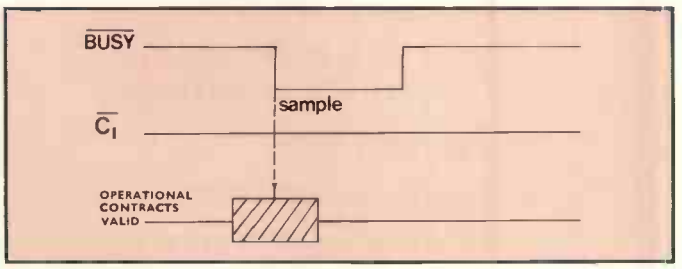


Figure 1. Operational Input.

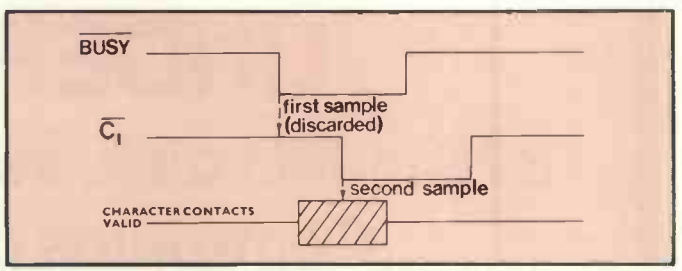


Figure 2. Character Input.

The software should be arranged to act as follows:

When expecting an input, the BUSY line is polled until it goes low. At that point the contacts are sampled in case it was an operational cycle. The result is stored. If, while the BUSY line is still low, the C1 line goes low, then the cycle is a character input and the contacts are once again sampled on the falling edge of C1. This sample replaces the previous result.

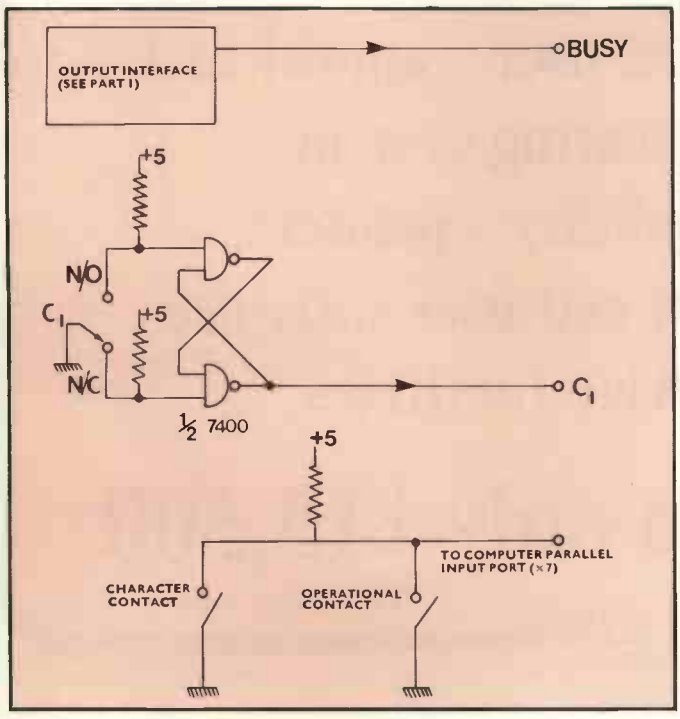
For an operational cycle the look-up table already existing for outputs is scanned between ASCII 00 and 20 inclusive, to determine the code for the input to be returned to the system.

If no contacts were detected as closed when the BUSY line fell, then the cycle was a shift and all that needs to be done is to examine the shift status-line for use when decoding the next character input.

For character cycles, the look-up table is scanned from ASCII 21 upwards, comparing the contents to a combination of the input IBM code and the shift status, to determine the ASCII for the input character.

Finally, when interfacing with the system software, be careful to program the routines for half-duplex operation, otherwise the system may echo all the input characters on to the printer, causing double-printing. Some care may also be required in the treatment of back-space characters.

Figure 3. Electronics.



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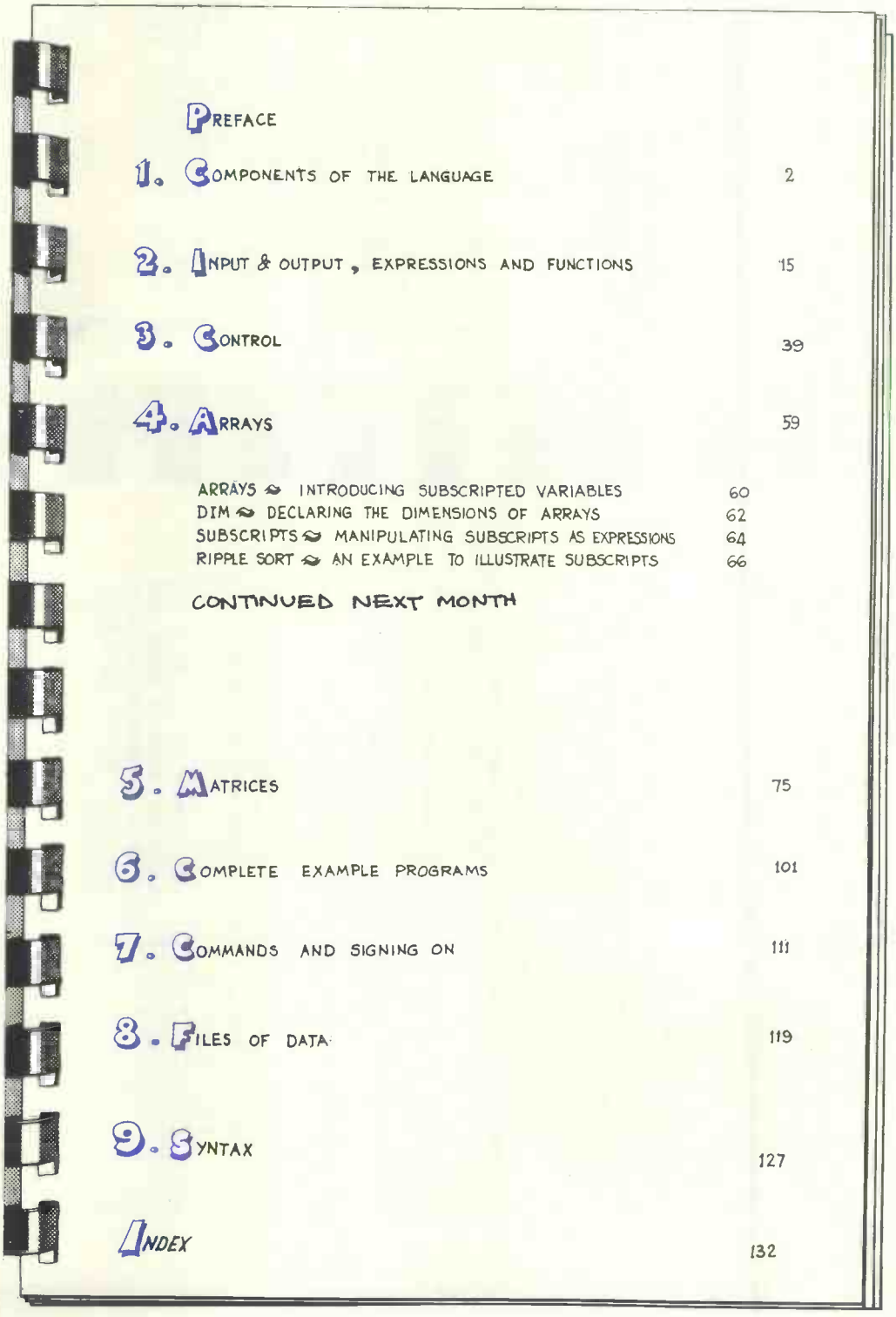


PREFACE

4 ARRAYS

IN *ADDITION* TO THE *SIMPLE* NUMERICAL & TEXTUAL VARIABLES YOU MAY USE THOUSANDS OF OTHER VARIABLES ARRANGED IN *ARRAYS*.

BELOW IS AN EXAMPLE OF A *ONE-DIMENSIONAL* NUMERICAL ARRAY CALLED A().

A(1)	3.56
A(2)	7.12
A(3)	10.68
A(4)	

A() HAS *ELEMENTS*, EACH OF WHICH CAN STORE A NUMBER IN THE SAME WAY AS ANY *SIMPLE* NUMERICAL VARIABLE:

```
100 LET A(1) = 3.56
110 LET A(2) = 7.12
120 LET A(3) = A(1) + A(2)
```

ANOTHER NAME FOR *ELEMENT* IS *SINGLY-SUBSCRIPTED VARIABLE* (OR JUST *SUBSCRIPTED VARIABLE* IF THE CONTEXT ALLOWS).

OTHER NAMES FOR A ONE-DIMENSIONAL ARRAY ARE: *VECTOR*, *COLUMN VECTOR*, & *COLUMN MATRIX*. YOU CAN ALSO THINK OF A() AS A ROW:

A(1)	A(2)	A(3)	A(4)
3.56	7.12	10.68	

AND CALL IT A *ROW VECTOR* OR *ROW MATRIX*.

BELOW IS AN EXAMPLE OF A *TWO-DIMENSIONAL* NUMERICAL ARRAY CALLED B(,). IT HAS 4 ROWS AND 3 COLUMNS.

	1)	2)	3)
B(1,	8.92		
B(2,		17.84	-8.92
B(3,			
B(4,			

JUST AS WITH A(), B(,) HAS *ELEMENTS* EACH OF WHICH CAN STORE A NUMBER IN THE SAME WAY AS A SIMPLE NUMERICAL VARIABLE:

```
130 LET B(1,1) = 8.92
140 LET B(2,2) = 2*B(1,1)
150 LET B(2,3) = -B(1,1)
```

ANOTHER NAME FOR AN ELEMENT OF A *TWO*-DIMENSIONAL ARRAY IS *DOUBLY-SUBSCRIPTED VARIABLE* (OR JUST *SUBSCRIPTED VARIABLE* WHEN THE CONTEXT ALLOWS).

OTHER NAMES FOR A TWO-DIMENSIONAL ARRAY ARE *RECTANGULAR ARRAY* AND *RECTANGULAR MATRIX*. (IF THE NUMBER OF ROWS IS THE SAME AS THE NUMBER OF COLUMNS THEN *SQUARE* MAY BE SAID IN PLACE OF *RECTANGULAR*.)

A FEW *BASICS* ALLOW *THREE*-DIMENSIONAL ARRAYS.

BELOW IS AN EXAMPLE OF A *TEXTUAL* ARRAY CALLED T$(). IT IS *ONE-DIMENSIONAL* ((SEVERAL *BASICS* DON'T ALLOW TWO-DIMENSIONAL TEXTUAL ARRAYS SO FOR THE SAKE OF "PORTABILITY" IT IS BEST TO DO WITHOUT THEM)).

T$(1)	HO
T$(2)	
T$(3)	KEGRAPHA
T$(4)	
T$(5)	KEGRAPHA

T$( ) HAS ELEMENTS EACH OF WHICH CAN STORE A TEXT IN THE SAME WAY ((AND USUALLY TO THE SAME LENGTH)) AS ANY SIMPLE TEXTUAL VARIABLE.

```
160  LET T$(1)="HO"
170  LET T$(3)="KEGRAPHA"
180  LET T$(5)=T$(3)
```

YOUR PROGRAM MAY HAVE UP TO 26 NUMERICAL ARRAYS:

A( ), B( ), C( ), . . . , Z( )

OF WHICH SOME MAY BE *ONE*-DIMENSIONAL AND SOME *TWO*-DIMENSIONAL: ONE LETTER CAN'T BE MADE TO SERVE FOR BOTH KINDS AT ONCE.

YOUR PROGRAM MAY ALSO HAVE UP TO 26 TEXTUAL ARRAYS:

A$( ), B$( ), C$( ), . . . , Z$( )

AND YOUR PROGRAM MAY USE ALL 286 SIMPLE NUMERICAL VARIABLES AND ALL 26 SIMPLE TEXTUAL VARIABLES WHICH ARE COMPLETELY DISTINCT FROM ELEMENTS OF ARRAYS: B(2,2) HAS NOTHING TO DO WITH B; T$(5) HAS NOTHING TO DO WITH T$.

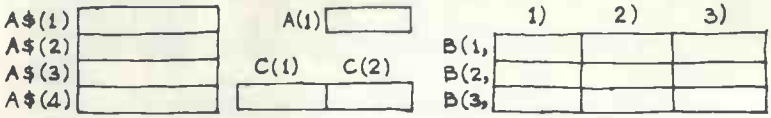
SPECIFY THE SIZES AND SHAPES OF THE ARRAYS YOU WANT TO USE BY THE "DIM" STATEMENT ((SHORT FOR *DIMENSION*)) AS EXPLAINED OVERLEAF. THE ARRAYS ON THIS DOUBLE PAGE WOULD BE SPECIFIED LIKE THIS:

```
10  REM A PROGRAM WITH ARRAYS
20  DIM A(4), B(4,3), T$(5)
```

DIM

DIM IS SHORT FOR *DIMENSION*
USE THIS STATEMENT TO SPECIFY THE DIMENSIONS OF *ALL* ARRAYS IN YOUR PROGRAM.

THE FOLLOWING SELECTION OF ARRAYS:



MAY BE SPECIFIED IN ONE "DIM" STATEMENT:

```
10  REM   PROGRAM WITH ONE DIM
20  DIM   A$(4), A(1), C(2), B(3,3)
```

OR IN MORE THAN ONE "DIM" STATEMENT:

```
10  REM   PROGRAM WITH SEVERAL DIMS
20  DIM   C(2), A(1)
30  DIM   B(3,3)
40  DIM   A$(4)
```

INTEGERS ONLY! EXPRESSIONS NOT ALLOWED

MANY *BASICS* ALLOW YOU TO *OMIT* "DIM" STATEMENTS WHEN DIMENSIONS ARE 10 OR LESS. BUT DON'T TAKE ADVANTAGE OF THIS. IF YOU GO BACK TO A PROGRAM WRITTEN LONG AGO OR HAVE TO SORT OUT SOMEONE ELSE'S PROGRAM IT IS HELPFUL TO KNOW STRAIGHT AWAY WHAT ARRAYS ARE BEING USED. IN ANY CASE THERE ARE SOME *BASICS* THAT DEMAND DECLARATION OF ALL ARRAYS HOWEVER SMALL.

ALL "DIM" STATEMENTS SHOULD BE NEAR THE BEGINNING OF THE PROGRAM BEFORE THE FIRST USE OF ANY SUBSCRIPTED VARIABLES AFFECTED AND YOU SHOULD ENSURE THAT "DIM" STATEMENTS (LIKE "DEF" STATEMENTS ON PAGE 26) ARE ACTUALLY ENCOUNTERED DURING EXECUTION.

```
50  LET P(1) = 4·5
60  DIM P(16)
```

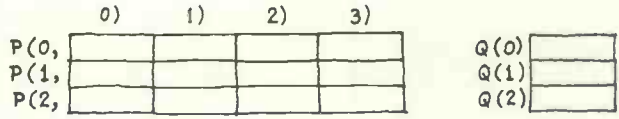
```
10  GO TO 30
20  DIM A(40,40), B(1000)
30
```

IN MANY *BASICS* THESE THINGS DON'T MATTER BUT IN SOME THEY *DO* SO FOR THE SAKE OF "PORTABILITY" ACCEPT SUCH LITTLE RESTRICTIONS.

IT IS ALWAYS A MISTAKE TO DECLARE AN ARRAY MORE THAN ONCE.

```
10  DIM A(100,20), B(60)
20  DIM B(60), C(500)
```

HISTORICALLY THE ROWS & COLUMNS OF ARRAYS IN *BASIC* WERE COUNTED FROM *ZERO* RATHER THAN UNITY.



AND THE "DIM" STATEMENT REFERRED TO *BIGGEST SUBSCRIPTS* RATHER THAN QUANTITIES OF ROWS AND COLUMNS:

```
10  REM   HISTORICAL BASIC
20  DIM   P(2,3) , Q(2)
```

BUT THERE ARE VERSIONS OF *BASIC* TODAY THAT COUNT FROM *UNITY* (AS IN THE ILLUSTRATIONS OPPOSITE) SO IT IS SAFEST TO *IMAGINE* YOUR VERSION COUNTS FROM 1. IF, IN FACT, IT COUNTS FROM ZERO IT MEANS YOU ARE WASTING SOME SPACE IN THE COMPUTER'S STORE BUT AT LEAST YOUR PROGRAM SHOULD BE "PORTABLE".

SOME *BASICS* CATER FOR BOTH METHODS WITH THE STATEMENT:

```
10  BASE  0
```

OR:

```
10  BASE  1
```

TO DECLARE WHETHER YOU WISH TO COUNT FROM ZERO OR UNITY RESPECTIVELY.

THE "DIM" STATEMENT MAKES *BASIC* RESERVE SPACE IN THE COMPUTER'S STORE FOR ALL YOUR ARRAYS, BUT THIS DOESN'T IMPLY THAT *BASIC* CLEARS THEM OF INFORMATION LEFT OVER FROM A PREVIOUS COMPUTER RUN. SOME *BASICS* DO SET SUBSCRIPTED VARIABLES TO ZERO (BLANKS IN THE CASE OF TEXTS), OTHERS "FLAG" THEM AS UNSET (AS DISCUSSED FOR SIMPLE VARIABLES ON PAGE 11), AND OTHERS LEAVE THEM FULL OF "GARBAGE". SO IF YOUR PROGRAM READS FROM AN ARRAY:

```
100  LET  A = B(2,2)
```

EXPECTING TO FIND ZERO WHEN NOTHING HAS YET BEEN PUT THERE, *MAKE SURE YOUR PROGRAM CLEARS THE ARRAY FIRST*. THE SIMPLEST WAY TO DO THIS IS EXPLAINED ON PAGE 86 WHICH WE ANTICIPATE WITH THIS EXAMPLE:

```
70  MAT  B = ZER
```

SETS ALL ELEMENTS OF ARRAY B(,) TO ZERO

CHAPTER 4

SUBSCRIPTS

THE FOLLOWING ARRAY:

```
10 DIM  B(4,3)
```

	1)	2)	3)
B(1,			
B(2,			
B(3,			
B(4,			

IS AN ARRAY OF 12 SUBSCRIPTED VARIABLES EACH OF WHICH CAN BE USED AS THOUGH IT WERE A *SIMPLE* NUMERICAL VARIABLE:

```
100 LET  B(1,2) = B(2,2)↑2 + 6.8
110 LET  B(3,3) = FNC( B(1,1)/B(2,2))
120 PRINT  B(1,2) ; B(3,3)
130 FOR  I = B(1,1)  TO  B(1,2)  STEP B(1,3)
140 IF  B(3,3) >= B(2,3) THEN 600
```

EXAMPLES OF SYNTAX: THE CONTENT IS MEANINGLESS

THIS APPLIES TO TEXTUAL VARIABLES TOO:

```
150 LET  T$(6) = "PONZIO"
160 IF  T$(7) <> "PILATO" THEN 200
170 PRINT  T$(6); T$(7)
```

IN ANY EXPRESSION WHERE A *SIMPLE* VARIABLE IS ALLOWED A *SUBSCRIPTED* VARIABLE IS ALSO ALLOWED.

BUT THERE ARE PLACES OUTSIDE EXPRESSIONS WHERE YOU *CAN'T* HAVE A SUBSCRIPTED VARIABLE:

NOT AS A LOOPING VARIABLE:

```
180  FOR  B(1,1) = 1 TO 3
```

```
190 DEF FNC( B(1,1) ) = SQR(A↑2 + B↑2)
```

NOT AS THE DUMMY ARGUMENT OF A FUNCTION.

THE *REAL* ADVANTAGE OF SUBSCRIPTED VARIABLES, HOWEVER, IS NOT AS A SUBSTITUTE FOR SIMPLE VARIABLES BUT BECAUSE THEIR

SUBSCRIPTS MAY BE VARIABLES + EXPRESSIONS

EVEN COMPLICATED EXPRESSIONS, THEMSELVES CONTAINING SUBSCRIPTED VARIABLES.

ILLUSTRATING BASIC PAGE 64

THUS IT IS SIMPLE TO READ A ROW OR COLUMN VECTOR:

```
200 DATA "A","B","C","D"
210 FOR I = 1 TO 4
220 READ T$(I)
230 NEXT I
```

OR CLEAR A RECTANGULAR ARRAY:

```
240 FOR R = 1 TO 4
250 FOR C = 1 TO 3
260 LET B(R,C) = 0
270 NEXT C
280 NEXT R
```

OR PRINT A VECTOR (IN THIS CASE AS A ROW):

```
290 FOR I = 1 TO 4
300 PRINT T$(I);
310 NEXT I
320 PRINT
```

OR PRINT A RECTANGULAR ARRAY (IN THIS CASE BY ROWS):

```
330 FOR R = 1 TO 4
340 FOR C = 1 TO 4
350 PRINT B(R,C);
360 NEXT C
370 PRINT
380 NEXT R
```

OR SCAN A LIST OF ITEMS TO FIND THE LOCATION OF A PARTICULAR ITEM.

```
390 FOR I = 1 TO 4
400 IF T$(I) = "C" THEN 430
410 NEXT I
420 LET I = 0
430 PRINT "LOCATION IS"; I
```

BUT BEWARE OF USING COMPLICATED EXPRESSIONS AS SUBSCRIPTS:

```
440 LET X = B(A↑2/2, 3)
```

WHAT WOULD HAPPEN IF A↑2/2 TURNED OUT TO BE 3.99999 ?

- SOME *BASICS* WOULD TAKE THE *INTEGRAL PART* OF THE RESULT AND LET X = B(3,3)
- OTHER *BASICS* WOULD TAKE THE *NEAREST INTEGER* TO THE RESULT AND LET X = B(4,3)

YOU CAN EASILY TEST WHAT YOUR OWN VERSION OF *BASIC* DOES BY RUNNING THE LITTLE PROGRAM BELOW. BUT YOU SHOULD NOT WRITE PROGRAMS THAT RELY ON ONE PARTICULAR INTERPRETATION. KEEP SUBSCRIPTS SIMPLE AND USE "INT( )" IF THEIR VALUES COULD HAVE FRACTIONAL PARTS.

```
10  DIM   A(2)
20  LET   A(1) = 100
30  LET   A(2) = 200
40  LET   I = 1.99
50  PRINT A(I)
60  END
```

CHAPTER 4

RIPPLE SORT

AN EXAMPLE TO ILLUSTRATE *SUBSCRIPTED VARIABLES*

SORTING NUMBERS INTO ASCENDING ORDER IS SIMPLE IN CONCEPT BUT SURPRISINGLY DIFFICULT TO ORGANISE WHEN THERE ARE LARGE VOLUMES OF DATA. THE EXAMPLE BELOW USES THE SIMPLEST TECHNIQUE OF ALL ⇄ THE *RIPPLE* SORT ⇄ WHICH IS ADEQUATE FOR SMALL VOLUMES OF DATA ((100 OR SO NUMBERS)) STORED AS ARRAYS IN *BASIC*.

A(1)	6.5
A(2)	13.9
A(3)	4.6
A(4)	10.2
A(5)	3.5

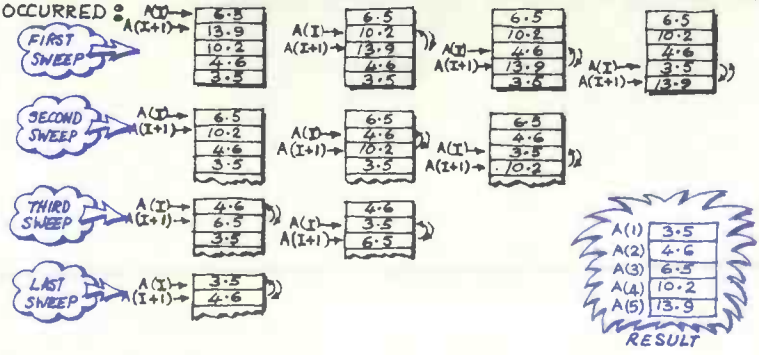
ARRAY A(), A COLUMN VECTOR, IS TO BE SORTED INTO ASCENDING ORDER ⇄ HEAVIEST NUMBERS SINKING TO THE BOTTOM. YOU CAN REVERSE THIS ORDER BY REVERSING THE CONDITION IN THE "IF" STATEMENT.

WE START WITH AN "INDEX" I POINTING TO ROW 1; THEN WE ADVANCE I ROW BY ROW. AT EVERY ADVANCE WE LOOK AT THE NUMBER I IS POINTING TO ⇄ AND ALSO AT THE NUMBER ONE ROW AHEAD OF I. IF THE FORMER IS GREATER THAN THE LATTER WE SWOP THE TWO NUMBERS.

HAVING FINISHED ONE "SWEEP" OF I WE SWEEP AGAIN ⇄ BUT STOP ONE ROW SHORT OF THE PREVIOUS SWEEP BECAUSE THE HEAVIEST NUMBER MUST ALREADY HAVE SUNK TO THE BOTTOM.

WE CONTINUE SWEEPING ⇄ EACH SWEEP A ROW SHORTER THAN THE PREVIOUS ONE ⇄ UNTIL THERE IS A WHOLE SWEEP WITHOUT A SINGLE SWOP IN IT OR THE LENGTH OF SWEEP IS REDUCED TO NOTHING.

HERE IS THE WHOLE PROCESS:)) SHOWS WHERE A SWOP HAS JUST OCCURRED:



ILLUSTRATING BASIC PAGE 66

THE PROGRAM BELOW IS DESIGNED TO SORT A COLUMN VECTOR, A(), HAVING N ROWS. THE VECTOR IS FILLED FROM "DATA" STATEMENTS ↝ THE FIRST NUMBER IN THE FIRST "DATA" STATEMENT TELLING THE NUMBER OF NUMBERS TO BE SORTED. THE LOGIC ILLUSTRATED HERE IS USED AGAIN IN A MORE USEFUL WAY ON PAGE 71 WHERE WE AVOID ACTUALLY HAVING TO MOVE THE NUMBERS BEING SORTED.

```
10  REM  RIPPLE SORT; MAX 100 NUMBERS
20  DIM  A(100)
30  DATA  5
40  DATA  6.5, 13.9, 4.6, 10.2, 3.5
50  REM  CONTINUE DATA STATEMENTS AS REQD.
60  REM
1000  READ  N
1010  FOR  I = 1 TO N
1020  READ  A(I)
1030  NEXT I
1040  REM
1050  REM
1060  FOR  S = 1 TO N-1
1070  LET  M = 0
1080  FOR  I = 1 TO N-S
1090  IF  A(I)  <= A(I+1)  THEN  1140
1100  LET  X = A(I)
1110  LET  A(I) = A(I+1)
1120  LET  A(I+1) = X
1130  LET  M = 1
1140  NEXT  I
1150  IF  M = 0  THEN  2000
1160  NEXT  S
2000  REM
2010  REM
2020  FOR  I = 1 TO N
2030  PRINT  A(I)
2040  NEXT  I
2050  END
```

NUMBER OF NUMBERS

FILL VECTOR A()

SWEEPS

INDEX IN EACH SWEEP

DON'T SWOP

EARLY EXIT

VARIABLE M IS A "MARK" SET ZERO BEFORE EACH SWEEP BUT SET NON-ZERO EVERY TIME THERE IS A SWOP. M IS TESTED AT THE END OF EACH SWEEP AND IF IT SHOWS THERE WERE NO SWOPS THEN CONTROL JUMPS TO AN EARLY EXIT.

THIS TECHNIQUE ↝ AND OTHERS USED IN THE LONGER EXAMPLES IN THIS BOOK ↝ ARE EXPLAINED VERY CLEARLY BY A. COLIN DAY IN "FORTRAN TECHNIQUES" ↝ CAMBRIDGE UNIVERSITY PRESS (1972).

This month we review two more books which have been published with the beginner in computing in mind.

This calls for patience

BASIC—A Self-teaching Guide

by Robert Albrecht, LeRoy Finkel and Jerald Brown (published by John Wiley & Sons, 1978; limp cover, 325 pages, £3.25)

PUBLISHED as a second edition in 1978, the authors claim that "tens of thousands of people of all ages have used the first edition for a fast and thorough introduction to programming in Basic". We would not dispute the total for the number of people who may have achieved a thorough introduction to Basic by using this book but to claim it would be a speedy process is outrageous.

The book is of 325 pages, albeit with much use of space on the pages, a giant Teletype

for most of the printout examples, and a large type-face for the text—it is also written in a style reminiscent of a children's primer.

Even so, it does no more than cover the elementary structure of the Basic language. The discerning reader might well feel some insult to the intelligence by the level at which some of the questions in the text are posed.

An example of this approach is on page 2—"this first section starts off slowly and simply to kind of ease you into things". There the reader will find a photograph of a teletype-writer—a Teletype 33, in fact—and what is described as a CRT is a Commodore Pet microcomputer.

The reader is asked to identify which of three characteristics these devices have in common—a television screen, a typewriter-like keyboard, or a steering wheel. We are not saying this is a *bad* approach to teaching a language—we do have doubts about the content.

As a more pointed example, the book will teach the reader how to write and run a simple Basic program but it will not tell you how to store a program as anything other than a source library.

The concept of storage space for files is introduced in the final chapter, with the explanation that a numeric variable occupies two "words" of file space while a single character of a string variable occupies *approximately* half a "word" of file space. That is not good enough.

Simplistic

Simple error correction is explained but almost no mention is made of the syntactical checking facilities available with the majority of Basic systems today. In fact, the authors do not acknowledge the existence of or difference between interpreters or compilers—their examples are produced, however, from an (un-named) interpretative time-sharing system.

Some of the differences in language implementation are pointed out but with insufficient attention for our taste—there is no standard Basic. The chapter on files adopts a most simplistic approach; this is probably the area of concern for the user of a small business system.

Conclusions

- **True to its title, this book is indeed a self-teaching guide but only for readers endowed with a large amount of patience and only for those who will be satisfied with learning no more than an elementary usage of the Basic language.**

Beginner's Guide to Computers

by T F Fry (Butterworths, 1978; paperback, 182 pages, £2.95)

WE LIKED this book. In it Fry has revealed the technicalities and complexities of the computer with lucidity and simplicity.

The book is very much an elementary and commendably light *technical* introduction, using basic mathematics and electronics. It is recommended

for the technically-inclined layman and as background reading for students of computer technology beginning their studies. Consequently, the author, who has already established something of a reputation as a clear expositor of electronics and computer techniques, takes few short cuts.

He starts by introducing three basic terms—data, process and information. Data he defines as consisting of "facts and figures relating to a situation which in isolation may not be meaningful"—a trifle heavy for our tastes, but accurate.

Processing is the business of relating and interpreting data in such a way as to provide information as a useful and meaningful statement upon which action can be taken.

The distinction between data and information is critical to an appreciation of computers—data is disorganised, information is elegant—and it is proper that it should be introduced even before computers are discussed.

Fry gives three numbers as an example—7, 78, 8. In the right context, for instance, the top right-hand corner of a cheque, this becomes a meaningful statement of information: the date 8–7–78.

Number systems, logic and the central processing unit, together with storing and retrieving information, are explained with the aid of small diagrams. They and the printing could have been larger for clarity.

Not dated

There is a reasonable introduction to the intricacies of programming, an overview of hardware systems, including small computers. Fry's terminology is by no means dated, so one may suppose that he keeps on top of his subject but the way he glosses-over small business computers is depressing.

Minis are given a paragraph, microcomputers three; floppy discs do not even warrant a mention. Visible record computers, curiously enough, are given a couple of pages and a photograph. Fry winds up with some ideas on "the computer and society" which comprises a neat enough overview of applications.

An index is included but, sadly, no glossary. On the whole, though, we were inclined to forgive this omission because of Fry's diligent care for explanatory detail.

Conclusions

- **Excellent value at less than £3 for the student as a broad outline to a deeper technical study. Not recommended for the businessman, who will probably find it too technical, and perhaps a trifle boring.**
- **The computer hobbyist might find it a good introduction.**

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Moving software from one micro to another

This is the second part of the article by Mark Witowski on how to overcome the difficulty of moving software written for one make of computer to another. The first part appeared in the February issue.

PART 1 showed how the operator and operand fields of an object-coded program can be displayed in a pseudo-assembly listing format. More information, however, can be gleaned from the code. Looking at the disassembly listing produced by the simple program, and then comparing it to any piece of assembly language text, it can be seen that only certain statements have labels. For the others this field is left blank. A label is required on a statement only if it is the destination of a program branch, jump or subroutine call.

Data statements, ones which reserve memory storage for use by the program, are also labelled. So they can be accessed by direct and extended mode instructions. The first pass of a two-pass assembler is concerned mainly to assign a numeric value to each label. It does this by keeping a hypothetical "program counter", which is updated by the correct amount for each statement.

The current value of this variable is assigned to the label. This will then be substituted for the label whenever it is used as part of an instruction operand. Conversely, the operand of an instruction statement can be used to determine which disassembled statements should have labels, and of what type, data, instruction, subroutine or fixed.

Fixed labels are ones in which the programmer makes a label directly equal to some constant, with "EQU", and not to the current program counter. This disassembler is a direct extension of the one given in part one.

Label operator (mnemonic) operand comment

A typical assembly language statement will be typed on one line, and will have up to four fields. The first is the label field. This gives an effective name to the instruction. "Labels" in Basic are the line numbers. In assembly language statements, labels are optional; they are required only if the instruction is the destination of some branch or jump command. Statements are assembled in order down the page.

Because each line is unnumbered and therefore anonymous, different techniques for editing have to be employed. The rules in M6800 assembly language state that a label may be up to six characters long; that the first character must be a letter "A" to "Z", and that the remaining five may be a letter or a digit "O" to "9". Therefore, "START", "PART 1" and "Q12345" are all valid label names. Since the label is symbolic it need in no way be related to the machine location of the instruction. Even if it is related, that fact is ignored totally by the assembly program. If all the labels in a program were the numeric address of the instruction, each preceeded by a letter, they are still valid as labels, even if the program is then re-located to some completely different part of the memory space.

Powerful feature

It is this that gives the upgraded disassembler its most powerful feature. Every time an instruction or data location is mentioned in the operand field of any instruction statement, a label is generated. The last five characters of the label produced will be the actual numeric value of the operand. Whenever the label is used in the disassembled code, this number will be preceeded by a single letter. The letter tells us what kind of operand generated the label.

If the operand was associated with a branch or jump instruction, the label will be that of an ordinary instruction statement. Any label so produced will be preceeded by the letter "I"—for instruction. If the mnemonic was JSR or BSR, first letter "S", a subroutine call, the label is at the start of a subroutine, and will have a matching RTS.

Immediate mode operands are treated as literal constants and consequently generate no label. This reflects the usage of this mode on the M6800. Extended Immediate mode can refer to either an instruction or data statement, as well as a genuine constant. It is assumed to refer to a data statement. Direct and extended mode instructions are also assumed to point to data, first letter"D".

A fourth type of label, denoted by a "Q" in the first letter position, is used if the generated label points to a location outside the specified program limits. Such

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labels will be used for fixed locations, ACIA and PIA ports, monitor routines and the like.

As with the assembly phase, the disassembler works in two "passes". During the first pass a symbol table is built from all the memory locations referred to explicitly in the operand fields of all the instructions in the program. This symbol table mimics the original produced by the first pass of the assembler. Additions are made to the symbol table by subroutine 4000. Each direct, extended, relative or extended immediate mode instruction will call subroutine 4000.

The symbol table is searched to see if the label is already defined (st.4190-4210). If it is, the types are compared, (st.4290) and if the new type is higher than the last the type number is upgraded (st.4300). Thus a label assumed previously to be data becomes an instruction, and an instruction a subroutine.

This is based on the assumption, mostly valid, that a labelled statement to which a program jumps is an instruction. A label is built from a character which shows the label type.

Hash functions

Subroutine 7500 converts the type digit, stored with the actual label value, to its corresponding character format, and loads this into D$ (st.4330). This is then ready to be printed as the operand of the instruction. If the location was not found in the symbol table it is added, along with the current guess at its type (st.4150). Here D$ contains the numeric value of the label preceeded with an "X", to show it has been newly defined (st.4150).

Because the SWTP Basic is very slow, it is impossible to store the symbol table as a linear list. In such a scheme a label would be found by starting at the top of the symbol table and then matching each entry to the one being searched for, until it is found, or an empty entry signals the end of the list. New entries would be placed at the end of the list.

This takes a prohibitively long time, particularly since it must be done twice for each instruction. Instead, a technique known as "hash coding" is employed. A "hash" function is applied to the symbol. This returns a value which is essentially random and connected to the original symbol only insofar as each time you apply the same hash function to the same symbol you get the same result. The ideal hash function returns values for each symbol—there are about $1{\cdot}5 \times 10^9$ possible combinations for a valid M6800 symbol—evenly distributed throughout the hashed symbol table, which is somewhat smaller—typically 250 to 1,000 entries.

Because of their value in compiler writing, hash tables and hash functions have been subjected to a great deal of scrutiny. The hash technique used here is probably the simplest possible. As the label is already numeric, there is no need to convert the symbol from characters to digits. A possible technique to do this would be to regard each character as an octal number, concatenate these to form a string, and then regard that as a decimal number. In either case, these numbers will be larger than the size of the symbol table.

At first sight, a division by the size of the table would appear to solve the problem. Unfortunately, this would lead to considerable "clumping", where many symbols equate to a few locations, leaving most unused. Division by a prime number always leaves a non-zero remainder.

The hash function, subroutine 7000, multiplies the label by a constant, adds a constant, divides by the prime 727 and finally extracts the remainder, which is always less than one. This remainder is then multiplied by somewhat less than the overall size of the symbol table, leaving room at the end of the table for expansion. The program tests during a search to see if the next location is, in fact, beyond the end of the table. Instead of causing an "array out of bounds" failure, it wraps the search around to the beginning of the table (st.4400-4410). If it wraps round twice while looking for the same symbol, the table is completely full and the program must stop (st.4420-4440).

Because the symbol table is made up of a number of segments, each 255 long, X1 has to be split into two variables, one for each of the two dimensions of S(,) (st. 4070-4095).

Label values

This hash technique has the effect of breaking the symbol table into many smaller fragments. Whether we wish to find if a label is already stored, or if we wish to add a new label, the hash function tells the program where to start the search. Optimally each label would go to a special place in the symbol table. With a less-than-perfect hash function it is possible for two labels to fall on the same location. This presents no problem. We are concerned to know only if a label has been used or not, and if it has, what its type is.

Label value and type are stored as a single integer value, to save space. The label is an integer in the range zero to 65536. Added to this is the type digit (data=1, instruction=2, subroutine=3, fixed=4), multiplied by 100000 (st.4160). So a data type label of 2020 is stored as 102020, an instruction as 200000 plus the label value, a subroutine as 300000 plus the label value and a fixed label as 400000 plus its numeric value.

When searching for a label the program starts looking at the location given by X1, the hash result, and stops if the stored value is equal to the one required. Finding an unused location (70000) in the symbol table shows that the label is undefined.

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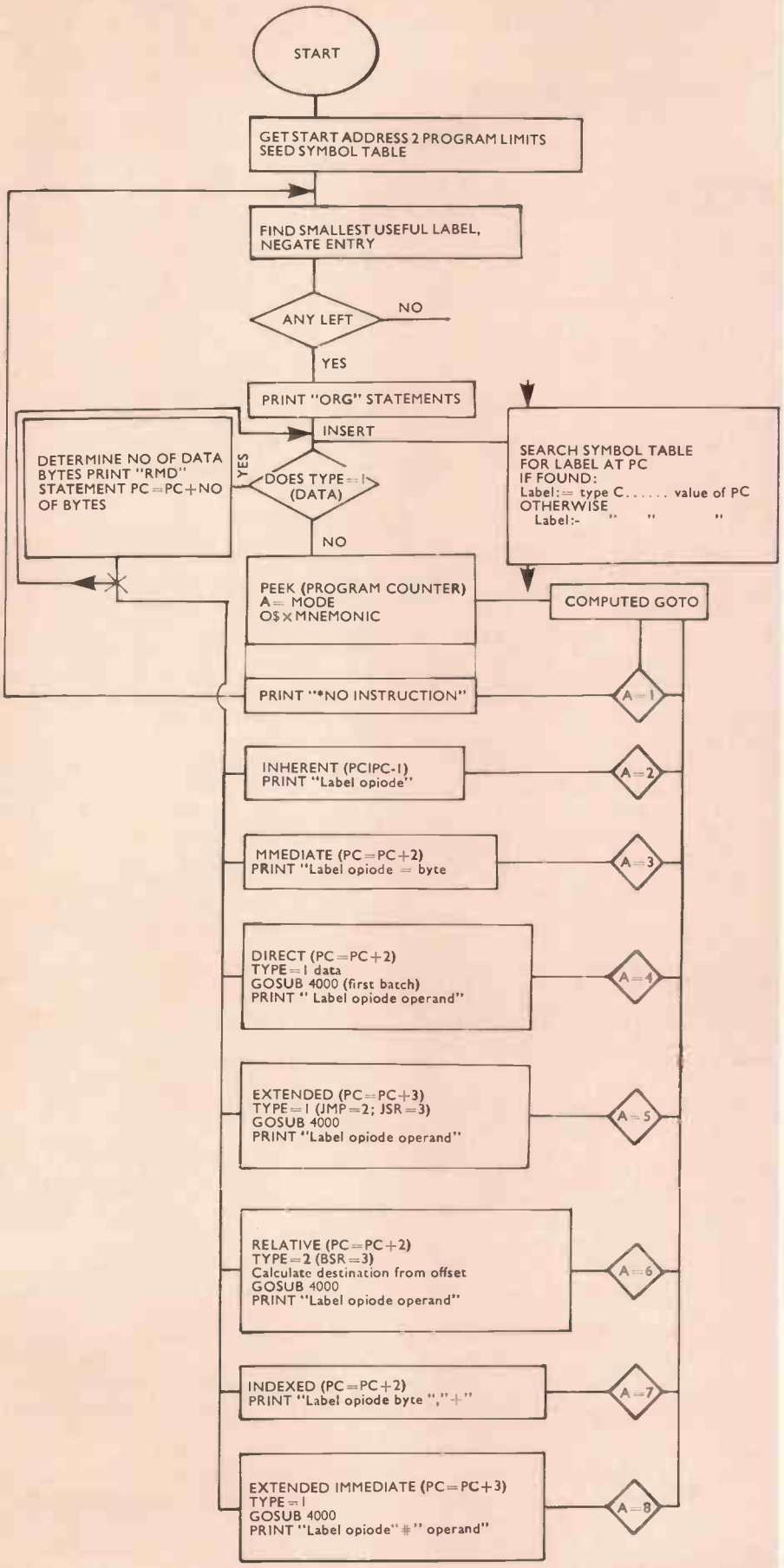

Figure 1. Algorithm flowchart.

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If a previously-undefined symbol is to be added, it is stored in the first free (70000) location, starting from the entry pointed to by X1.

Figure 2 shows a portion of a partially-filled symbol table after a program run. Ideally there is never any searching of a hash-coded symbol table, in practice there is always a little to be done. Even when the table is almost full, and there are very few undefined locations to act as stops, it is still better than the sequential search algorithm.

```
113 70000 113 70000
114 70000 114 70000
115 70000 115 70000
116 357546 116 70000
117 70000 117 257977
118 70000 118 70000

119 70000 119 70000
120 70000 120 70000
121 461446 121 70000
122 157745 122 70000
123 70000 123 70000
124 357481 124 70000
125 357415 125 70000
126 70000 126 257780
127 70000 127 157714
128 70000 128 70000
129 70000 129 70000
130 70000 130 70000
131 357548 131 70000
132 258143 132 70000
133 358077 133 257847
134 70000 134 70000
135 257879 135 70000
136 461448 136 258244
137  0000 137 257451
138 70000 138 70000

139 70000 139 70000
```

Figure 2. Part I of symbol table for 5(225,2). Notice small clump around (131,1) and how generally even distribution of entries is. Label value is stored in last five digits, type in the first.

Figure 1 is a flowchart of the program. The only thing you should need to know to run a program on the M6800 is its start address. In most cases, this is all that is required to disassemble the whole program. Even if the second instruction is of the "No Instruction" mode, then the first one must have been a control branch or jump, and disassembly can continue from there.

To start the program the symbol table is "seeded" with the start address (st.310-350). Disassembly will begin at this address. Every time the disassembler gets stuck it searches the symbol table, sequentially, for the smallest, still undisassembled label and re-starts disassembly from that point, using subroutine 6000 (st.400-430). For each instruction it checks, using the current program counter (P1) to see if a label has been defined for this location, and if it has it loads L$ with the type character and value (st.4330). If it has not defined it loads L$ with eight spaces (st.4130).

One space is sufficient for the assembler but it would leave the listing with a very rugged appearance. Whenever it finds a label—as opposed to printing a symbol in the operand position—it negates the value stored in the table (st.4270). Whenever it finds a negative entry (st.4230) it re-starts disassembly from the smallest positive label, which is within the user-specified program limits (subroutine 6000). If no label meets this criterion then the whole program has been disassembled.

The first byte pointed to by the program counter is the operator for the instruction (st.640). This is extracted and converted to the mnemonic form, as described in part 1 (st.660-670), using the mnemonic table (st.99-126) stored in Q$. The use of the computed GOTO (st.680) and the mode digit (st.660) were both described fully in part one.

For all modes except inherent, which has none, the operand is extracted from the next one or two bytes. With the exception of immediate mode the operand is treated as a label. Variable M3 is loaded with a guess at the operand type. The symbol table is again searched for this operand value by subroutine 4000. If the operand value was stored the types are compared, and changed if necessary. An operand symbol is generated from the symbol table and loaded into D$. If the value was not found it is stored, along with its type number, in the next free symbol table location.

Saving time

Decimal, not hexidecimal as in part one, is used in this program, saving the conversion time. Any constant not preceeded by a "$" for hex, "G" for octal or "%" for binary is treated as a decimal number by the assembler. It is immaterial to what number base the body of the label is printed, so long as it starts with a letter. Hexidecimal could be used by incorporating the decimal-to-hex routines given in part one.

For each instruction statement a line of text is produced. The label from L$, the operator mnemonic from O$ and the operand from D$, along with any assembler directives ("+", "×" etc). Items may be placed in the comment field. A programmable switch, F6, is used to determine whether subroutine 4000 will search the symbol table to see if a label should be placed at the current location (st.440, F6=1). With F6 set to zero, subroutine 4000 searches the symbol table to find the operand type, and to add it as a new label if it is not found (st.630).

This algorithm leads to some apparently silly things happening on the first pass. Whenever the disassembler is forced to re-start, it does so at the smallest label in the symbol table at the time. Since new labels are being added continually by the

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disassembly process, these will invariably be smaller than the current location. Disassembly will re-start until a negated label is found, and so on.

Each branch or jump backwards introduces a new, smaller label. So the next re-start will tend to split the listing into smaller and smaller fractions, all in the wrong order. If a data location is found then some data bytes must be reserved (st.420-620). The decision as to the number of bytes is taken to be the next smallest label from the symbol table, minus the current location (st.490). In the first pass code of the form:

```
D342    RMB    -246
```

is not uncommon, and should be ignored. During the second pass, when the symbol table is complete, the algorithm works well. The next smallest symbol value is always larger than the current location.

When all the operands have been looked at, and all the labels so generated printed and negated, then the symbol table is complete. The first pass is finished and the second pass may begin. Program control jumps to statement 9000. The value of this algorithm is that it is thorough. Any location referred to, whether as data, instruction, subroutine or fixed, is found and exhaustively disassembled.

Before the second pass we can print the symbol table; the code is at 9500. This produces a complete list of all labels and their types. The first digit is the type (in the hundred thousands), the remainder is the label value. (Figure 2).

The second pass begins by making all the labels in the symbol table positive again (st.9050-9140). It also prints all the fixed labels, those outside the specified program limits, in the form:

```
Q62720    EQU    62720
```

Once defined by "EQU" they will resist attempts at re-location. Figure 5 is a header generated by this program, showing all the fixed locations, even though the rest of the code will re-locate by changing any of the "ORG" statements produced at the beginning of the disassembly (st.430). (Figure 5).

Any "ORG"s which appear in the body of the code may be due to "No instruction" breaks, or because of a genuine re-location. In the former case it would be best to work out what the invalid code locations did, and then edit the listing, before reassembly, to do the same.

Throughout the second pass the symbol

(*continued on next page*)

```
E0E1   01                      NOP
E0E2   01                      NOP
E0E3   86 11      I57571       LDAA   #17
E0E5   B7 F500                 STAA   Q62720
E0E8   7F F01A                 CLR    Q61466
E0EB   BE F008                 LDS    Q61448

E0EE   CE E172                 LDX    #D57714
E0F1   8D 92                   BSR    S57477
E0F3   BD E1A4                 JSR    S57772
E0F6   16                      TAB
E0F7   8D D3                   BSR    S57548
E0F9   C1 4C                   CMPB   #76          #'L
E0FB   27 69                   BEQ    I57702
E0FD   C1 4D                   CMPB   #77          #'M
E0FF   27 68                   BEQ    I57705
E101   C1 50                   CMPB   #80          #'P
E103   27 61                   BEQ    I57702
E105   C1 52                   CMPB   #82          #'R
E107   27 36                   BEQ    I57663
E109   C1 43                   CMPB   #67          #'C
E10B   27 5F                   BEQ    I57708
E10D   C1 54                   CMPB   #84          #'T
E10F   27 5E                   BEQ    I57711
E111   C1 47                   CMPB   #71          #'G
E113   27 0A                   BEQ    I57631
E115   B6 E3F8                 LDAA   I58368
E118   81 7E                   CMPA   #126         #'
E11A   26 C7                   BNE    I57571
E11C   7E E3F8                 JMP    I58368
E11F   BD E310    I57631       JSR    S58136
E122   30                      TSX
E123   B6 F01E                 LDAA   Q61470
E126   A7 05                   STAA   5,X
E128   B6 F01F                 LDAA   Q61471
E12B   A7 06                   STAA   6,X
E12D   3B                      RTI
```

Figure 3. Portion of disassembled code re-assembled at the same locations.

(*continued from previous page*)

table is complete and fixed. Because of this exactly the same program can be used for both the first and second pass. The first operation is to call subroutine 6000 to find the smallest useful label, an "ORG" statement is produced and disassembly continues. If this was a data statement the next smallest label is found and the difference between the two shows how many bytes to reserve with an "RMB", for instance:

```
D176    RMB    47  71'G,79'O,84'T,79'O,32' ,54'4,
D223    RMB    17  48'0,48'0,44',,49'1,56'8,48'0,
```

shows two disassembled data labels, the first reserves 47, and the second 17 data bytes. As an aid to indicate whether the data should be pre-determined, with "FCB", FDB" or "FCC" etc., the actual contents of the data locations are printed, up to the first six.

If it is decided that the data was present at the start of the program, then these statements must be edited before re-assembly. If the contents of a byte correspond to an ASCII character, this is printed, too (st.550-570). The letters "GOTO" should give a clue in the first example. During the second pass, the disassembler will happily mix data and code instructions, modelling the way they were laid out in the original assembly language listing.

The program is easy to use. Only three decisions have to be made before leaving the program to disassemble. Statement 192 determines the size of the symbol table. Variable U is the second dimension of the two-dimensional array S; the first dimension is fixed at 255. The size of the symbol table is 255 × U. The larger the program to be tackled, the larger the symbol table required.

Since the symbol table can be increased only in steps of 255, some rules-of-thumb are required for choosing a suitable value for U. As a very rough guide, each 1K of program requires space for about 100 labels. If the final number of labels is close to the symbol table size, the program will operate more slowly than it might as the table fills up. If the symbol table is too generously dimensioned, however, the code will slow down due to the sequential search at each re-start to find the next smallest label.

Subroutine 6000, the code for this, takes about 30 seconds for each of 255 label sections. At the end of each section a delete character (127, all ones) is sent out, as a precaution against a Teletype device "falling asleep" and therefore missing the

(*continued on next page*)

```
 04C9   01                    NOP
 04CA   01                    NOP
04CB   86 11        157571   LDAA   #17
 04CD   B7 F500               STAA   Q62720
 04D0   7F F01A               CLR    Q61466
 04D3   BE F008               LDS    Q61448
 04D6   CE 055A               LDX    #D57714
 04D9   8D 92                 BSR    S57477
 04DB   BD 058C               JSR    S57772
 04DE   16                    TAB
 04DF   8D D3                 BSR    S57548
 04E1   C1 4C                 CMPB   #76          #'L
 04E3   27 69                 BEQ    I57702
04E5   C1 4D                 CMPB   #77          #'M
 04E7   27 68                 BEQ    I57705
 04E9   C1 50                 CMPB   #80          #'P
 04EB   27 61                 BEQ    I57702
 04ED   C1 52                 CMPB   #82          #'R
04EF   27 36                 BEQ    I57663
 04F1   C1 43                 CMPB   #67          #'C
 04F3   27 5F                 BEQ    I57708
 04F5   C1 54                 CMPB   #84          #'T
 04F7   27 5E                 BEQ    I57711
 04F9   C1 47                 CMPB   #71          #'G
 04FB   27 0A                 BEQ    I57631
 04FD   B6 07E0               LDAA   I58368
 0500   81 7E                 CMPA   #126         #'
 0502   26 C7                 BNE    I57571
 0504   7E 07E0               JMP    I58368
 0507   BD 06F8    157631     JSR    S58136
 050A   30                    TSX
 050B   B6 F01E               LDAA   Q61470
 050E   A7 05                 STAA   5,X
 0510   B6 F01F               LDAA   Q61471
 0513   A7 06                 STAA   6,X
 0515   3B                    RTI
```

Figure 4. Disassembled code, re-located and then re-assembled; compare this to Figure 3.

(continued from previous page)

first few characters of the next statement, while the motor starts up (st.6120).

Remember that data storage is not particularly compact in SWTP Basic; each 255 dimension of S(,) uses 1,536 bytes. Add this to the interpreter (about 7K), the program itself and the stored mnemonic table (4,596 bytes) and random access memory is soon used up. A run with a symbol table of 1020 labels runs comfortably in a 24K system.

The second decision involves the limits of the memory to be disassembled. The program requests two (decimal) numbers with:

```
*LOWER AND UPPER PROGRAM LIMITS?
```

Any label generated outside these limits will be defined with an "EQU" statement at the beginning of the second pass. Without this facility the program would disassemble all code in the machine accessed by the code being tackled, almost certainly including all of the monitor. These limits will often be set to the extent of the random access memory in the microprocessor system.

Lastly, the program asks for the start address, in decimal, of the code to be disassembled. If hexidecimal input is preferred, the hex-to-decimal routine of part 1 could be added. The same applies to the user program limit requests. Type these and off it goes—slowly. Expect longish waits—about 30 seconds to three minutes—at random intervals, particularly before an "ORG" or "RMB" statement.

Of the two large programs on which the disassembler has been tested, the MSI monitor (U=2), and the Basic interpreter (U=4), the former took about 90 minutes, the latter a staggering 30 hours for both passes.

Fortunately, the code has been improved since the latter case and it should be much better. Figure 3 shows a portion of disassembled program, re-assembled at its original location of $E000. Figure 4 shows it re-assembled at a different origin, decimal 1000. Notice how "Q" labels keep their original value, and how "D", "I" and "S" have changed.

Modifications

All programs should have a "bugs and modifications" section. This program is no exception. There are a number of snags to this approach to disassembly, which becomes rather apparent when relocation to a new part memory is attempted. Whiles it is not affected by interspersed code and data, which may occur in any assembly language program, it is upset by the use of indexed "JMP" and "JSR". In these cases no explicit mention is made of the original label in any operand.

Most usually, it will have been set-up by "LDX +CODE", and so will be assumed to be data, possibly incorrectly. When checking the final listing, be on your guard for this type of instruction. They

(continued on next page)

```
                    *       DISSASSEMBLED LISTING
                    *       FIXED LOCATIONS
          F500      Q62720  EQU     62720
          F01A      Q61466  EQU     61466
          F01B      Q61467  EQU     61467
          F01C      Q61468  EQU     61468
          F01D      Q61469  EQU     61469
          F01E      Q61470  EQU     61470
          F01F      Q61471  EQU     61471
          F508      Q62728  EQU     62728
          F000      Q61440  EQU     61440
          F006      Q61446  EQU     61446
          F008      Q61448  EQU     61448
          F00A      Q61450  EQU     61450
          F00B      Q61451  EQU     61451
          F00C      Q61452  EQU     61452
          F00D      Q61453  EQU     61453
          F072      Q61554  EQU     61554
          F00E      Q61454  EQU     61454
          F00F      Q61455  EQU     61455
          F010      Q61456  EQU     61456
          F011      Q61457  EQU     61457
          F012      Q61458  EQU     61458
          F014      Q61460  EQU     61460
          F016      Q61462  EQU     61462
          F018      Q61464  EQU     61464
                    *       RELOCATABLE LOCATIONS AND CODE
E000                        ORG     57344
E000   FE F000     I57344  LDX     Q61440
E003   6E 00                JMP     0,X             IIDXD JMP
```

Figure 5. Header of fixed locations printed at beginning of second dissassembly pass. After re-assembly.

(continued from previous page)

are specially warned in the comment field by either "! IDXD JMP" or "! IDXD JSR" last statement on Figure 5. The missing code can often be detected by a data statement following directly an instruction which is NOT an unconditional program counter change (RTS, RTI, JMP, BRA, or some combination of relative branches).

Any instruction which follows directly such a statement and is not labelled should also be treated with the utmost suspicion. These cases may require a little careful "hand-disassembly", using the package presented in part 1.

Extended immediate mode provides the real teaser—should the operand be re-located or not? "LDX +CODE" and "LDX +DATA" probably should; something like "CPX +100" will almost certainly be indicative of something more subtle, probably requiring to be left un-re-located. This depends entirely on the nature of the program and is unresolvable by the disassembler. You may finish having to understand how a program you re-locate works if it doesn't run first time.

On the other hand, if you write programs you don't want disassembled, think of these points fondly. If you want to be really sure nobody disassembles code, try making it self-modifying. That should really upset the program. It probably won't improve your temper, much as you try and de-bug it, or anybody else's when they try to use it.

```
LIST 99, 290
0099 DATA "2NOP ",2NOP ,1,1,"1"
0100 DATA "2TAP ",2TPA ,2INX ,2DEX ,2CLV
     ,2SEV ,"2CLC "
0101 DATA "2SEC ",2CLI ,2SEI ,2SBA ,2CBA ,1,1,1,1,
     "2TAB "
0102 DATA "2TBA ",1,2DAA ,1 2ABA ,1 1,1,1,
     6BRA ,1,6BHI ,6BLS ,"6BCC "
0103 DATA "6BCS ",6BNE ,6BEQ ,6BVC ,6BVS ,6BPL
     ,6BMI ,6BGE, "6BLT "
0104 DATA "6BGT ",6BLE ,2TSX ,2INS ,2PULA,
     2PULB,2DES ,2TXS ,"2PSHA,"
0105 DATA "2PSHB",1,2RTS ,1,2RTI ,1, 1,2WAI
     ,"2SWI "
0106 DATA "2NEGA",1,1,2COMA,2LSRA,1,2RORA,
     2ASRA,2ASLA,2ROLA,"2DECA"
0107 DATA "1"2INCA,2TSTA,1,2CLRA,2NEGB,1,1,
     2COMB,"2LSRB"
0108 DATA "1",2RORB,2ASRB,2ASLB,2ROLB,2DECB,
     1,2INCB,2TSTB, "1"
0109 DATA "2CLRB",7NEG ,1,1,7COM ,7LSR ,1,
     7ROR, 7ASR ,7ASL "7ROL "
0110 DATA "7DEC ",1,7INC ,7TST, 7JMP ,7CLR,
     5NEG ,1,1,5COM ,"5LSR "
0111 DATA "1",5ROR ,5ASR ,5ASL ,5ROL ,5DEC
     ,1,5INC ,5TST ,"5JMP"
0112 DATA "5CLR ",3SUBA, 3CMPA,3SBCA, 1,
     3ANDA, 3BITA ,3LDAA, "1"
0113 DATA "3EORA", 3ADCA, 3ORAA, 3ADDA,
     8CPX ,6BSR ,8LDS ,1,"4SUBA"
0114 DATA "4CMPA", 4SBCA, 1,4ANDA, 4BITA,
     4LDAA, 4STAA, 4EORA, "4ADCA"
0115 DATA "4ORAA", 4ADDA,4CPX , 1, 4LDS
     ,4STS , 7SUBA, 7CMPA,"7SBCA"
0116 DATA "1", 7ANDA, 7BITA, 7LDAA, 7STAA,
     7EORA, 7ADCA, 7ORAA, "7ADDA"
0117 DATA "7CPX ", 7JSR , 7LDS , 7STS , 5SUBA,
     5CMPA, 5SBCA, "1"
0118 DATA "5ANDA", 5BITA, 5LDAA, 5STAA,
     5EORA, 5ADCA, 5ORAA, "5ADDA"
0119 DATA "5CPX ", 5JSR , 5LDS , 5STS , 3SUBB,
     3CMPB, 3SBCB,"1"
0120 DATA "3ANDB", 3BITB, 3LDAB, 1, 3EORB,
     3ADCB, 3ORAB, "3ADDB"
0121 DATA "1", 1, 8LDX , 1, 4SUBB, 4CMPB, 4SBCB,
     1, 4ANDB, 4BITB, "4LDAB"
0122 DATA "4STAB," 4EORB, 4ADCB, 4ORAB,
     4ADDB, 1, 1, 4LDX ,"4STX "
0123 DATA "7SUBB", 7CMPB, 7SBCB, 1, 7ANDB,
     7BITB, 7LDAB, "7STAB"
0124 DATA "7EORB", 7ADCB, 7ORAB, 7ADDB, 1, 1,
     7LDX , 7STX ,"7SUBB"
0125 DATA "5CMPB", 5SBCB, 1, 5ANDB, 5BITB,
     5LDAB, 5STAB, 5EORB, "5ADCB"
0126 DATA "5ORAB," 5ADDB, 1, 1, 5LDX , "5STX "
0190 RESTORE
0191 C=100000
0192 U=2
0200 DIM Q£(255)
0210 DIM S(255,U)
0220 FOR M9=1 TO 255
0230 READ Q£(M9)
0240 NEXT M9
0250 FOR M9=1 TO 255
0260 FOR M8=1 TO U
0270 S(M9,M8)=70000
0280 NEXT M8
0290 NEXT M9

READY
#

LIST 300, 680

0300 INPUT "★ LOWER AND UPPER PROGRAM
     LIMITS", U1, U2
0310 INPUT "★ START ADDRESS" P1
0320 F6=0
0330 P6=P1
0340 M3=2
0350 GOSUB 4000
0400 GOSUB 6000
0410 P1=P4
0420 IF P4<0 THEN 9000
0430 PRINT "          ORG    "; STR£(P1)
0440 F6=1
0448 M2=2
0449 P6=P1
0450 GOSUB 4000
0460 IF F7<0 THEN 400
0470 IF M2<>1 THEN 630
0480 GOSUB 6000 . .
0485 IF P4<0 THEN 9000
0490 T1=P4-P6
0500 PRINT L£;"RMB ";STR£(T1);" ";
0510 IF T1>6 THEN T1=6
0520 FOR M9=P1TO (P1+T1)-1
0530 T2=PEEK(M9)
0540 PRINT STR£(T2);
0550 IF T2<32 THEN 580
0560 IF T2>127 THEN 580
0570 PRINT " ' "; CHR£(T2);
0580 PRINT ",";
0590 NEXT M9
0600 PRINT " "
0610 P1=P4
0620 GOTO 440
0630 F6=0
0640 I1=PEEK(P1)
0650 IF I1=0 THEN 1100
0660 A=VAL (LEFT£(Q£(I1),1))
0670 O£=RIGHT£(Q£(I1),4)
0680 ON A GOTO 1100, 1200, 1300, 1400, 1500, 1600,
     1700, 1800

READY
#

LIST 1100, 1835
1100 PRINT "★ NO INSTRUCTION"
1110 GOTO 400
1200 REM INHERENT MODE
1205 PRINT L£;O£
1210 P1=P1+1
1215 GOTO 440
1300 REM IMMEDIATE MODE
1305 I2=PEEK(P1+1)
1310 P1=P1+2
1330 PRINT L£;O£;" #"; STR£(I2);
1335 IF I2<32 THEN 1350
1340 IF I2>127 THEN 1350
1345 PRINT " #' "; CHR£(I2);
1350 PRINT " "
1355 GOTO 440
1400 REM DIRECT MODE
1405 I2=PEEK (P1+1)
1410 P1=P1+2
1415 M3=1
1420 P6=I2
1425 GOSUB 4000
1430 PRINT L£;O£; " ";D£
1435 GOTO 440
1500 REM EXTENDED MODE
1505 I2=(PEEK(P1+1)★256)+ PEEK(P1+2)
1510 P1=P1+3
1511 M3=1
1515 IF I1=126 M3=2
1520 IF I1=189 M3 =3
1525 P6=I2
1530 GOSUB 4000
1535 PRINT L£;O£;" ";D£
1540 GOTO 440
1600 REM RELATIVE MODE
1605 I2=PEEK(P1+1)
1610 IF I2<128 P6=I2+2+P1
1615 IF I2>=128 P6=P1-254+I2
1620 M3=2
1625 IF I1=141 M3=3
1630 GOSUB 4000
1635 PRINT L£;O£;" ";D£
1640 P1=P1+2
1645 GOTO 440
1700 REM INDEXED MODE
1705 I2=PEEK(P1+1)
1710 PRINT L£;O£;" ";STR£(I2);",X";
1715 IF I1=110 PRINT" !IDXD JMP";
1720 IF I1=173 PRINT " !! DXD JSR";
1725 PRINT " "
1730 P1=P1+2
1735 GOTO 440
1800 REM EXTENDED IMMEDIATE MODE
1805 I2=(PEEK(P1+1)★256)+PEEK(P1+2)
1810 M3=1
1815 P6=I2
```

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```
1820 GOSUB 4000
1825 PRINT L£;O£;" #";D£
1830 P1=P1+3
1835 GOTO 440

READY
#
LIST 4000, 4490

4000 REM HASH SYMBOL TABLE LOOK-UP ROUTINE
4001 REM IF F6=0 ADD SYMBOL IN NEXT FREE
     LOCATION
4002 REM IF F6=1 THEN GENERATE LABEL FROM
     TABLE
4005 F7=1
4006 F8=0
4010 IF P6<U1 THEN 4040
4020 IF P6>U2 THEN 4040
4030 GOTO 4050
4040 M3=4
4050 P9=P6
4060 GOSUB 7000
4060 Y=INT(X1/255)
4080 X=X1-(Y★255)
4090 Y=Y+1
4095 IF X=0 X=1
4100 FOR M9=X TO 255
4105 T6=S(M9,Y)
4110 IF ABS(T6)<>70000 THEN 4180
4120 IF F6=0 THEN 4150
4130 L£="                "
4140 GOTO 4480
4150 D£="X"+STR£(P6)
4160 S(M9,Y)=(M3★C)+P6
4170 GOTO 4480
4180 M4=M2
4190 M2=INT(ABS(TC)/C)
4200 P3=(ABS(T6))-(M2★C)
4210 IF P3<>P6 THEN 4360
4220 IF F6=0 THEN 4290
4230 IF T6<0 F7=-1
4240 GOSUB 7500
4250 L£=R£+STR£(P6)
4260 GOSUB 7700
4270 S(M9,Y)=(ABS(T6))
4280 GOTO 4480
4290 IF M2>=M3 THEN 4320
4300 S(M9,Y)=((M3★C)+P6)★SGN(T6)
4310 M2=M3
4320 GOSUB 7500
4330 D£=R£+STR£(P6)
4340 M2=M4
4350 GOTO 4480
4360 M2=M4
4370 NEXT M9
4380 X=1
4390 Y=Y+1
4400 IF Y<(U+1) THEN 4100
4410 PRINT "★! SYMBOL TABLE OVERFLOW"
4420 IF F8=0 THEN 4450
4430 PRINT "★! SYMBOL TABLE FULL"
4440 STOP
4450 F8=1
4460 Y=1
4470 GOTO 4100
4480 RETURN
4490 END

READY
#
LIST 6000, 7750

6000 REM REACHES HASH TABLE FOR SMALLEST
     POSITIVE
6001 REM LABEL WITH-IN THE PROGRAM LIMITS.
6002 REM IF NONE FOUND P4=-1
6010 P4=70000
6020 FOR M9=1 TO U
6030 FOR M8=1 TO 255
6040 T6=S(M8,M9)
6050 IF T6=70000 THEN 6110
6060 IF T6<0 THEN 6110
6070 M3=INT(T6/C)
6080 P3=T6-(M3★C)
6090 IF P3<U1 THEN 6110
6100 IF P3<P4 THEN P4=P3
6110 NEXT M8
6120 PRINT CHR£(127);
6131 NEXT M9
6140 IF P4=70000 P4=-1
6150 IF P4>U2 P4=-1
6160 RETURN
6170 END
7000 REM HASH FUNCTION, FROM P9 TO X1.

7010 X9=((P9★11)+1111)/727
7020 X1=INT((X9-INT(X9))★(245★U))
7030 IF X1=0 X1=1
7040 RETURN
7050 END
7500 REM TURNS LABEL MODE INTO CHARACTER.
7510 R£="I"
7520 IF M2=1 R£="D"
7530 IF M2=2 R£="I"
7540 IF M2=3 R£="S"
7550 IF M2=4 R£="Q"
7560 RETURN
7570 END
7700 REM PADS L£ TO EIGHT CHARACTERS WITH
     SPACES.
7710 FOR M7=1 TO 8-LEN(L£)
7720 L£=L£+" "
7730 NEXT M7
7740 RETURN
7750 END

READY
#

LIST 9000, 9590

9000 PRINT "★ GOTO 9500 TO PRINT SYMBOL
     TABLE"
9010 PRINT "★ CONT FOR NEXT PASS"
9020 STOP
9030 PRINT "★ DISASSEMBLED LISTING"
9040 PRINT "★ FIXED LOCATIONS"
9050 FOR M9=1 TO 255
9060 FOR M8=1 TO U
9070 T6=ABS(S(M9,M8))
9080 IF T6<400000 THEN 9120
9090 L£="Q"+STR£(T6-400000)
9100 GOSUB 7700
9110 PRINT L£;" EQU ";STR£(T6-400000)
9120 S(M9,M8)=T6
9130 NEXT M8
9140 NEXT M9
9150 PRINT "★ RELOCATABLE LOCATIONS AND
     CODE"
9160 GOTO 400
9500 REM PRINT SYMBOL TABLE
9510 LINE= 100
9520 FOR M9=1 TO 255
9530 FOR M8=1 TO U
9540 RPINT M9;
9550 PRINT ABS(S(M9,M8));
9560 NEXT M8
9570 PRINT " "
9580 NEXT M9
9590 GOTO 9000

READY
#
```

Tandy 10 latest addition

TANDY was slightly unprepared for the instant take-off in the U.K. of the TRS-80 but things are now ticking along well in that area. Whether the company follows by bringing the Tandy 10 to these shores is still debatable, though.

This is an interesting small business system, released at less than $10,000 in the States. The interest does not lie in its design, which is conventional enough. Packaged as a desk unit with integral screen and two single-density, single-sided floppies, it looks positively conservative, in fact. The printer is a separately-attached Centronics 700, programming is in Basic or Fortran IV (or Assembler).

The interest lies in Tandy intentions. The 10 apparently owes nothing to the TRS-80 in styling, design or marketing.

On Target

NASCOM Microcomputers has appointed Target Electronics as distributor for the Nascom-1 system in the Bristol area.

Target was established 20 years ago as the Radio Shop but changed its name this year to reflect its growing business outside the radio industry.

One of the largest suppliers of semiconductors and other electronic components in Bristol, Target is managed by David Britton.

Full address is Target Electronics, 16 Cherry Lane, Bristol BS1 3NG. Telephone (0272) 421196

Business games with commercial connotations

MARTIN MITCHELL is justifiably proud of having written one of the longest and fastest programs for the Tandy TRS-80. He works for Understanding, a firm which runs computer training courses and first published his business game program in 1974, with little success.

It "reared its ugly head again" when the micro revolution took off. It is being run as a game and a financial planning package, the object of which is to run a firm successfully against market competition.

"If you want to learn about business, this is a marvellous way of simulation", says Mitchell. As a game, the program has certain financial parameters written into it but if you want to use if for a real situation, all you have to do is re-write a line of the Basic program.

Menu form

The game begins in menu form, with 14 items to call up, including a double-entry accounting system and a forecast for the next five years of your firm, based on current policy.

The heart of the game is the decision-making, in which you decide how the firm is going to be run. You have to spend certain amounts of money on items such as new factories, issuing shares, promotion of your product, whether to hire or fire staff, take on more salesmen, and at what price you will sell each unit.

Once you have done this, the computer will work out the results of your efforts. As a beginner with the system, you will probably find yourself going bankrupt more often than not but once you have become used to the way in which a business is run, you will, no doubt, be a much-sought-after commodity.

It is certainly an enjoyable game to play but the practical implications of the program are immediately apparent. It is being used seriously by only two firms at the moment and they are certainly not treating it as a toy. In fact, it has become the basis of their financial planning.

New version

Mitchell has written the program on a 48K system, with two discs—an expensive addition to the TRS-80. At the moment, it is being run on the normal tape cassette, taking 300 cycles of tape. This, Mitchell admits, is ridiculous, so he is now in the process of writing it for a 16K version. It is that version which he is now marketing commercially. He expects to generate plenty of interest, especially in the management development programme area.

Mitchell's other program, which he claims to be the fastest for a Tandy system, is a graphics package. An example of its speed is its ability to select any predetermined variable within the program in a matter of seconds.

Pet printer

A COMPANY called Peripheral Hardware, from West Molesey, Surrey, has decided to cash in on the popularity of the Pet personal computer, and has brought out a printer for use with the system.

It has, in fact, taken a standard Teletype 43 table-top keyboard printer, and modified it so that it can be plugged straight into Pet. This provides Pet with full 64-character upper case character set.

Up to 132 characters can be printed per line using 12-inch wide continuous stationery.

Further information: Peripheral Hardware Ltd, Link House, Pool Close, West Molesey, Surrey KT8 0HW. 01-941 4806.

Handy guide

RAPID RECALL, the company which specialises in supplying bits and pieces of microprocessor systems, has produced a handy reference card for users of the Digital LSI-11 microcomputer.

The guide, designed to slip into the pocket, lists the whole instruction set and system commands for the LSI-11/2. It should prove a valuable aid, especially to the winner of the latest *Practical Computing* competition—first prize, a Digital LSI-11.

Rapid recall says it can supply from stock a wide range of memory expansion boards for LSI-11/2 and PDI-11/03 systems. Delivery normally can be made within 48 hours of receipt of order.

More power

RESEARCH MACHINES of Oxford are adding power to its 380Z microcomputer system with the introduction of standard and minifloppy discs.

This follows a deal the company has signed with peripheral supplier BASF to provide about 500 floppy disc subsystems over the next two years.

The general-purpose 380Z system, based on the Zilog Z80A microprocessor, could previously support only a tape cassette for back-up storage. The system is marketed by Sintel.

Nine finalists

FINDING nine finalists for our £5,000 Win-a-Computer Competition from the hundreds of entries was no easy task.

COMMERCIAL CATEGORY

In the commercial category our first pruning session reduced the 150-plus entries to 25. Most entrants offered solutions for stock control, payroll, general accounting and information retrieval—applications for which software has already been developed or is at least near completion.

Among the 25, special mention must go to J. Addison, who suggested a veterinary surgeons' system; T. Taylor, for a TV contacts information retrieval system; J. Hall, for a micro business game; and C. Boreham, for the computerised milkman.

The 25 were pruned to six. The three who "almost made it and we hope you will stand by in reserve" are I. Carbans, who wants to automate hearing tests; J. McCullough for computers in baby care; and D. Byford, who suggests an automated league management system.

The three finalists are M. STANLEY, to automate taxi reservations; G. BLIGH, for sea search planning; and D. GREEN, with a cargo management system.

EDUCATION CATEGORY

In the education category we received 122 qualifying entries and between them they represented individual and group efforts of more than 200 people. We were pleasantly surprised by the diversity of projects and producing the short-list was not easy.

The three who go through to the final are J. R. ENNALS, of Essex, who proposes to use the computer for history simulation games; MARY RUSSELL, from Hull, who wants to use the computer to teach English in the remedial department; and ELIZABETH MOORE, whose application is to monitor the progress and development of children.

PERSONAL CATEGORY

The personal category produced 107 qualifiers. Inevitably the bulk of them were for home computers which did everything but brush your teeth. At the end we felt somewhat wary about living in a computerised home.

The three who go to the final are N. GREENWOOD, with his guidelines for an integrated domestic computer; CLAIRE GAETH, with a home diet management system for diabetics; and JANET HILL, who wants to computerise a survey she is carrying-out on facilities for the disabled in Stratford-upon-Avon.

The next step is for the nine finalists to produce a working flowchart of their systems. The three most practical, detailing how the system could be implemented, will be the winners.

Prizes are a complete Digital Equipment LSI-11 system from Dicoll; a Research Machines 380-Z; and a Nascom 1.

Advertisement Index

A PRACTICAL GLOSSARY

Continuing the terminological gamut from F to G

Floating point

Floating point representation is a clever way of manipulating numbers so that no matter how big or small the number is, it always takes up the same amount of storage space.

Frankly, most micros do not have the ability to handle floating point, and unless you're a scientist or a numbers nut you probably don't need it. There are some plug-in S100 boards which give you floating point arithmetic commands, implemented as microcode in PROM.

Floating point extends a computer's calculation abilities and simplifies the programming of complicated arithmetic operations.

You still want more? Your ordinary decimal number is turned into a mantissa and an exponent. We're not going to tell you what a mantissa is, but the result looks like this:

The bit in front of the E is a mantissa, the bit after is an exponent. The mantissa is always less than 1·0 and multiplying it by the exponent gives you the decimal number you first thought of (4.8 in this case).

FP/2

The opposite of floating point is, would you believe, fixed point, which are ordinary, familiar decimal numbers with a point in the same position all the time—after the whole number, before the fraction—remember?

Foreground

Where the foreplay takes place? No, it's just a way of indicating what's happening in the computer when two (or more) tasks, programs, jobs, or whatever are competing for resources. It applies only to multiprogramming systems, and denotes the program with the highest priority.

The converse is *background*, naturally enough, and what happens is typically something like this. Your printer program is happily trundling away, printing. Then in comes something from you on the VDU. The computer knows that the VDU doesn't want to wait for the printer program to complete, not in view of the fact that it's printing the whole London telephone directory and has reached only AAA Car Hire; so it suspends the print job automatically, gives its full resources to this piece of VDU activity, and returns to the printing when the VDU interaction is finished. Servicing the VDU is the foreground job, the printing is going on in the background.

Format

The logical organisation of programs or data. In practice, this formatting will cover all kinds of preambles, postambles, check digits, stop and start indicators, beginning and end marks, and so on.

FORTRAN

FORmular TRANslator. It's another IBM invention (c. 1957) though it's travelled a long way since then; it is still the single most widely-used scientific programming language. It's not much good for anything else (though a company called General Automation has a business version called Commerical FORTRAN). Basic owes some of its parentage to FORTRAN.

Front-end

All-purpose buzzword meaning 'at the front', though often used as a verb, meaning 'to put on to or at the front'.

It's not all nonsense though. A front-end processor is a separate mini or micro which does something to input (pre-processes it, in fact) to help optimise the work of the main processor. This might be unscrambling a coded message of some sort, figuring what files will have to be accessed, and so on.

Full duplex

This describes a simultaneous but independent two-way transmission of data. It is distinguished from *simplex* (one-way transmission only) and *half-duplex* (two-way transmission, but alternatively rather than simultaneously). More about this when we get to H.

Function

In practical terms, a function is essentially a subroutine—either literally (a bunch of program statements) or figuratively (a set of operations and events which can be repeated as required when they are called on). The classic functions are the four basic arithmetic operations. In a pocket calculator, for instance, pressing the ADD key initiates a (quick) set of programmed operations which produces the desired result for the data presented to it.

Function key

Obviously, a key which calls up a function. Your keyboard may not have any (there are two other types of key on it, alphanumeric and control). You can activate functions in other ways, though, typically by a code key sequence, like pressing CONTROL and another key at the same time.

On the other hand, your keyboard may have a row of keys with no labels, perhaps, or cryptic messages like 'PF0'. In that case you'll have a manual which shows you how to set up functions (typically as conventional program codes) and assign them to particular function keys. Subsequently you can call up function with a single keystroke.

Nearly all keyboards will have some function keys, in any case—like NEWLINE, CR, RETURN, LF, ENTER. They're just not very complicated functions.

Games

You don't really need a definition of a game, do you? It is, however, worth spending a few words on the subject, because it is far from trivial. On the one hand, games represent an excellent use of computers; they involve rules and alternative decision paths, both of which are highly appropriate to the computer. So games actually make good use of the computer.

They also make good use of you, not least because you can plumb your potential and exercise your mind in a situation where you are calling the shots. If you don't like the game or if you don't want to play, that is up to you: if you win, it's you who did it: if you lose, it doesn't matter; and if you don't like losing, that's your business, too.

There are more serious games, too, of course—'serious' in this context referring to social repercussions. You might be playing in a team—the family which plays together stays together?; and there isn't really much difference between *Star Trek* and the kind of what-if business planning programs widely available.

Gas-discharge display

Also called a plasma display. This is an alternative to the TV-type cathode ray tube as a way of displaying man-machine communication. The CRT works by firing electrons at a phosphor-coated surface, which lights up at the point where the electrons hit. The gas discharge display consists of many tiny, gas-filled cells, the gas in which lights up when a small electrical current is passed through it. The character which results depends exactly on which cells in the matrix are illuminated, of course, since the illumination produces a pattern of dots like the glowing dots build up a character on a CRT screen.

There are good and bad points to gas-discharge displays. In particular, you do not have to fit in an electron gun; so this kind of display can be very flat, and that means a VDU using it doesn't occupy as much space on the table as one with a CRT screen. Also the electrical stimulation can be constant, so you don't have the flickering which sometimes occurs with a CRT; the phosphor glow starts to fade when the electron gun has moved on to illuminate the next dot, and the flickering is caused when the electron beam re-stimulates the point.

The cells have to be reasonably large, and the dots can't be defined as clearly as the small CRT dots. So you don't have many characters on the screen and they certainly do not resemble 'joined-up' writing in the way CRT characters sometimes do.

The killer is that gas-discharge displays are more expensive than CRTs on a per-character basis, if you have many characters to display, and LEDs are cheaper if you want to display only a few. So you probably won't see many gas-discharge displays.

Gate

A single logic function. Formerly, electronic systems used electromagnetic relays which opened and closed electrical paths in different directions; that's where the term originated, for the way a path was routed is analagous to a gate opening or remaining closed. A gate is thus a point at which a logic decision has to be made; more about this under *Logic*.

Gigo

Acronym for garbage in—garbage out. The sense is obvious; if you use duff input you can't expect elegant output. It's not much use these days, but oldsters of the computer business go into paroxysms of knowing chuckles whenever they meet the term.

Golfball

The resemblance gave the name to the type element on IBM typewriters and this genre of electric typewriter. It's properly called a *typesphere*, in fact. The key point as far as the personal computer user is concerned are two. The typesphere rather than the paper moves, and the printing produced is of excellent quality. A moving type element involves much less mechanical effort than an ordinary type-bar typewriter, so it is reliable enough and fast enough to be used by a computer. If you want to do word processing—like write form letters to your bank managers, lovers, or wine suppliers—the print impression cannot be bettered.

On the other hand, the design of the golf-ball type mechanism is such that you'll never achieve much faster than about 15 characters per second. If you use it for long jobs, it is likely to fall apart; wonderous though it is, the typesphere printer is still delicate by comparison with other printer mechanisms, notably the *matrix* printer.

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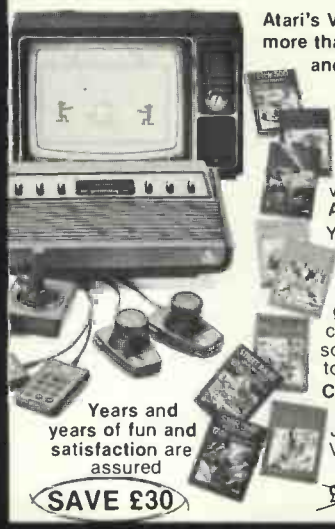

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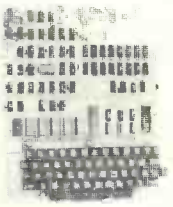

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