

Computing today

DECEMBER 1984

90p

GRAPHICS GALORE!

Bits and blobs:
drawing with Acorn's Bitstik



Taking the tablets:
Koalapad reviewed



Art and the Amstrad:
simple drawing program

PLUS:

GRiD
lines—
Compass
computer
reviewed

Psion
Organiser—
Pocket
Power?

IO's Pluto
for out of
this world
graphics



ATTENTION! ATTENTION! ALL COMMODORE USERS!

A FREE LIGHTPEN!

Yes a FREE Light Pen! with every **GRAPHKIT!** Graphkit is the ultimate in drawing!, designing! or painting! (using the light pen of course, which incidentally has a full 3 year warranty!) Graphkit will amongst other things allow you to:

- Draw free handed on the screen anything from a Micky Mouse to your latest integrated circuit! With all the fill colour and erase facilities of course!
- Save/load your latest master piece to/from the disk/tape drive
- Or directly copy the drawing on the screen to the printer! And keep it for ever or send to a friend as a post card!
- Design your own colourful sprites and characters
- Play the games in the package! or use the light pen in your own games/education/programs

GRAPHKIT is available on disk and tape. Tape version is £1595 and disk version (recommended) is **£19.95.**



All you 1540/1541 disk users **DMON!** Is here at last. Dmon is the disk monitor you have been waiting for it will allow you to:

- read/write blocks from/to the disk
- display and edit blocks on the screen
- display and send disk messages/commands
- transfer your programs from tape to disk or disk to disk or even disk to tape! ● and more!

DMON comes on **DISK** at only **£9.95.**

TORNADO 20/64

Do you use tapes? Are you sick and tired of waiting for your programs to be Loaded/Saved from/on the tape? Then you need a **TORNADO!!** Tornado allows you to Save/Load/Verify your Basic/machine code programs faster than a CBM 1541 disk drive does! Due to popular demand! Tornado now comes with new and more powerful commands plus extra instructions to assist you in making fast versions of your existing machine code/Basic programs. Tornado is available on tape for CBM 64 and 8K + Vic 20.

BREAKER 20/64

Do your Run/Stop and Restore keys often fail? Do you want to come out of those crashes?! Or get into those unbreakable programs?! Then what are you waiting for, get yourself a **BREAKER!!** Reset switch and let your computer know who is the boss!! Breaker can be connected to your machine in seconds, no soldering. Included with the Breaker is a copy of basic recovery software on tape. Now available for any CBM 64 or Vic 20.

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EVERY TORNADO IF YOU
USE THE COUPON BELOW
NOW!**

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RH10 6JE.**

CT/12/84

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free! Breaker

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Please send meLight Pen at £11.95

Please send meGraphkit at £15.95 (tape) + my free LP

Please send meGraphkit at £19.95 (disk) + my free LP

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Computing Today is constantly on the look-out for well written articles and programs. If you think that your efforts meet our standards, please feel free to submit your work to us for consideration.

Potential contributors are asked to take note of the points raised in our Program Submissions page, which can be found on page 24 of this issue.

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PRINTERS

DOT MATRIX

All printers have centronic parallel interface unless otherwise stated. All printers have hi-res dot addressable graphic mode. Please send SAE for full details.

EPSON

FX80 160CPS 10" wide friction & pin feed	£324 + VAT £373
FX100 160 CPS 15" wide friction & tractor feed	£499 + VAT £574
RX80 F/T 100 CPS 10" wide friction & tractor feed	£239 + VAT £275
RX80 100 CPS 10" wide tractor feed	£199 + VAT £229
RX100 F/T 100 CPS friction & tractor feed	£385 + VAT £443
8143 RS 23 Interface for FX and RX printers	£39 + VAT £45
8148 RS 232 Interface with 2K buffer x on x off	£60 + VAT £69
Ribbon Cartridge for RX80 FX80 & MX80	£5 + VAT £6
Ribbon Cartridge for FX100 & MX100	£7 + VAT £8

STAR

Gemini 10X120 CPS 10" wide friction & tractor feed	£200 + VAT £229
Gemini 15X120 CPS 15" wide friction & tractor feed	£295 + VAT £339
Gemini Ribbon	£3 + VAT £3

SEIKOSHA

BP 420 designed for the business world, 420CPS in draft mode, 110CPS in NLQ mode. £1095 + VAT £1259

SMITH CORONA

Fastext 80: 80 col, 80CPS. Friction feed standard £149 + VAT £171

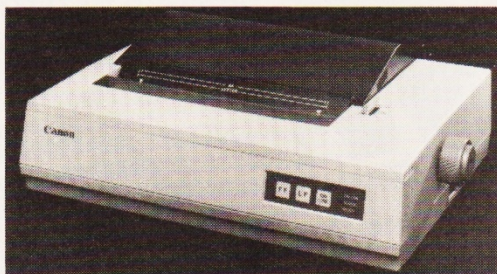
ENSIGN

1650 Standard, NLQ Mode Correspondance and Graphics Modes; friction and tractor feed; 165 CPS; bi-directional logic seeking £269 + VAT £310

TAXAN KAGA OR CANON

160CPS 10" wide
27CPS NLQ 24 x
16 matrix
£269 + VAT £310

160CPS 15" wide
27CPS NLQ 24 x
16 matrix
£349 + VAT £401



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Seikosha GP700A 7 colour 50CPS printer	£347 + VAT £399
Canon PJ1080A 7 colour 40CPS ink jet printer	£391 + VAT £449

DAISYWHEEL

JUKI 6100/I PRINT

20 CPS Bi-Directional Logic seeking 10 12 15 CP1	£324 + VAT £373
+ PS spacing 2K buffer best selling Daisywheel	£217 + VAT £249
Singer sheet feeder unit	£95 + VAT £109
Tractor Unit	£52 + VAT £59
RS 232 Interface	£14 + VAT £16
Spare Daisywheel	

BROTHER HR-15

13 CPS Bi-directional 10, 12, 15 CP1 + PS	£344 + VAT £395
Keyboard Unit	£139 + VAT £159
Single Sheet Feeder Unit	£217 + VAT £249
Tractor Unit	£95 + VAT £109

QUENDATA

20 CPS Unidirectional 10 12 15 CP1	£217 + VAT £250
------------------------------------	-----------------

All our printers have 1 year warranty

MONITORS

PHILIPS

7001 High Res Green Screen with sond input £65 + VAT £75

GM1211

GM1211 18 MHZ High Res Monochrome Monitor with tilt and swivel stand available in green or amber etched antiglare screen (please specify colour £86 + VAT £99

SANYO

DM8112 12" Green screen 18MHZ Hi-Res £86 + VAT £99

DM2112 12" Green screen 15MHZ £66 + VAT £75

MICROVITEC CUB

1431 MS 14" RGB Normal Res Colour £173 + VAT £199

1451 MS 14" RGB Medium Res Colour £269 + VAT £309

1441 MS 14" RGB High Res Colour £417 + VAT £479

MICROVITEC FOR QL

1451 14" Medium Res Colour. Specially designed for Sinclair QL £239 + VAT £275

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24MHZ High Res Monochrome etched antiglare green screen IBM/BBC Compatible £86 + VAT £99

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WE STOCK A LARGE RANGE OF SOFTWARE FOR
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FOR FULL DETAILS.

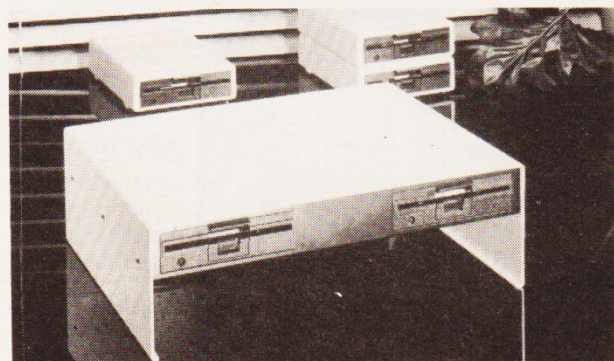


COMPUTER
GROUP

28/29 BURNT MILL HARLOW, ESSEX CM20 2HU U.K.
Tel. HARLOW (0279) 443521 Telex: 818894 AKHTER G

DISC

100% BBC COMPATIBLE MITSUBISHI AND
TEAC SLIMLINE DISK DRIVES



These drives are supplied ready cased with all the necessary cables formatting program and User Guide There are some very useful utilities included on formatting disc e.g.

- * DISASSEMBLER: This is 6502 machine code disassembler
- * DUP: To copy and rename a file on disc
- * FORMAT: Formatting program for 40 & 80 tracks
- * FREE: This utility provides a disk usage analysis
- * MDUMP: Enables you to display and modify any part of BBC memory
- * MERGE: Merge a number of text files into one file
- * RELOCATE: Downloads a basic program to &E00
- * SDUMP: Screen dump for EPSON in all graphic modes
- * VERIFY: Verifies every sector on a disk
- * MENU: A flexible menu program

PRODUCTS

BBC Microcomputer Model B	£348 + VAT	£399
BBC Mod B - disk interface	£409 + VAT	£469
BBC Mod B - Econet interface	£389 + VAT	£447
BBC Mod B - disk and Econet interfaces	£450 + VAT	£517
BBC Compatible 100K disk drive	£86 + VAT	£99
BBC Compatible dual 800K disk drive	£312 + VAT	£359
Acorn Z80	£347 + VAT	£399
Acorn 6502 Second Processor	£173 + VAT	£199
Acorn Bit stick	£327 + VAT	£375
Acorn IEE Interface	£282 + VAT	£325
Acorn Electron plus 1 interface	£52 + VAT	£60
BBC Prestel Adaptor	£115 + VAT	£132
BBC Telex receiver (Aug)	£196 + VAT	£225
BBC cassette recorder and lead	£30 + VAT	£35
Disk interface kit (free fitting)	£84 + VAT	£96
Mod A to Mod B upgrade kit	£70 + VAT	£80
Fitting charge for A to B upgrade kit	£20 + VAT	£23
16K memory upgrade kit	£30 + VAT	£34
Games paddles	£17 + VAT	£19
User Guide	£10	
Advanced User Guide	£12.95	
Econet Guide	£ 7.50	
Econet interface (free fitting)	£60 + VAT	£69
Speech interface (free fitting)	£47 + VAT	£54
BBC disk manual - formatting disk	£30 + VAT	£34
Parallel printer cable	£10 + VAT	£11
BBC word processor (view)	£52 + VAT	£59

YOUR CONTACT AT AKHTER Tel: 0279 443521 (12 lines)

DEALER/BULK ENQUIRIES	HAMAYUN MUGHAL	EXT 202
TELEPHONE ORDERS	CARON ANDREWS	210
DEALER ORDERS	JULIA ALLUM	209
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ORDERING INFORMATION

We accept official orders from UK Government and Education establishments. Carriage is £2.50 + VAT (UK only) for normal delivery. If express delivery is required please add £8.00 + VAT per parcel. We accept telephone orders on Barclay and Access card please ring (0279) 443521 (10 lines), all cheques made payable to "AKHTER INSTRUMENTS".



N.B. All prices are subject to change without notice and are rounded up to the nearest pound

OPENING HOURS: MON-FRI 9am-6.30pm. SAT 10am-5pm.
We welcome callers, no parking problems.

DRIVES

Single drive 100K 40 trks single sided	£86 + VAT	£99
Dual drive 200K 40 trks single sided	£164 + VAT	£189
Single drive 200K 40 trks double sided	£138 + VAT	£159
Dual drive 400K 40 trks double sided	£260 + VAT	£299
Single drive 400K 80 trks double sided	£152 + VAT	£175
Single drive 400K 40 80 trks switchable DS	£155 + VAT	£179
Dual drive 800K 80 trks double sided	£303 + VAT	£349
Dual drive 800K 40 80 trks switchable DS	£312 + VAT	£359
Dual Drive 800K 40 80 trks + PSU + built in monitor stand	£373 + VAT	£429

All above drives are low power slimline (0.3 A typ at + 12v and 0.4 at + 5v per drive) Normally extra power supply is not required. The BBC Computer power supply is designed to drive to low power drive (IT IS NOT DESIGNED TO DRIVE INTERNAL ROM BOARD)

SS DD diskettes (10 Box)	£18 + VAT	£20
DS DD diskettes (10 Box)	£23 + VAT	£26

BUSINESS SYSTEMS

COMPLETE BUSINESS PACKAGE

This system is based on 16 Bit 8088 Processor 128K RAM, 2X730K Floppy Disc Drives, High Res Monitor, fast (160cps) Dot Matrix Printer, Wordstar Wordprocessor, Calcstar Spreadsheet Program, complete integrated Accounts package consisting of Sales Ledger, Purchase Ledger, Nominal Ledger, Invoicing, Stock Control, Payroll and Pro-mail. Complete turnkey system at an unbelievable price.
Delivered Only £1495 + VAT £1719
Delivered and Installed plus 1 day training £1595 + VAT £1834



APRICOT PC

"Portable Executive Computer" 16 Bit Micro. 256K RAM up to 1.44 megabytes floppy disk storage. 3 1/2" Sony disks. Portable brief case styling. Modem with auto dialler (optional) hard disk optional. Vast software library (compatible with Sirius 1).

Apricot with Double Drive, Monitor and Free Printer £1790 + VAT £2059

APRICOT XI

As above but with 10MB Winchester Drive and Single 315K Drive plus Superwriter, Supercalc and FREE JUKI 6100 Printer

£2995 + VAT £3444

SANYO PROFESSIONAL COMPUTER

SANYO 550

16 Bit Micro 128K RAM expandable to 256K. Single or Double Disk drive built in full colour graphics (640 x 200 pixels in 8 colours) IBM compatible. Free software. Sanyo MBC 550 128K RAM single drive and free software including Wordstar and Calcstar

£749 + VAT £862

SANYO 550-2

As 550 but with Dual Drive 2 x 160K

£849 + VAT £976

SANYO 550-360

As 550 but with 2 x 360K Drives

£999 + VAT £1149

SANYO 550-730

As 550 but with 2 x 730K Drives

£1049 + VAT £1206

SANYO 555

Sanyo MBC555 128K double drive and free software including Wordstar, Calcstar, Inforstar, Datastar etc.

£999 + VAT £1149

SANYO 555-360

As 555 but with 2 x 360K Drives

£1249 + VAT £1436

SANYO 555-730

As 555 but with 2 x 730K Drives

£1299 + VAT £1494

**SANYO SYSTEMS INCLUDE
FREE HIGH RES GREEN
MONITOR**

WORD PROCESSING

COMPLETE SYSTEMS FROM £650 + VAT

BBC 1: BBC Micro Model B, View (or Wordwise) Wordprocessor, Quendata 20 CPS Daisywheel Printer, High Res Green Monitor, Cassette Recorder plus 10 cassettes and all the necessary cables
£650 + VAT = £747.50

BBC 2: BBC Micro Model B + Disk Interface, View (or Wordwise) Wordprocessor, 100K Disk Drive, High Res Green Monitor, Quendata 20 CPS Daisywheel Printer, 1 Box of Disks and all the necessary cables
£799 + VAT = £918.85

BBC 3: Same as System BBC2 but with 400K Drive
£875 + VAT = £1006.25

BBC 4: Same as System BBC 2 but with 400K Drive and JUKI 6100 Daisywheel Printer
£975 + VAT = £1121.25.

BBC 5: BBC Model B + Disk Interface, View (or Wordwise) Wordprocessor, 800K Dual Disk Drive (Mitsubishi), High Res Green Monitor, JUKI 6100 Daisywheel Printer, 1 Box (10) of 80 Track DS discs and all necessary cables
£1145 + VAT = £1316.75.

SAN 1: Sanyo MBC 550 Series 16 Bit Microcomputer, 128K Ram, Dual 160K drives (2 x 160K), High Res Graphics (600 x 200 pixels in 8 colours), JUKI 6100 Daisywheel Printer, High Res Green Monitor, 1 Box of 10 discs, Wordstar Wordprocessor, Calcstar spreadsheet and all the necessary cables
£1175 + VAT = £1351.25
SAN 2: Same as SAN 1 but with Dual 360K Drives (2 x 360K)
£1345 + VAT = £1546.75
SAN 3: Same as SAN 1 but with Dual 720K Drives
£1395 + VAT = £1604.25

SAN 4: Sanyo MBC 555 Series 16 Bit Microcomputer, 128K Ram, Dual 160K Drives (2 x 160K), High Res Graphics (600 x 200 pixels in 8 colours) JUKI 6100 Daisywheel Printer, High Res Green Monitor, 1 Box of 10 discs, Wordstar, Wordprocessor, Calcstar spreadsheet, Mailmerge, Spellstar (dictionary), Datastar (database), Reportstar plus all the necessary cables
£1295 + VAT = £1489.25.

SAN 5: Same as SAN 4 but with Dual 360K Drives
£1475 + VAT = £1696.25

SAN 6: Same as SAN 4 but with Dual 730K Drives
£1525 + VAT = £1753.75

If you require High Res Colour Monitor instead of High Res Green Monitor in Sanyo Systems please add £320 + VAT = £368 to the above prices.

*128K RAM Upgrade for all above Sanyo systems (makes a total of 256K RAM) £150 + VAT = £172.50 including fitting.

VERO INTERESTING

Verospeed have added a new acoustic coupler/modem suitable for most modern telephone handsets to their range of computer peripherals and accessories. The Sendata 700B is a 300 baud full-duplex modem with a switchable answer/originate facility. This compact coupler can be powered either from internal rechargeable batteries (NiCd) giving up to 10 hours use, or from an external 5V source (from equipment or a mains adaptor). Power consumption is only ¼W.

The modem connects to the

host computer via a standard RS232 (V.24) or TTL interface and a six-core curled cable carries all the necessary connections. The 700B features a power saving automatic on/off switch and has indicators for received signal quality and battery condition. The crystal-controlled circuitry provides stable transmit and receive frequencies. Receiver sensitivity is -40 dBm, making the unit suitable for use with most modern telephone handsets.

For further details please contact Verospeed, Stansted Road, Boyatt Wood Industrial Estate, Eastleigh, Hants (sales telephone number 0703 641111).



THE COMING OF COMPUNET

Over half a million Commodore 64 owners will initially have access to Commodore's Compunet network by purchasing the Commodore Communications Modem, which was launched at the PCW Show. Software built into the modem allows users to prepare material before connecting to Compunet and then to send it up the line directly into the database where it is immediately available to other subscribers. Text, graphics, programs and data are all acceptable to the service. Compunet expect a marketplace to develop from this feature since uploaded

material can be sold, as well as exchanged or offered free. Compunet will handle all the accounting aspects on behalf of users with billing by Direct Debit.

"Direct Debiting is really very simple and convenient for users and enables us to keep the costs of running the service down to a minimum so the first year's subscription is free, as is access to the service in evenings and weekends," says John Clarke, Compunet's commercial manager. "Users can check their account in detail at any time on-line and a full statement is sent by post well before the Direct Debit takes effect," he adds.

The modem also contains

NEWS



special communications software which ensures the material going up and down the line cannot be damaged by a poor telephone connection. No other service currently offers such protection at all times and it is regarded as essential for reliable two-way use by the public at large.

Also a key part of the Compunet service is a range of software which users can buy at discount prices and load directly down the line into their computer. Security features built into the Commodore Modem and Compunet service ensures such software will only run on the user system to which it was sent. A major step forward in the war against software piracy, this feature is already attracting suppliers of good products to sell them through Compunet. Telesoftware cuts middle man and distribution costs and these savings are passed on to subscribers in the form of lower prices.

The educational software area will also be a strong feature of Compunet with some 53 programs being offered by Commodore to begin with, 10 of these being updated every month.

Other features of Compunet include computing information

and advice, tele-shopping at guaranteed minimum prices using COMP-U-CARD, a national estate agency service to be launched later this month and home financial services to be offered by a well known bank. Discount shopping services such as COMP-U-CARD will be a major feature of the system, giving users the benefit of both competitive prices and doorstep delivery on a wide range of goods.

Compunet have also signed an agreement with Century Publications to make Essex University's internationally famous Multi-User Dungeons (MUD) game available. Computer games in which a large number of players can participate are made possible by Compunet's communications network and enhance this already highly successful area of home computing.

Users can also leave messages for one another, work together on new programs and swap information on their micros. A Commodore database provides hints on all aspects of microcomputing and users can access information on the latest products and peripherals. All material displayed by a Compunet user is automatically stored in the home

A HUSKY VOICE?

A new communications package enabling the Husky Hunter handheld microcomputer to talk to the IBM Personal Computer has been introduced by Husky Computers Ltd. Known as the Husky IBM-PC Comms Pack, it is the

first of a series which will cover a wide range of popular personal computers.

The new package, which consists of an interface cable, a simple disk-based communications program and an instruction manual, allows any IBM Personal Computer equipped with an asynchronous communication card to take part in two-way data and program transfers with a Husky Hunter.

The CP/M-compatible Husky Hunter can be used as an IBM terminal emulator using the normal IBM asynchronous protocols, or as a user-defined terminal. In addition, programs, object code or data files can be downloaded from the Husky Hunter to the IBM machine.

The new communication facility is expected to be especially useful to users of popular database-management programs like dBASE II, as it allows data files to be exchanged in fully compatible form between the IBM Personal Computer and the Husky.

The Husky IBM-PC Comms Pack costs £98 (plus VAT). Husky Computers Ltd are at PO Box 135, 345 Foleshill Road, Coventry, CV6 5RW.

DOUBLED UP

The double-sided version of the 3½" micro floppydisk from Sony is now available from Action Computer Supplies. Both single and double-sided micro floppydisks include features such as a metal centering hub, disk rejection if inserted wrongly, an automatic shutter which protects the recording surface until the diskette is loaded, and colour-coded labels for easy indexing.

Supplied boxes in tens, price of the double-sided diskettes is £59 for a single box, falling to £51 per box for 10 boxes or more. For more details contact Action Computer Supplies, 6 Abercom Trading Estate, Manor Farm Road, Wembley, Middlesex HA0 1WL (phone 01-903 3921; telex 922493 Action G).



computer by the modem software. This means it can be studied later or put on to disk or cassette, and saves telephone connection charges.

The Commodore Modem at £99.99 comes complete with all the software required to access Compunet, including off-line editing facilities, and a year's subscription to the service. Viewdata software is also available for a small extra charge. Further information is available from Compunet Teleservices, Metford House, 15/18 Clipstone Street, London W1P 5DS.

SPECTRUM DISKS

Datafax Systems Ltd have announced the launch of their new Sinclair ZX Spectrum disk interface. This system is designed for the Datafax/Hitachi 3" disk drive; however, it can also be used on single-sided 40 track 5¼" disk drives.

The disk interface comes complete with leads and a comprehensive manual. The interface uses only 8K of user memory for the operating system and still allows other peripherals to be added via its own edge connector. The inter-



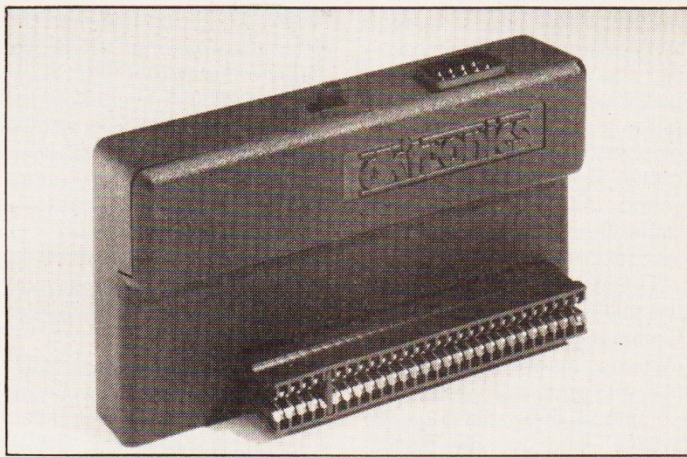
OH JOY!

The joystick situation on the Spectrum can be a little on the frustrating side, with three main formats and only the more user-friendly of games providing a menu selection of the one that suits you. Now DK'tronics have solved the problem once and for all with a fully programmable joystick interface.

The company claim that you will now be able to run any software from any supplier on the Spectrum using a standard Atari/Quickshot type of joy-

stick. The interface comes complete with machine code software and can be programmed in seconds to give eight-way joystick movement. The unit has a through connector allowing other add-ons to be plugged into the rear and the system is compatible with the complete range of DK'tronics interfaces. (A catalogue is available).

DK'tronics are at Unit 6, Shire Hill Industrial Estate, Saffron Walden, Essex CB11 3AQ (phone 0799 26350; telex 817812).



face also has a system reset button on the case to save the continuous plugging and unplugging the Spectrum to the mains. The system will save BASIC and machine code programs as well as array files using simple-to-learn commands. A utilities diskette is supplied, although formatting of diskettes is performed by the interface rather than a BASIC program. The purpose of this diskette is to allow immediate use of the system whilst learning.

There will also be a number of free games on the diskette. The maximum number of files per diskette is 78 (39 per side), pro-

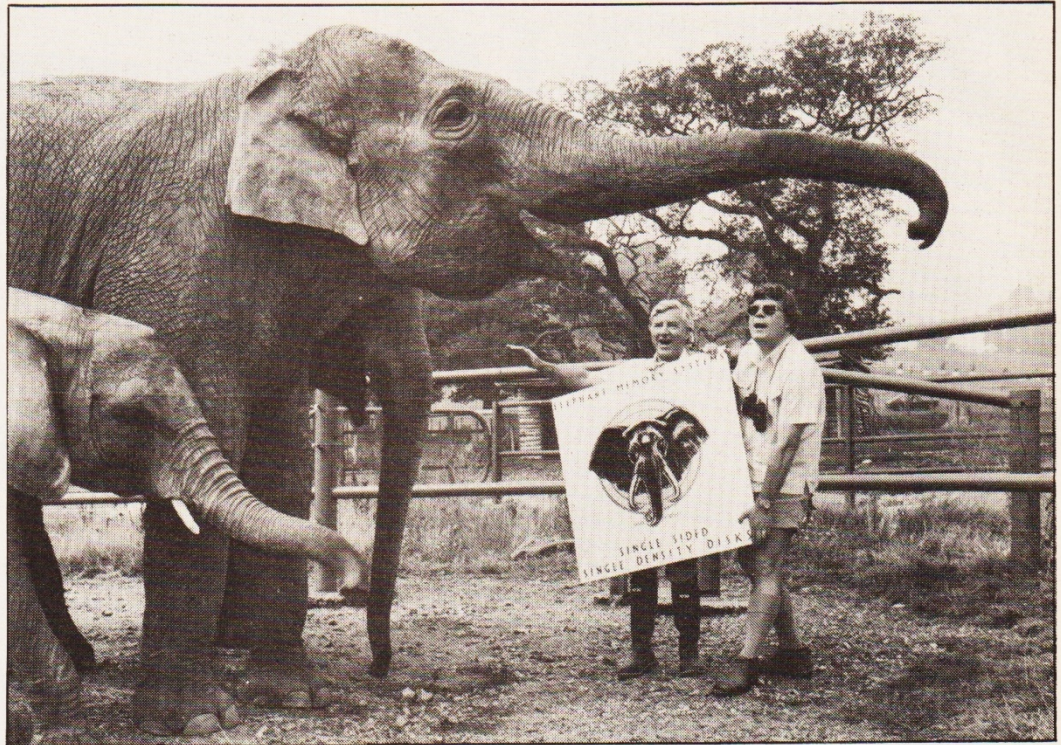
vided each file is less than 3K. The diskettes have a storage capacity of 100K on each side. Each diskette can be titled on formatting as to the nature of the programs saved on the disk. The interface operating system incorporates commands that enable the user to call up the diskette directory, erase unwanted files and make backup copies of diskettes.

Statacom Distribution Ltd have the sole distribution rights to this disk interface and can be contacted at 65 Inveresk Gardens, Worcester Park, Surrey KT4 7BB (phone 01-337 0311).

TRUNK AND DISK-ORDERLY

Floppy disks, made by Dennison and marketed under the Elephant Memory Systems trade mark, have sold successfully in the USA for some years. Using experience already gained in this highly competitive market, Elephant disks are now being made available to both home users and small businesses in the UK.

Elephant Memory Systems are easy-to-use high quality products with a simplified and easily understood consecutive numbering system. Available single or double sided and in single, double and 96 TPI densities, as well as both hard and soft sectored, each disk is certified 100% error-free and problem-free. With quality maintained for at least 12 million passes, they guaranteed to meet or exceed all industry standards. The simplified range of eleven related products is compatible with virtually every personal computer



on the market.

Elephant disks will be available from a nationwide network of dealers, who will also stock

other related Elephant products, including a wide range of ribbons and cleaning and maintenance kits for screens,

printers and disk drives.

The photo shows the 36" floppy disk, although standard 5¼" disks are also available.

A CHATTY COMMODORE

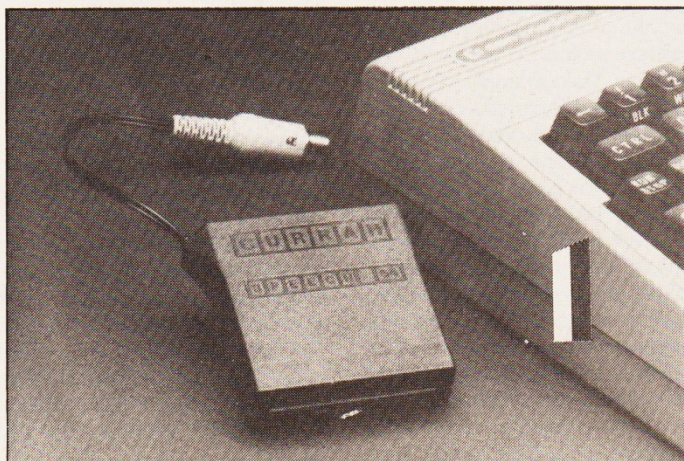
Currah Computers have recently launched a speech synthesiser for the Commodore 64. The Speech 64 is a small unit, roughly hand-sized, which plugs into the back of the Commodore 64 using only a single cable. The device modulates sound onto the TV receiver rather than having a separate loudspeaker.

Containing only three chips, the unit doesn't use any of the Commodore 64's operating system so the system is compatible with games programs. The command INIT starts up the system, and a new BASIC keyword SAY is used to trigger the text-to-speech synthesis.

Hence any speech may be generated, not just pre-recorded phrases.

Speech 64 has two separate voices, high and low, with different intonations, which are selected using SAY 0 or SAY 1. As well as text-to-speech, the system can be programmed with conventional allophones. Currah expect that many games featuring speech synthesis will appear for the Commodore 64, as happened for the ZX Spectrum when they launched the Spectrum Microspeech unit.

The retail price of the Speech 64 is £29.95, and further details can be obtained from Currah at Graythorp Industrial Estate, Hartlepool, Cleveland (phone 0429 72996).



A CASE IN POINT

Executives and managers travelling nationally or internationally can now enter messages and sales information to central computers using a briefcase microterminal developed by GEISCO, the General Electric Information Services Company. The terminal, based on Epson's HX-20 microcomputer, gives rapid access to GEISCO's global computing service which is available via local telephone call in over 30 countries and through public data networks in a further 25.

When used in conjunction with GEISCO's Quick-Comm electronic mail service, the briefcase terminal can enter and receive messages from any location where a telephone is available. In applications involving access to a central database the terminal can be programmed to meet individual requirements.

A built-in acoustic coupler allows any conventional telephone handset to provide a link with the GEISCO network, and a text editing feature called GXTXT incorporated in the terminal enables users to edit their messages or orders before transmission. Error-free transmission of data between the ter-

minal and the GEISCO network is then provided by another GEISCO developed facility called GXCOMM.

Once the automatic sign-on facility for accessing the network has completed its function, the briefcase terminal allows information residing on GEISCO's central computers to be used in conjunction with its own local facilities. This gives travelling executives on-line access to the same systems that are used by corporate and functional management, ensuring that up to date information is available throughout the organisation.

The new briefcase terminal is one of a wide range of machines that can be interconnected with GEISCO's services. These include word processors, microcomputers, minicomputers and mainframes. The service incorporates the world's largest teleprocessing network which, in conjunction with over 50 large scale central computers, can act as a means of integrating local systems of virtually any type.

The network incorporates more than 1000 communications and control computers and uses over half-a-million miles of landlines together with intercontinental satellite links

THE BIG MAC

Apple Computer have introduced a new Macintosh personal computer with 512K of internal memory. This the latest addition to the Macintosh product line — introduced several months ahead of schedule due to the significant quantities of 256K chips now available — offers users another option in choosing the Macintosh system that best fits their needs.

The Macintosh 512K has a suggested retail price of £2,595. In addition, Apple is also announcing memory expansion for the £1,795 Macintosh 128K system. The 512K memory expansion kit costs £800, the difference in price between the 128K and 512K systems.

The Macintosh 512K, which looks identical to the smaller system, offers users faster response time and the capability of creating larger documents and models. For example, it increases the capacity of MacProject, Apple's project management tool to be released next month, enabling users to work on up to 2,000 tasks per project. In addition, users can work with ten times the number of objects in

MacDraw, a structured graphics program scheduled for release in November. Microsoft's Multiplan spreadsheet models also are significantly larger. For users who want to run the Lotus Macintosh project, available from Lotus Development Corporation in the future, a 512K system is essential.

The Macintosh 512K will be available in October through authorised Apple dealers. Both 128K and 512K systems include free copies of MacWrite and MacPaint. Macintosh owners can expand their 128K systems to the Macintosh 512K at authorised Apple dealers and service centres. The expansion can be completed in less than thirty minutes by replacing the Macintosh digital board.

On the other hand, for people who require even more computing power, Apple Computer have announced availability of Lisa 7/7, an integrated software package for the Lisa 2 personal computer. Lisa 7/7 combines fully integrated and enhanced versions of the seven original Lisa Office System applications into one software package. Priced at £545, it includes project management, word processing, spreadsheet, data



communications, data base, business graphics, and structured graphics.

Significant features include:

- Enhanced integration between functions, enabling users to move data easily between functions, and to manipulate and present it in various ways.
- Enhancements to the individual functions such as a built-in English spelling corrector, more graph types, faster spreadsheet calculations, and the ability to calculate job costs in the project management tool.
- High-quality colour printing on the Canon PJ-1080A ink-jet printer, in addition to black and white output on the Apple Daisy Wheel and Imagewriter printers.

Users also can switch quickly between Macintosh and Lisa environments, as Lisa 7/7

allows the user to partition the hard disk for the purpose of storing Macintosh data files on it. An updated version of MacWorks (the Macintosh Operating System for the Lisa) that is available from October in the UK will be required for storing Macintosh files on the hard disk.

Designed for either the Lisa 2/5 or Lisa 2/10 systems, Lisa 7/7 requires a hard disk and one megabyte of internal memory, available by adding an optional memory upgrade board to the standard Lisa 2/5 or 2/10: the suggested retail price is £545. Lisa users will be able to upgrade Lisa Office Systems software to the Lisa 7/7 for £120. The upgrade includes a new operating system, all seven functions, and new manuals. Upgrade information will be available through Lisa dealers.



and undersea cables. Its applications are supported by more than 5000 GEISCO staff located in 200 offices worldwide.

GEISCO is located at 25-29 High Street, Kingston-upon-Thames, Surrey KT1 1LN (phone 01-546 1077).

PASCAL ON THE BEEB

The popular portable operating system P-System is now available as an integrated program development package for the 6502 Second Processor-enhanced BBC Microcomputer. The new implementation has been developed by Acomsoft Ltd working with TDI, who have already versioned P-System for over thirty other business and home micros, including the ACT Sirius and Apricot, and the IBM PC.

The Acomsoft/TDI P-System is the latest and most complete version (IV.1) of the UCSD Pascal Project, and includes Filr, Editor, Utilities and compilers for both UCSD Pascal and Fortran 77. The P-System is widely used in universities and colleges, and increasingly in business software develop-

ment where it offers unique advantages of high level facilities, ease of use and finished product portability. For example, the local government computing body LAMSAC recently strongly recommended UCSD-p to its members because it would allow easy software exchange between authorities.

The Acomsoft/TDI version is £299 including VAT, and includes two diskettes and three comprehensive user guides covering all aspects of the system and language. To implement it requires a BBC Micro with Disk Filing System, 6502 Second Processor and 800K dual disk drives. It is available now from Acomsoft dealers and mail order from Vector Marketing Ltd, London Road, Denington Estate, Wellingborough, Northants, NN8 2RL.

MORE ON MSX

JVC (UK) Ltd are set to enter the home computer market. The new computer, the HC 7GB, will have a suggested retail price of £279 and will be available with a number of peripherals. The HC R105 is a high speed data recorder retailing at £89 which offers exceptionally high access speeds to material laid down on audio tape, Britain's favourite method of data storage, thus alleviating

one of the problems normally associated with storage on audio tape.

Also available with the HC 7GB will be the HC J615 joystick, which retail for £12.95. Other peripherals will become available after Christmas, with a steady increase in the possibilities presented by JVC's new home computer hardware.

JVC have adopted MSX because of the versatility they see in the system. Being a com-

pany at the forefront of home entertainment development, JVC have long seen the need and the possibilities of incorporating a computer into the home entertainment system, with video machines and audio systems lending themselves to this amalgamation of high technology.

With the HC 7GB, the complete home system has become reality, with both video and audio equipment forming the ideal partnership with the new

MSX standard. As technology advances and becomes even more refined, so this concept of the complete home entertainment system takes on new possibilities: control of audio systems, superimposition of graphics onto video images, musical composition and a multitude of domestic uses such as budget advice, security programs, and interactive communication networks with other sources are among the possibilities JVC envisage.



THOSE AWFULLY NICE SONY PEOPLE...

...will be among the first manufacturers to bring MSX to the UK, with their HB-75B 'Hit Bit' microcomputer, together with a range of peripherals, available from early October. While using MSX BASIC as its core, the Sony machine goes far beyond the minimum requirements of Microsoft's specification for the MSX operating system.

The executive style 'Hit Bit' has an QWERTY keyboard layout, five function keys and a cluster of simple cursor control keys; 64K RAM, MSX BASIC, a choice of video outputs (including RF, composite, audio, video and RGB) twin joystick ports and a standard cassette interface. In addition to the MSX compatible cartridge slot at the rear of the keyboard, a second slot can be found at the back of the unit, replacing the Japanese I/O port, and enabling the peripherals to be connected either via the cartridge port or the built-in Centronics (printer) interface.

The HB-75B is built around the same four chips that are specified in the MSX standard,

but an additional chip is unique to Sony. This 16K ROM contains a collection of programs and utilities built-in to the system as firmware, thereby providing a valuable facility to the user. When used in conjunction with a CMOS RAM battery-powered 4K data cartridge — one of the peripherals being

offered by Sony — the user has instantaneous storage and retrieval of data at his fingertips.

Sony's HB-75B displays a menu of options as soon as the machine is switched on. The address book, memo pad and schedule reminder are identical in structure and contain nine lines of characters on the

screen. For ease of use, entries can be made, updated, sorted, located and finally stored on the data cartridge, at the touch of a button. The fourth option on the menu is MSX BASIC, which takes the user into the standard programming screen.

To complement the HB-75B, Sony will introduce a range of



CANON'S COMPUTER LAUNCHED

The new Canon V-20 Home Computer is an easy-to-use 64K MSX microcomputer for either home or small business applications. The machine follows the MSX standard closely, with 32K of ROM and 16K video RAM. There are 73 full stroke keys, including a full QWERTY keyboard, a conveniently large cursor keypad and function keys.

Included on the back of the V-20 are easily accessible external connection points for peripherals such as a printer, video, audio or cassette recorder, enabling the machine to expand its capabilities. The V-20 is compatible with the RS-232 interface for telecommunications, while the specially developed MSX-DOS operating system shares the disk format of MS-DOS, allowing communication between eight-bit MSX machines and 16-bit MS-DOS microcomputers.

peripherals, comprising the 3½" disc drive, printer, joystick and, of course, the data cartridge.

The 'Hit-Bit' package comes complete with three manuals, the built-in software, the BASIC language and all the necessary television and cassette leads.

Peripherals for the V-20 will include the VJ-joysticks, for use with games software; these will be available before Christmas. In addition, a standard thermal printer for word processing, letters and program printouts and a graphic tablet for image processing, will be available at the beginning of 1985.

The V-20 MSX Home Computer will be available through major retail outlets and distribution houses, at a price of approximately £280 including VAT. The VJ-200 joysticks will cost approximately £15 per pair, including VAT.



SPECTRAVIDEO MAKE THE GRADE

Spectravideo have announced the arrival in the UK of its full MSX specification home computer, the SVI728. This follows a

long period of uncertainty over the 'almost-MSX' SV318 system, which did not carry the Microsoft-approved logo. With shipments to the UK due to commence in October 1984, Spectravideo are likely to be one of

the first manufacturers to deliver this new generation of microcomputers in the UK.

Priced at £249.95 (retail), the SVI 728 incorporates Microsoft's full MSX standard. This includes the use of common input/output ports, common cassette interface, common chip architecture and common acceptance of ROM packs.

The SVI 728 has been designed to combine the power and speed of a professional computer with full ergonomic features and a pleasing appearance, say Spectravideo. It has 80K RAM built in (64K user RAM and 16K video RAM). The keyboard has 90 keys, 10 of them user programmable for special functions with a numeric key pad featured on the right hand side of the keyboard.

MITSUBISHI (BLESS YOU)

Mitsubishi Electric (UK) Limited has announced its MSX range of computers in this country; at present it is the only company marketing two systems. The ML-F 80 and ML-F 48 both have 32K of ROM, but the former has 64K of RAM, whilst the latter has 32K. The ML-F 48 is expandable to the larger configuration, and the choice provides the home computer programmer with a range of software and computing power. The machines will be sold by Mitsubishi through its existing outlets and will be available from November.

A full range of peripherals is also planned, with joysticks already available.

The Mitsubishi ML-F 80 and ML-F 48 will cost £299 and £249.



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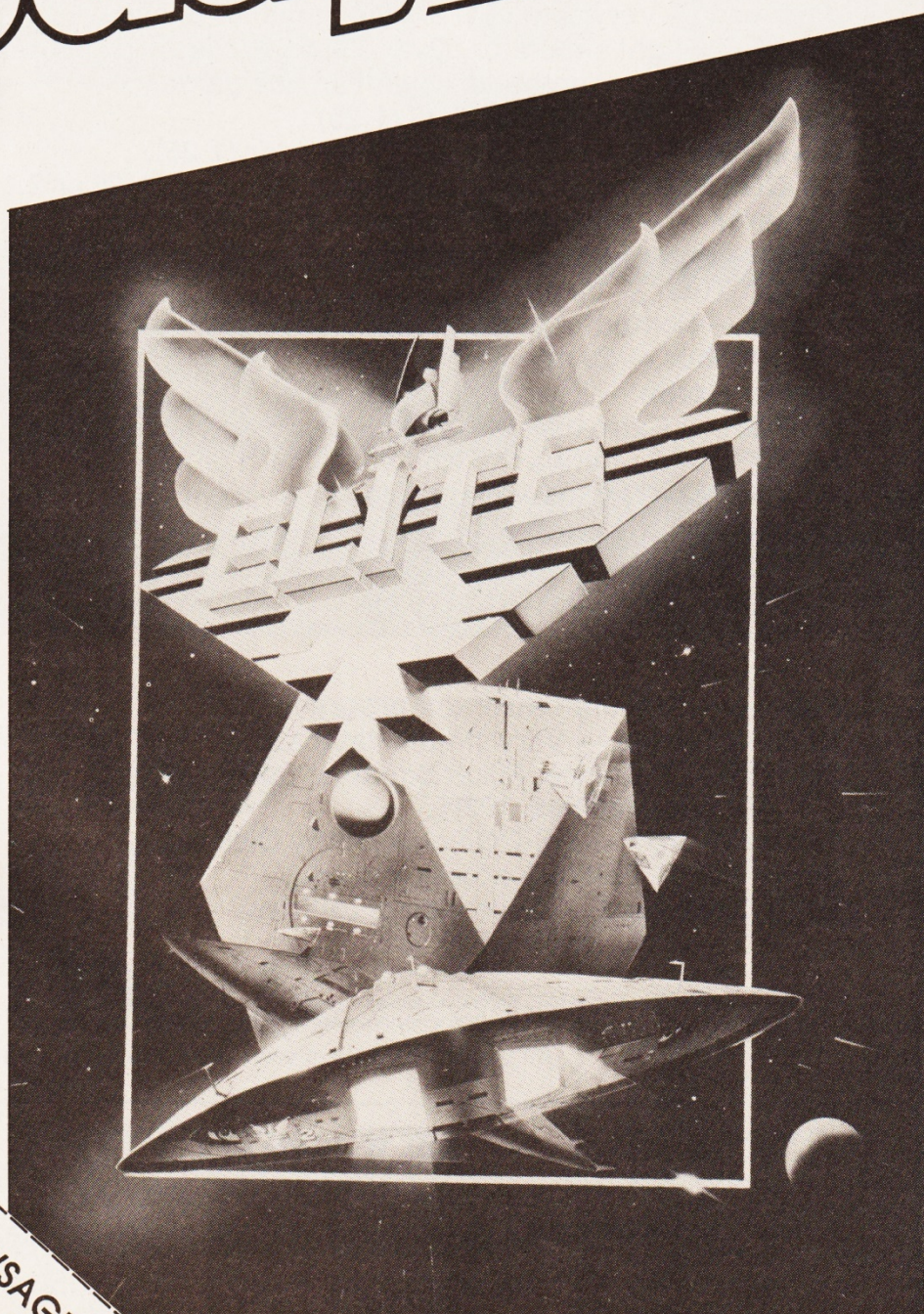
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NEXT MONTH

Computing today

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Next month in Computing Today, the name of the game is... games. We'll be taking a look at the rights and wrongs of writing a piece of games software, and there'll be a feature on the latest craze down among the trolls, MUD. To the uninitiated, this is an acronym for Multi-User Dungeons, a multiple role-playing game that will shortly be appearing on Compunet. Game of the year will definitely be Acomsoft's Elite, the 3D real-time space trading/raiding game for the BBC and Electron, and CT will be telling you all about it. (This was held over due to the sudden appearance of The Last Starfighter). Type-it-in games listings include Commodities, a stocks and shares game for the BBC B, and an MTX 500 version of Conway's Game of Life. Finally, our hardware reviews are of the Tatung Einstein and the Fujitsu F16-M. Don't miss the January issue of Computing Today.



Articles described here are in an advanced state of preparation but circumstances may dictate changes to the final contents.

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For all its virtues, the BBC computer has always been short of memory. Without using special tricks, there is, at the very most, 27.5K of RAM available for programs and data storage. At the other extreme, if you are using disks and high resolution graphics, there is only 5.75K to play around with.

This has often put the Beeb at a disadvantage, despite the (almost) unchallenged superiority of its other facilities — speed and BBC BASIC. Even for some games it is a little restricted ('The Hobbit' has no graphics) and the lack of memory has prevented the computer's having much impact in the business market.

Acorn implicitly acknowledged the problem with their long-term plans for

STIKS AND TONES

David Peckett

The long-awaited 6502 Second Processor for the BBC Micro was launched together with the Bitstik, a hardware/software drawing tool. Professional computer graphics for less than £2000 — you CAD, Sir!

'Second Processors', and these plans have recently come to fruition with the release of two systems, one based on the 6502 microprocessor and one using the Z80. In this article I will take a look at the 6502-based add-on and also investigate a remarkable graphics system, the Bitstik, which uses the 6502 processor.

The 6502 second processor is a simple computer, containing a 6502, 64K of RAM, interfacing electronics and its own power supply, which connects to the Beeb via the 'Tube' interface. The system is housed in a box with the same profile as the BBC computer, but half its width.

In use, programs no longer run in the Beeb but are stored and run in the second processor, with the original computer relegated to the role of



'I/O Processor'. This means that the BBC provides the new, double-computer system with all its links to the world using the original keyboard, disk and/or cassette interface, A/D converters, sound system, and display drive. The main operating system also stays in the original computer.

This work-sharing is the key to the second processor's power. For instance, it does not have to sacrifice up to 20K of its RAM to the demands of graphics — the display memory stays in the I/O processor. If you are running in BASIC, up to 44K is available for programs and data, while machine-code programs can use up to 60K of memory.

There is yet another benefit — the second processor runs even faster than the Beeb. The 6502 in the add-on is 50% faster than the original and, as the two computers work simultaneously (one is calculating while the other is I/Oing) you can get even greater speed increases. The precise improvement depends on just what a program does and how it does it, but it is not difficult to double the effective speed of some BASIC programs.

SETTING UP

The 6502 Second Processor comes as a package containing four items: the processor itself, an instruction book in the usual ring-bound Acorn style, and two ROMs which you must fit into your Beeb. The more important of the latter is the DNFS (Disk/Network Filing System) ROM, which replaces any existing DFS and NFS (for Econet) ROMs which may be in the computer. Since it contains the code needed to let the two processors work together, the DNFS ROM must be fitted even if you have neither disks nor Econet. Mind you, you would probably have to be a masochist to try to use the second processor from cassette.

The second ROM ('Hi-BASIC') can either replace, or be used with, your existing BASIC ROM. Alternatively, you can, if you wish, not fit it at all. It contains a special version of BASIC II which makes the best use of the second processor's extra memory; a few routines, such as those for SIN and COS, are also recoded to improve their accuracy.

Setting up the second processor system is fairly

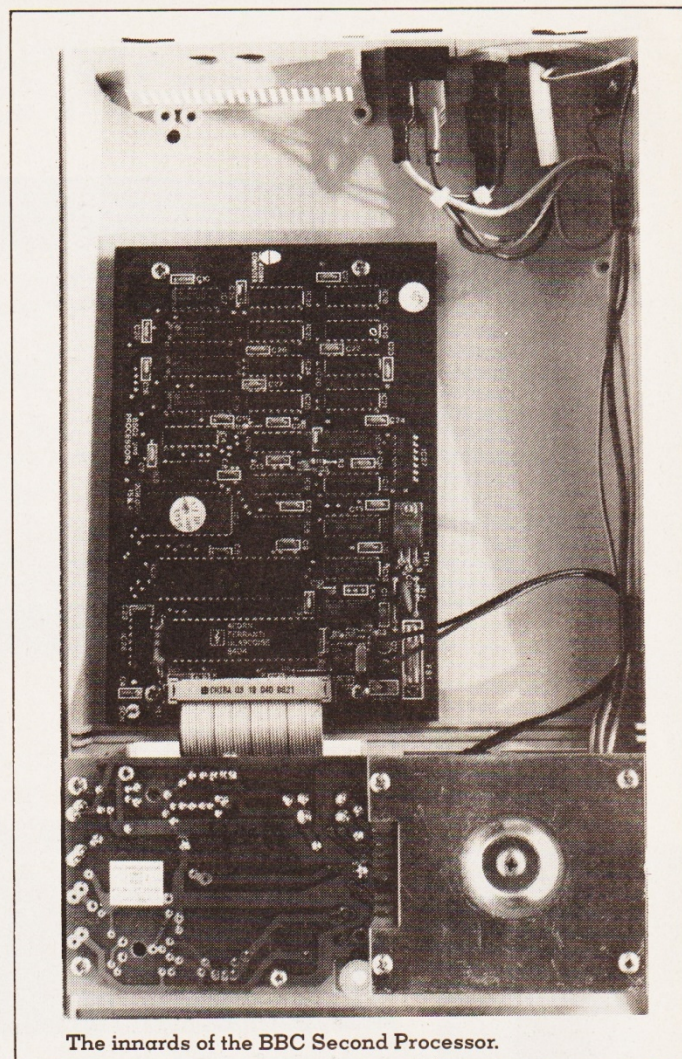
straightforward, if fiddly. There is the usual nerve-wracking ROM change procedure and the processor is then plugged into the Tube connector under the key board. For good electrical reasons the cable is rather short (about 20 cm long) which means that the second processor *must* sit next to the Beeb and on its right. This is fine if you have a big desk top but could be most irritating if you are short of space and would prefer to tuck the processor out of the way at the back. If you also have, for example, a Prestel interface and disks, the result is a system around 100 cm wide: this is a bit excessive and I would like to think that Acorn are considering alternative layouts.

Once the system is assembled it can be switched on, second processor first. At start-up, key information is copied into the very top and bottom of the second processor's memory and then the 'active language ROM' (the one nearest the right) in the Beeb is copied into the add-on, going into the same place in memory as it was in the original.

This copying process is the reason for Hi-BASIC. If you leave the chip out, then your original BASIC will be happily copied into the second processor at its original addresses from &8000-&BFFF. Unfortunately, this is in the middle of the new computer's memory map and leaves a big hole from &C000 to &F800. Although you can use this area for machine-code routines and, with a bit of fiddling, BASIC variables, it is awkward and puts a absolute maximum of 30K on the size of BASIC programs. Hi-BASIC, however, goes to the top of memory, leaving an unbroken 44K for programs and data. This is a much more practical solution.

If you expect to use the Beeb on its own, you must also retain the BASIC ROM, since Hi-BASIC only works in the second processor. Switching between the two is a little complicated but the manual explains it very well. If, though, you will only run with both processors operating, install Hi-BASIC and forget the original ROM.

There is a further catch to the configuration problem. A full system with Hi-BASIC, DNFS, BASIC and OS ROMs fitted has only one spare ROM slot. What if you want to take advantage of



The innards of the BBC Second Processor.

the second processor's power by setting up a business system with, for instance, word-processor and spreadsheet ROMs? No problem. The manual explains how ROMs (including Hi-BASIC) may be transferred to disk and then loaded directly into the second processor via a "*" (name) command. Further, permission is given to copy all Acornsoft ROMs in this way, although there is a very firm warning against breaching the copyright of other suppliers.

The disk-based approach is also Acorn's cunning way around the ROM expansion board problem. The company have never officially acknowledged the need for more than the four installed ROM slots. If languages (spreadsheets, word-processors and so on are no more than very specialised languages) are stored on disk, then "What expansion board problem?"

IN USE

Once set up, and that's not very difficult, using the second pro-

cessor is simplicity itself. In fact, short of noticing the increased speed and memory, there is no obvious sign that it is there. It does, however, make the Beeb a practical and very attractive computer for business and technical purposes. It can now handle sensible amounts of data, while very complex high-resolution displays can be set up without fear of the "no room" error message.

To take the best advantage of the extra speed, it is best to design programs so that the two processors work together as much as possible. For instance, if you are using graphics, arrange for the Beeb to be displaying one set of points while the second processor is calculating the next. As an example, a simple high-precision circle-filling routine runs in 5.96 seconds on the Beeb alone and in 2.82 on the second processor — that's an improvement of 2.11 times!

One small limitation, not so much of the second processor but of Beeb software, is that many programs will not run

on it. The 'User's Guide' to the BBC computer goes to great pains to describe the use of OS calls to set at the machine's workings and explains clearly that these *must* be used to guarantee Tube compatibility. Unfortunately, many programs and ROMs do not use the calls — most arcade games, for instance, write directly to the screen for speed. Mind you, if games work properly on the Beeb, there is not much point in trying to run them anywhere else. The very popular Wordwise word processor will not work over the Tube either, so I couldn't write this article on the second processor.

Most BASIC programs should not give any trouble, since the correct calls are used automatically, but even some of these may have problems if they use the "!" and "?" operators to access memory directly. A quick survey shows that programs and ROMs such as View, Viewsheet, Ultracalc, Watford DFS, Logo and BCPL will run on the second pro-

cessor. On the other hand, Wordwise, Disk Doctor, Exmon, Toolkit, Amcom DFS and Aviator will not.

Who, then, is the second processor aimed at and who will use it? Probably anyone using the BBC computer for business, for technical purposes, for serious program development, for displaying complicated graphics... In short, almost anyone who needs more speed and/or memory. If you only use the computer for your own, small, programs or for playing commercial games, then there probably is not a lot of point in the investment.

The combination of BBC computer, second processor and disk drives provides the basis of a powerful system for small to medium-sized businesses, and software (eg Viewsheet) is already appearing to exploit the system. With very slight reservations over the price of £199, and the somewhat fiddly need to swap BASICs, I thoroughly recommend it.

WHAT'S A BITSTICK?

An example of the sort of thing made possible by the second processor is the Bitstik system, a powerful graphics design tool. An earlier model appeared for the Apple around three years ago and enjoyed considerable success; its manufacturers, Robocom Ltd, have now released this version which makes the most of the BBC computer's display facilities.

The system costs £375, for which you get the Bitstik itself, a ROM to plug into the I/O processor, three floppy disks containing programs and data, and a comprehensive manual in the usual Acorn style. Superficially it is pricey, but it includes some extremely clever programming and a piece of precision hardware.

Before you can use the system, you must also have the 6502 second processor (of course!) twin 80-track disk drives and, if you want to make hard copies of your drawings, an Acorn Inkjet printer. For best results, you also need a medium- to high-resolution colour monitor. The whole system, then, will cost at least £2000, which puts it out of reach of all but the wealthiest private users. For designers or other professionals, however, at whom the system is aimed, the price is very reasonable and it would be hard to buy an equivalent for less than £4000.

BITSTIK HARDWARE

The Bitstik itself looks like a large ball-mounted joystick in a neat housing measuring 18cm X 11cm X 14cm. The plastic housing is in Acorn cream and, as well as the joystick, carries three push buttons (two white, one red), a power-on light and a rubber handrest. The joystick moves uncannily easily in the usual X and Y directions and can also be twisted to provide a third ("Z") analogue input. The stick has virtually no friction or stiction, yet stays exactly where it is put — the smoothness is an essential part of the system's ease of use.

The Bitstik plugs into the joystick port at the back of the Beeb, and the ROM must go into a spare socket inside the computer. As the ROM modifies the computer's operations to suit the Bitstik, it must plug in — you can't use the disk-based

approach I described above for second processor languages.

Once the system is up and running, it is controlled entirely from the Bitstik, using the joystick and the three buttons. The only time there is any need to touch the keyboard is to input text to a drawing or to recover from a system error, such as a full disk. The buttons are called "Top" (T), "Left" (L) and "Right" (R) and are used in a totally consistent way throughout the program. In many ways, using the Bitstik is like driving a computer via the fashionable Mouse, with the exception that you move a joystick rather than pushing something all over a crowded desk top.

UP AND RUNNING

The system is loaded from a 'System Master' disk which is then replaced by a 'Library' disk. Once running, the normal display (Figure 3) shows a menu of operating modes down the right-hand side of the screen. At the bottom of the screen is the drawing palette, used to select the type of line, colour and drawing mode. A cursor appears in the middle of the screen and, as you move the joystick, it splits into two parts. One, the 'origin cursor', is X-shaped and stays put; the second, which is called the 'dynamic cursor' and is + -shaped, moves round the screen but stays linked to the origin by a rubber-band line.

To select any operating mode, put the dynamic cursor on the label and press the 'L' button. If necessary, the screen will alter to show the effect of the selection. A palette option is chosen simply by putting the cursor on the symbol you want and then moving it away again. Your selections are shown by the right-hand menu label going contrast-inverted and by an arrow-head pointing to the symbol on the palette.

Once the system is up and running like this, you can turn to the excellent manual and start working through the 13 tutorials it provides to explain the Bitstik. These are needed, not so much because the system is difficult to use (it is not), but to describe its many facilities and how they interact.

Indeed, using the system is a model of common sense, thanks to the well-designed menus and total consistency of the Bitstik controls. The joystick always positions the cursor on, in

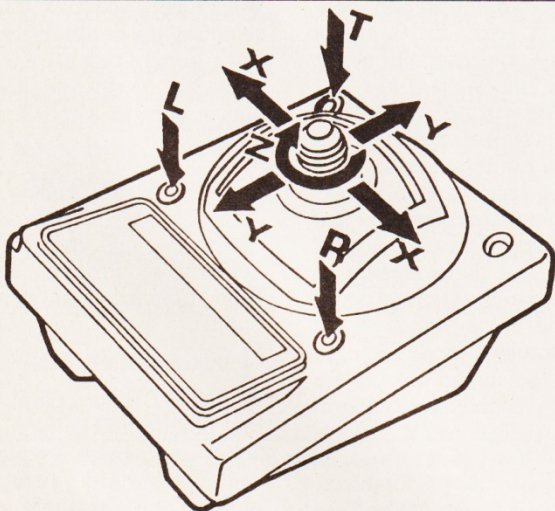
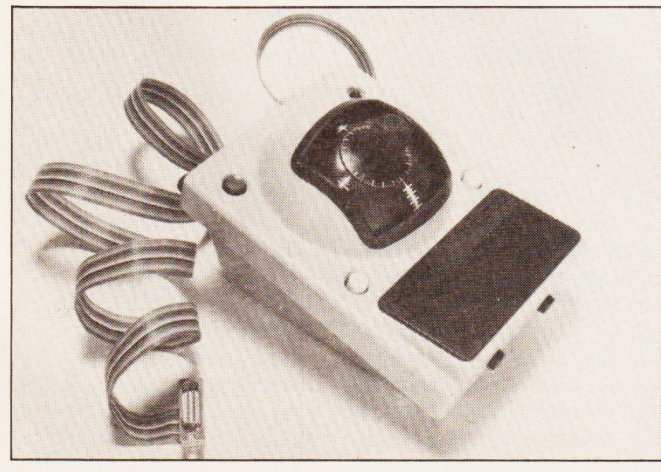


Fig. 1 A schematic diagram of the Acorn Bitstik, taken from their manual, and below, the beast itself



certain modes, a frame to select part of the picture. Pressing T completes a line or confirms the position of the frame. Pressing L selects an item from the operating mode menu. Pressing L and R together cancels a selection. It takes only a few minutes to learn these and a few other, equally consistent, rules. From then, learning to use the system is a matter of discovering its facilities and not how to use them.

BITSTIK FACILITIES

The menus which appear when the system boots up select all the Bitstik's main functions. These boil down to variations on drawing lines but that bald statement does not give much idea of the system's power.

The palette selects the type of line to be drawn. All lines can be solid or dotted (with three spacings of dots), and can be in any one of four colours. The default setting is solid white lines, but the standard palette also gives a choice of red, yellow or black lines; the last is useful for drawing on coloured backgrounds. If you don't like this choice, you can, at start up,

select any combination of the Beeb's 16 steady and flashing colours, with the proviso that the background and default colours must be steady.

There are also four types of 'line shape' available with, as well as the usual straight lines, three types of curve. Tangent Arcs start in the direction the last line ended in and curve round to the right or left to any point you may choose. These are just the thing for any sort of drawing in which straight lines must blend smoothly into curves.

Compass Arcs define the centre point and radius of an arc and then draw that curve between any two points. This is perfect for concentric circles, broken circles and anything else you would normally construct with a compass. They are a little fiddly to use but are invaluable.

Finally, you can draw complete circles of any on-screen radius and centre. The size is defined by the 'Z' control on the joystick and can be changed instantly. Like all the Bitstik facilities, the circle drawing is uncannily fast and circles of any size seem to appear immediately.

If you do not want any of these standard line types, the Bitstik also provides 'nibs'. You can use these to draw or fill shapes directly, defining only the starting and finishing edges and their orientations. The name is well chosen, since the effect is that of drawing with a variable-width nib in a pen. As well as filling solid blocks, the nib can also draw spaced lines, in which case you can get something close to a nail and string drawing (Figure 4). Naturally, you can select the colour and make the lines dotted.

Drawing lines of all types is only the start to using the Bitstik, however. The right-hand menu provides the tools to really exploit the system. From the top, what do they do?

- **DRAW** simply selects the default mode, in which you can draw lines of all the types described above. It is the normal way of adding information to a picture.

- **PAINT** gives a rapid colour fill of closed shapes. Select it, and a colour palette appears at the bottom of the screen, containing a total of 16 colour choices — the four main colours and 12 shades/textures obtained by mixing the colours together. Select a colour, put the cursor in the middle of the shape you wish to colour, press T and there is an almost instantaneous colour fill. One word of warning — if there is even a small gap in the shape's boundary, the colour will leak out with totally unpredictable effects! The mixed colours are clear on a monitor but can "crawl" badly on a TV.

- **TRACE** allows freehand, as opposed to straight or fixed curve drawing. It uses up a lot of memory and is fiddly but is occasionally very useful.

- **TEXT** allows you to enter text (eg labels and captions) anywhere, any size and at any angle on the screen.

- **FILE** and **COPY** are two of the system's most powerful commands. A professional tool like this must support a library of drawings and **FILE** is used to add the current picture to the library. **COPY** lets you take any picture from the library and add it to the current drawing. As with text, library pictures can be 'planted' anywhere, at any size

and orientation, and can be mirror-imaged about both X- and Y-axes.

The library is the key to the Bitstik's power and lets you build up pictures of any complexity from simple elements held on file. For example, in the house drawing (Figure 1) the windows and door were added from filed drawings. To take it further, the filed image of the door was constructed by repeatedly **COPY**ing a single filed rectangle, plus a few circles for the knocker and handle.

The only limitation is that all the filed drawings in use at any time must be available on the double-sided library disk in Drive 0. This is no real problem however, since the disk can hold up to 96 drawings, but you might need to construct the library disks carefully. For instance, an electronics engineer might use one holding transistors, resistors, gates and so on, while a kitchen designer would save his kitchen units, sinks, tables and the like.

- **ERASE** will rub out any selected line or library module in the current picture. It will not erase part of a planted file picture — only the whole image.

- **FIND** lets you put the origin cursor at any corner in the drawing — just the job for accurately drawing several lines radiating from a single point

- **MOVE** shifts a planted library unit from its original position to a new one. In a similar vein, **DUPL** will let you repeat a planted unit elsewhere on the screen without going through the sometimes tedious **COPY** procedure. **EXCH** lets you swap a planted unit for one on the disk.

- **ZOOM** is another of the Bitstik's most powerful commands. The display uses Mode 1, and is therefore limited to resolving a maximum of 320 points horizontally and 256 vertically. The system, however, works with effectively unlimited resolution and **ZOOM** lets you enlarge a part of the picture to add fine detail to it. When the picture is redrawn at the original scale, the detail is still

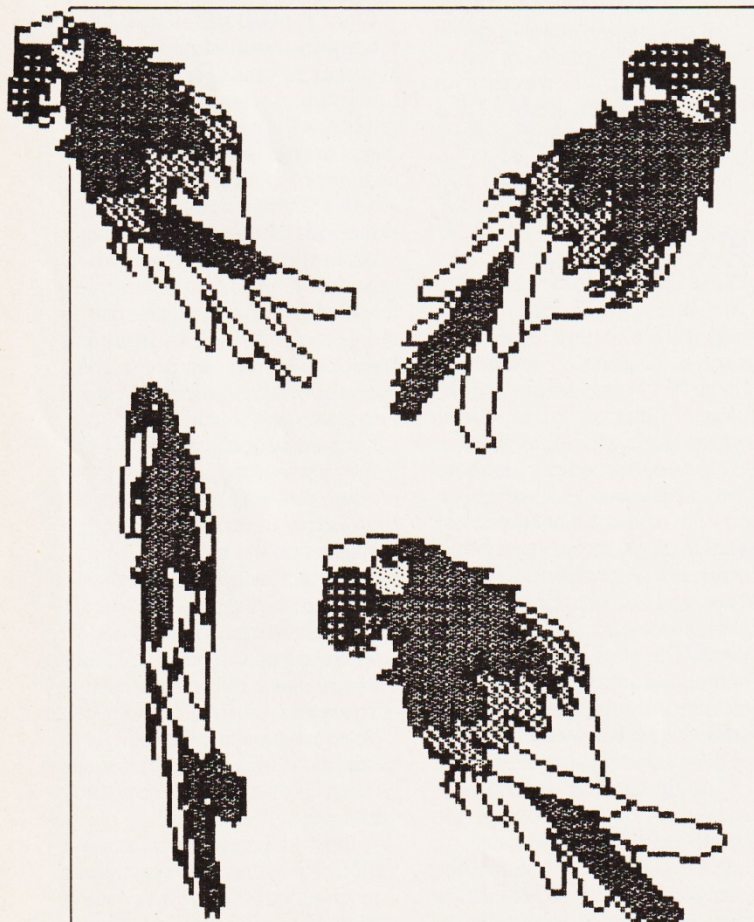
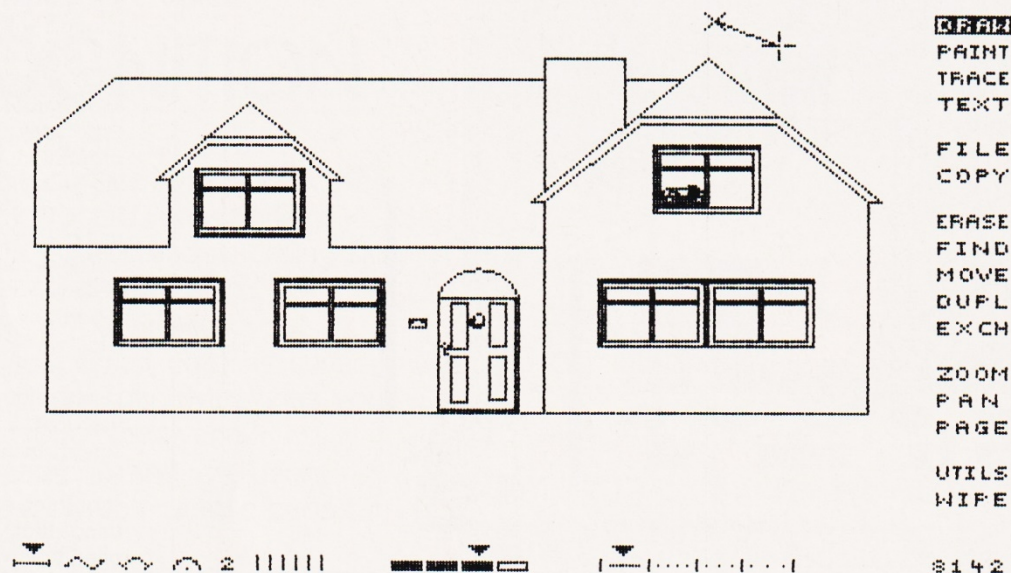


Fig. 2 This is not a dead parrot: it is a squashed and twisted one, courtesy of the Bitstik.

Fig. 3 A typical display with menu.



there, although you may not be able to see it ZOOM in once more, and there it is again.

There is no real limit to the number of times you can ZOOM in on a particular point, adding and/or seeing finer and finer detail at every stage. The cliché is a picture of the world, enlarging it to Britain, London, a road, a house, a window, an ant on the windowsill... Figure 5 to 7 show a simple sequence.

- PAN lets you move the ZOOMed view sideways, within the bounds of the original drawing. Very useful if you are adding detail to several adjacent areas.

- PAGE redraws a picture at

the original scale, cancelling any ZOOM or PAN selections.

- UTILS selects a special sub-menu which gives control of the library and temporary storage areas. You can also use it to save a screen image as a straight screen-to-memory dump — vital images are to be incorporated in other programs — and to make a hard copy of a picture on a printer. Unfortunately, the system only supports the Acorn inkjet printer. While this is, perhaps, inevitable, it would be nice to be able to make a hard copy on the far more common Epson printers, at least.

- Finally, WIPE acts as a

system reset, clearing the screen, making the default selections and generally putting everything back to the start position.

PRECISION DRAWING

All the facilities I have described so far, powerful though they are, are really only 'freehand' drawing tools. Everything is aligned by eye and there is no equivalent of a draughtsman's squares and protractors. The Bitstik does not miss out on this feature, however, and selecting the MENU caption from the main menu calls up a second menu of precision drafting aids.

By using these tools, which are just as simple as those I have described so far, drawings can be produced to any level of accuracy and repeatability. Further, by zooming it is possible to be far more precise than conventional drawing methods. The precision tools fall into two main groups: Angle Locks and Grids.

Angle Locks limit the cursor's movement — instead of being able to move in any direction, it can be forced to move in only two directions from the original cursor. One direction is at a defined angle to the horizontal, and the second is at a defined angle to the vertical.

Three sets of locks are available. Vernier locks are a bit fiddly to set up but allow repeatable drawing at angles defined to one minute of arc. Coarse

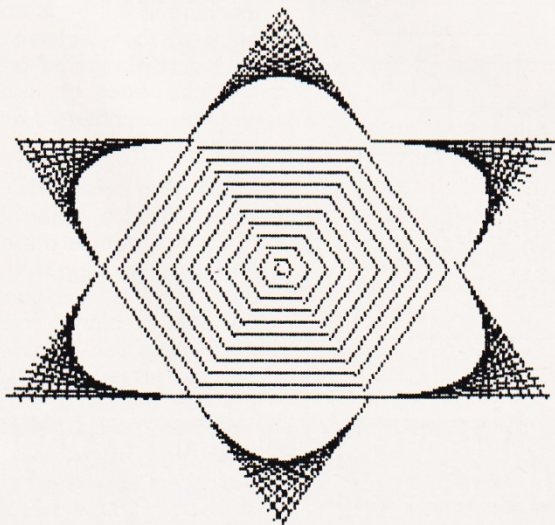
locks are simpler, but are only accurate to one degree. Finally, the orthogonal lock needs no setting up but only allows vertical and horizontal lines to be drawn.

Using the locks, lines can be drawn precisely at any angle on the screen. Further, since three types are available and can be preset to different angles, it is easy to draw along three different sets of axes. Selecting each lock uses the now familiar method of putting the cursor over the menu label and pressing L. The cursor can be freed from lock at any time by pressing R and moving the Joystick; as soon as the button is released, the lock is re-applied. When a lock is in operation, all the normal drawing functions are still available. Frame positioning for ZOOM and COPY operations is also locked.

The locks only allow accurate angles to be set up — they do not help position the cursor accurately. The GRID function, however, does. It throws upon the screen a grid of points at defined spacings and forces the cursor to be at a grid point. By combining GRID and ZOOM, the cursor can be positioned with any level of accuracy and with complete repeatability.

Three types of grid are provided: an adjustable one, and fixed ones with points spaced at 8 by 8 and 8 by 6 screen units. The adjustable one can be aligned with any selected

Fig. 4 This 'nail-and-string' drawing uses a special 'nib'.



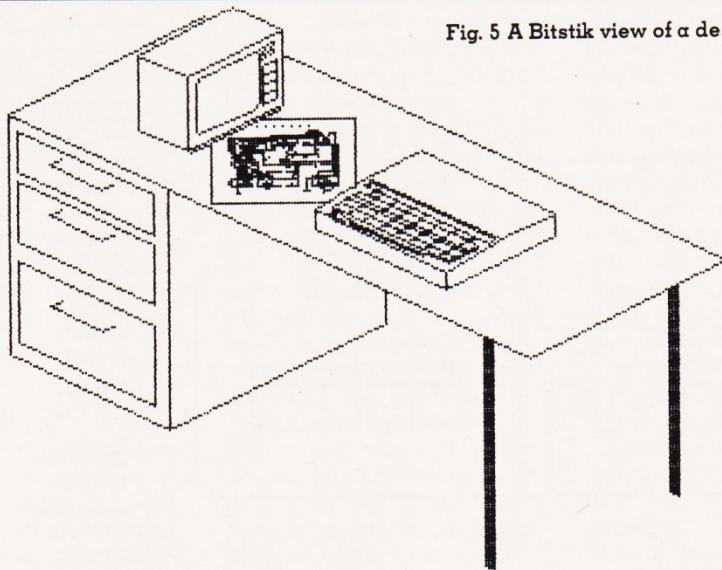


Fig. 5 A Bitstik view of a desk top...

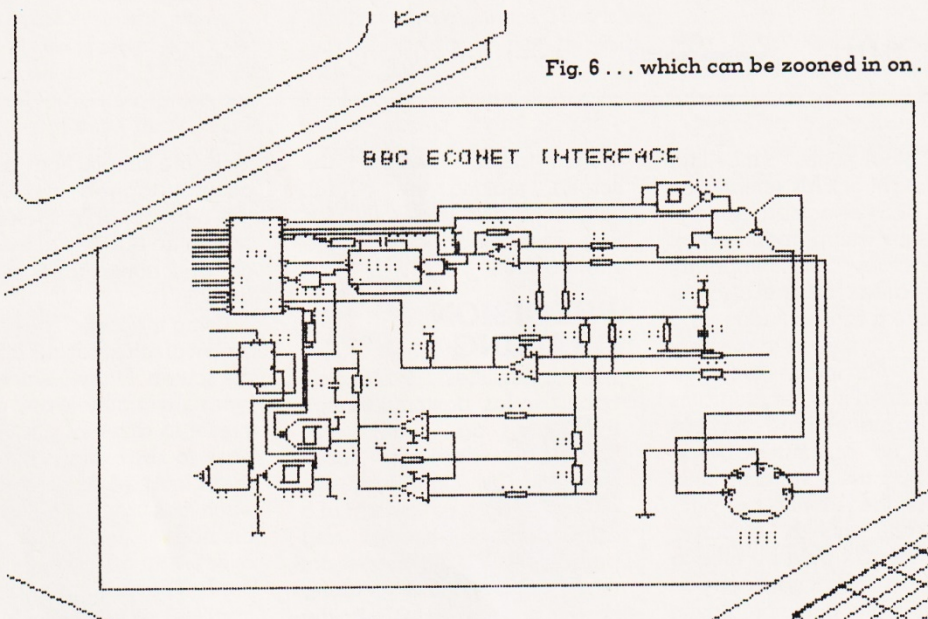


Fig. 6 ... which can be zoomed in on...

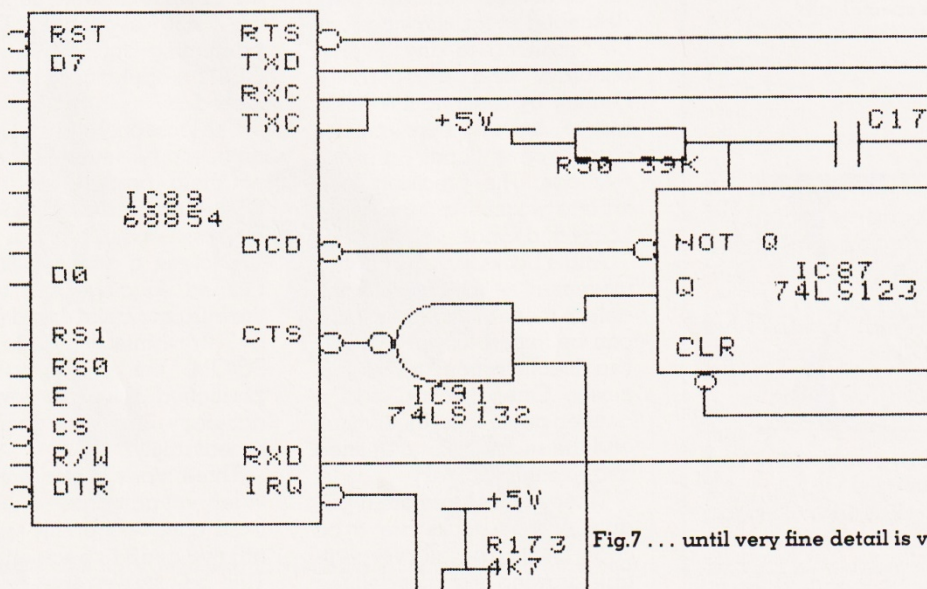


Fig. 7 ... until very fine detail is visible.

angle lock and is, for instance, essential for precision isometric drawing. The fixed grids are always orthogonal and aligned with the X and Y axes but make it simple to prepare and recover library units at fixed scales. The 8 by 6 grid is especially useful since it has the proportions of the screen, making it easy to link together multiple copies of the same library unit at different sizes.

The second menu also has an 'N-TAN' function which is roughly opposite to the Tangent Arcs we saw earlier. It effectively sets up an angle lock precisely aligned with the end of the last line drawn on the screen. In this way, curved lines can be faired precisely into straighter ones. One of those things that you don't need very often but, when you do...

LIMITATIONS

I hope that it is clear from my comments that I was very impressed by the Bitstik, which is a most versatile and powerful drawing tool. I felt, however, that it was limited by its lack of I/O flexibility.

The only way of putting data into the system is via the joystick, and the only usable outputs are a screen dump, which can be incorporated in another program, and a titchy hard copy produced by a matrix printer. A system of this quality deserves very much more.

I understand that Acorn are planning to extend the system to drive an, as yet unspecified, plotter. That will give a good way of producing high-quality output and, as long as the company specifies a suitable machine, it will be in colour. I hope that the selected plotter is an industry standard one and that the error of using an obscure printer is not repeated.

It is often necessary to copy drawings from paper into a graphics system. At present, the only way of doing it with the Bitstik is clumsy and inaccurate but the problems could be much simplified by adding a graphics tablet to the system. In this way, reading in a drawing would become the simple task of tracing it on the tablet. Unfortunately, if Acorn plan such an extension, they would not admit it to me.

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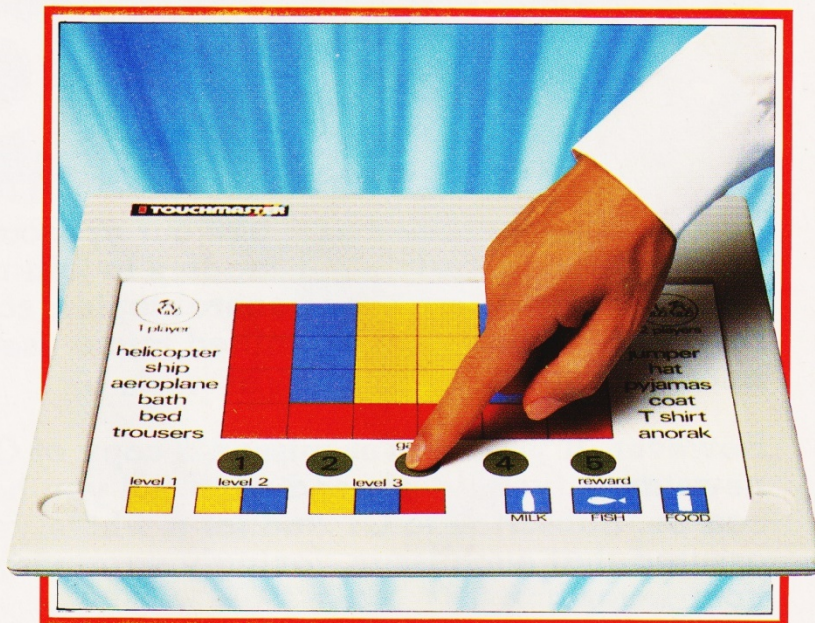
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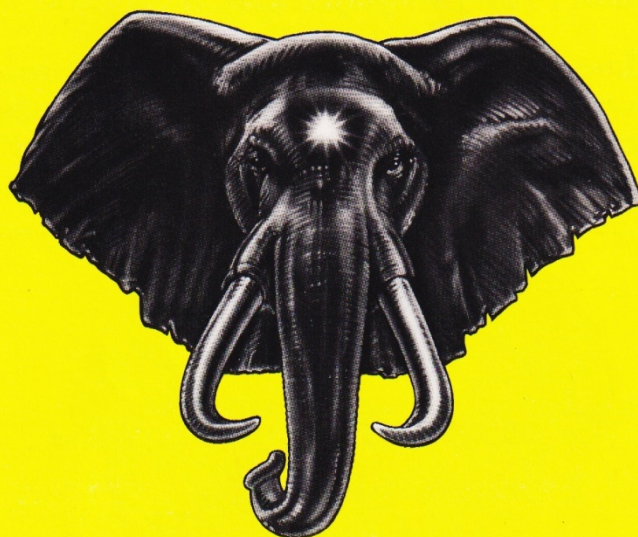
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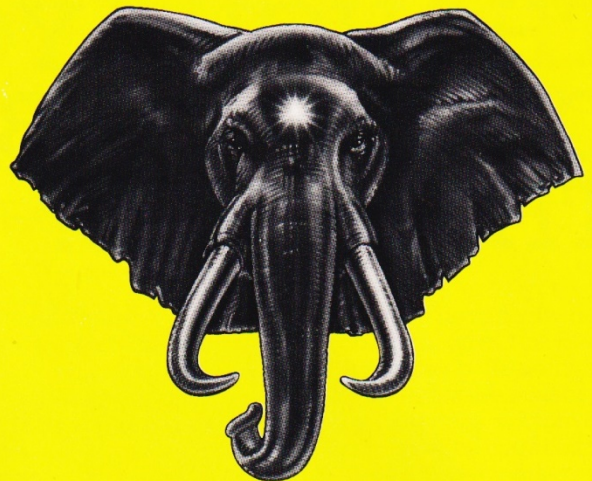
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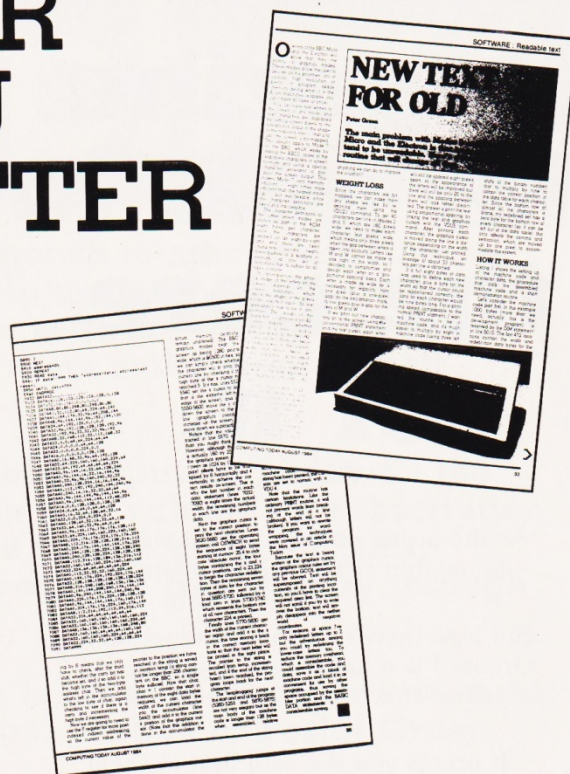
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Have you ever sat down to unwrap a Christmas or birthday present that you were certain was exactly what you had been asking for all year? Like all dreams, the reality of having the item in your hands often never seems to live up to the expectations you had of it. When offered the opportunity to review the 'Ultimate Professional Computer' (their words, not mine) I, just like anybody else, grasped at the chance with both hands. The GRiD system allocated to CT for review then failed to appear in time to meet the various deadlines, so a frustrating week was spent trying to get the best out of Uncle Clive's QL.

For those who can recollect my comments at the beginning of that review concerning the lack of time certain companies allocate the reviewer to complete the task, it should come as little surprise to hear that GRiD played the same kind of game as Sinclair Research. Unpacking the substantial carton revealed that not everything expected was actually included! Added to this was a review deadline of one week, although in fairness this did get somewhat stretched because they counted the week from when the missing bits arrived.

The very concept of a portable computer is what the GRiD range strives to

GRID LINES

by Henry Budgett

The sleek GRiD compass is a portable that does away with a dingy LCD and has enough interfaces to rival a desktop micro. Are good looks everything? We put the machine through its paces.

achieve. Judging the beast, therefore, becomes a matter of defining what a portable computer should be able to achieve, and then seeing just how the review machine measures up. After all, it's got to be something pretty special if it's been given a ride in the Shuttle and costs a whisker less than £6,000 (that's six thousand and not a misprint) without a disk drive... The machine supplied for the review was the Compass 1101 and they threw in the 2102 portable floppy disk unit for good measure. But throughout the review I'll just call it the GRiD as the comments made should apply right across the basic Compass range.

The Theoretical Machine

Establishing the criteria for a portable computer system

isn't difficult really, just a matter of defining the areas of use and applying a little logic. Assuming that there are three potential areas in which the portable computer can be used; the office, the home and on the move, the requirements almost speak for themselves.

At the office, the system must be capable of transferring information onto the main or host computer — ideally even the disks (where available) should be compatible — and using the standard printers and so on. On the move, the system needs to be lightweight, contain its own display system, have some easily portable form of mass storage system and, ideally, be able to communicate through a modem to any host system. The icing on the cake, so to speak, is that when you take the thing home you can run it off the mains and

use a normal TV for display purposes.

Software is the key to whether the machine actually gets used or merely decorates the executive suite as a toy. Programmability, in the sense of having a resident language is not an essential, although it should be possible to download any of the common languages from a host system or disk. What is essential is that the operating system be clear and easy to use without continuously getting in the way of the user's attempts to transfer information into, or out of, the various packages.

Essentials in the portable environment are limited; wordprocessing and spreadsheeting have obvious applications as does a simple form of data base. Communications software, where the machine allows modems and the like to be connected, is obviously pretty essential whereas graphics packages are of slightly less obvious appeal. Anything over and above these basics probably counts as dead weight in that the memory it uses would be better allocated to data storage.

What would be useful in the extreme is if the various packages on offer could all make use of the same data; add a spreadsheet's results to a written report, write mailshot letters from a data base and so on.

THE HARDWARE

No-one could accuse GRiD of not making their computer robust — anything going into space or a potential combat zone (the GRiD 'served' in Grenada apparently) has to be pretty well built. Packed into a magnesium alloy case of 380mm by 290mm by



50mm and weighing 4.5kg, is the electronic equivalent of a 256K 16-bit computer with screen and disk drive. The main processor is the by-now ubiquitous Intel 8086 and GRiD have included the normally optional 8087 maths co-processor as standard. 16k of ROM holds the bootstrap and BIOS while the 256k of RAM looks after the data and currently loaded application software.

Mass storage is provided internally by two bubble memory units, also made by Intel, which hold 384K between them and, functionally at least, look just like a disk drive to the system. Bubble memory isn't fast for the simple reason that it's a serial system. Detailed articles on bubble memory have appeared in past issues of CT, and to all intents and purposes, it operates at about the same speed as a standard 5¼" disk drive.

The keyboard and screen combination are concealed at first — all is revealed when the front half of the case is hinged up and back, offering the first of many surprises about the GRiD. The keyboard is a bare-bones 57-key unit. No numeric keypad and nice function key layout here, just four cursor keys and a pair of Code keys. The absence of Caps Lock Key is compensated for by pressing CODE-Escape but there's no indication that you are locked into this mode other than the capital letters on the screen. In actual fact, the numeric keys when used with the Code key (a sort of extra Control key) act as function keys but this option doesn't appear to be used much by the GRiD Management Tools software as they concentrate on



The electroluminescent display gives a sharp, bright image

CODE-letter combinations.

Just above the keyboard area is a flat 'trough' into which slips of card are inserted as instant reference guides. It's a neat idea but I'd have preferred a touch panel à la Osborne Encore. Each of the keys has a 'click' built in for tactile and audio feedback but the very small pitch, even with the rear stand down, means that typing is not as smooth as on some other machines. Overall the keyboard is not up to the machine's price tag and, as the prime man-machine interface, needs a total upgrade.

The display, on the other hand, is far from ordinary. GRiD describe it as a 6" 80 by 25 electroluminescent display but the machine actually boots up with 53 characters a

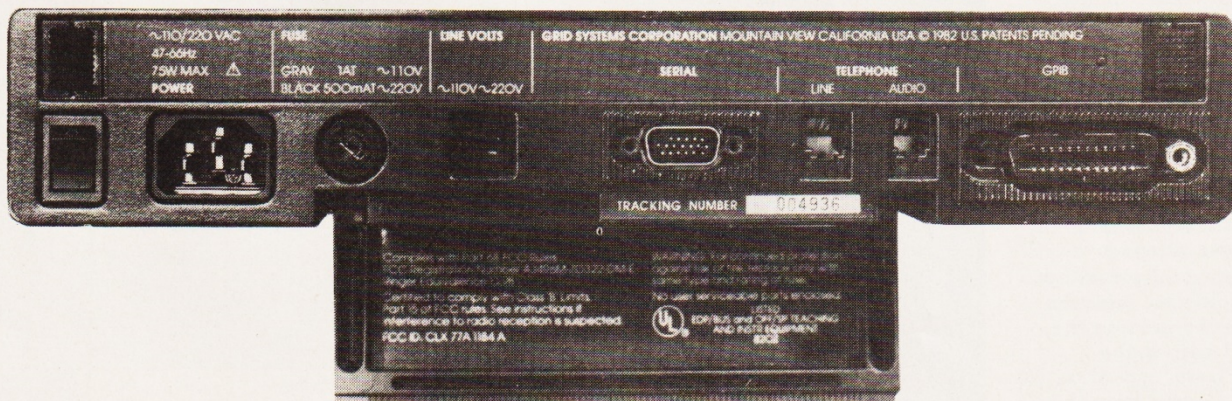
line and severe eyestrain results if you try the 64 or 80-character alternate fonts. Resolution is 320 by 240 and the whole area is bit-mapped, giving both high resolution graphics and clear text. One snag is that the thing buzzes most annoyingly although the reason for this is a mystery.

Colour is a uniform amber, quite pleasing to the eye, and because it generates its own light, it can operate in environments where an LCD is almost impossible to read. The disadvantage is that it costs an arm and a leg and guzzles electricity making the optional battery pack (a mere £350) last only an hour. The arguments against LCDs have tended to be based on the fact that they require ambient lighting to reflect

from the backplane and reveal the characters on the display. However, as a good friend of mine recently pointed out, if it's too dark to read the LCD it's probably too dark to see the keyboard anyway so what's the problem!

The lid could quite easily take one of the new 80 by 25 LCD displays: maybe GRiD will oblige... A small postscript here is that the makers of the new generation LCD displays seem to have run into some sort of trouble. Apple have had to postpone their optional LCD panel for the IIc until 1985 while Hewlett Packard's 16-line one also seems to be proving less reliable than expected. By the time this review reaches the streets things may have improved.

The GRiD's only other



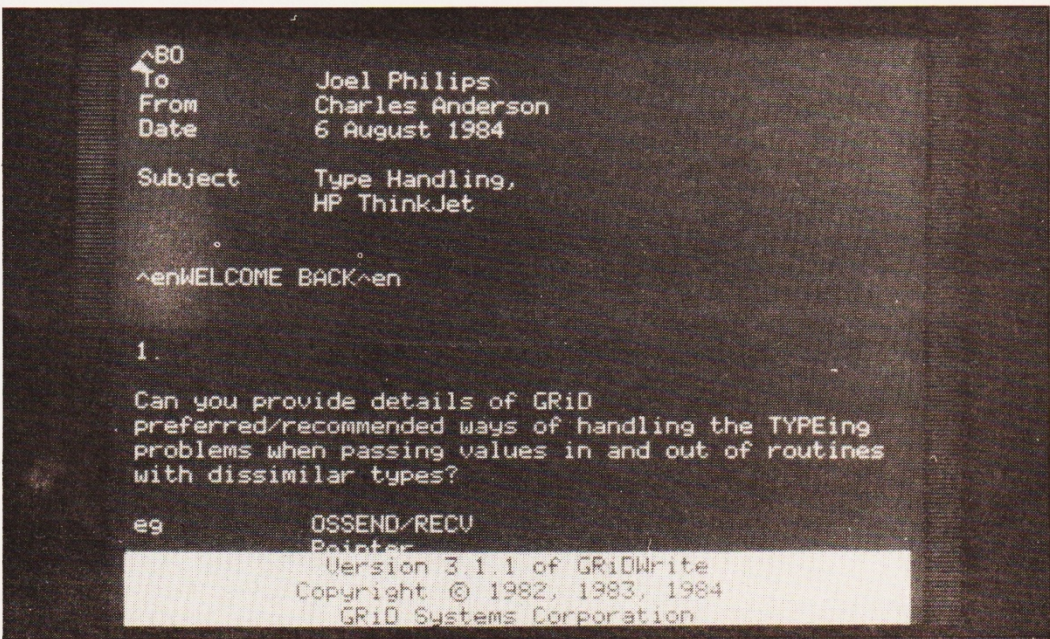
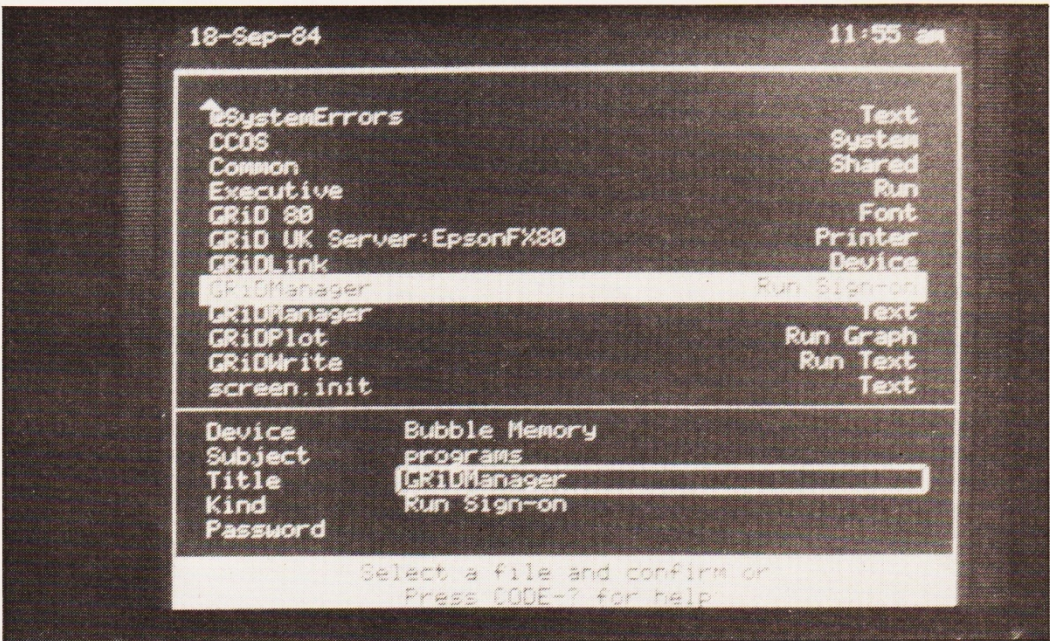
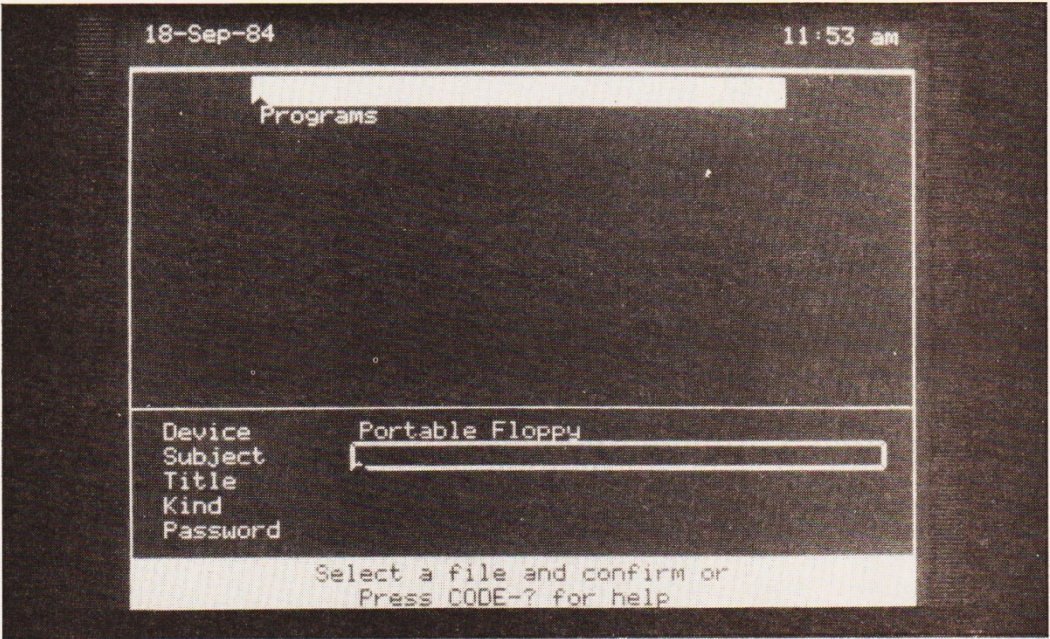
The rear panel of the compass is filled to overflowing with sockets.

obvious internal feature is the modem but being a Bell standard device and unapproved for use in the UK it wasn't much help. The rest of the I/O is, technically at least, pretty straightforward. The back panel from left to right contains the mains switch, IEC power socket, fuse and voltage selector. Then we have an interesting variation on the 'standard' D-type connector through which the RS232 and RS422 serial interfaces connect. The connector has three rows of pins which are shrouded — does anyone know where you can get one? Then come two of those nice new BT jack sockets for the modem; one for the line in and the other for the phone itself. The trouble here is that these sockets are now supposed to be unsafe on equipment containing hazardous voltages so BT is having to re-write the rules...

The final socket on the back panel was the biggest surprise of the lot — an IEEE-488 General Purpose Interface Bus capable of supporting up to 15 peripherals. As a means of transferring information between devices, this standard has a lot going for it but, apart from the Commodore PET and its replacements, only Hewlett Packard make much use of it. The idea is that everything connected to the bus has a unique address and you simply daisy-chain the cable from computer to disk drive to printer to atomic clock and so on. It certainly works and, because of its truly standard nature, means that you could connect up the GRiD to other systems very quickly indeed. On the review machine this socket was missing one of its retaining screws, indicating that the machine had been in heavy service somewhere.

The box is tilted forward by a snap-down metal flap under the rear of the case. While this does tend to improve typing on the very flat keyboard, its main function in life is to let air circulate around the

The Manager provides a simple method of accessing the GRiD software. selection is performed by moving the highlighted bar; at the bottom we have part of a "forgotten" memo from the review machine!!



machine. It certainly gets pretty warm in there even with all that black metal acting as a heatsink.

AND SOFTWARE

Although GRiD claim that the machine's disks are pretty much IBM-PC compatible this isn't strictly true. The disk system can certainly read data files but to use the software you've got to be running MS-DOS which costs another £135. To boot the machine from the floppy rather than the bubble memory, you have to keep the 'F' key pressed when the machine is turned on. MS-DOS wasn't supplied as part of the review setup so no detailed comments are available but if you wanted to make much use of the machine you would have to re-format the internal bubble memory to look like MS-DOS disks (it acts as drive E) rather than its normal GRiD-OS format.

The proprietary GRiD operating system has a mad-denyingly user-friendly front end that insists you fill in a little form on the screen before it will fire up any software. I have to confess that it took me over an hour to get anything running but this apparent ineptitude is partially explained by the fact that one of the essential manuals was omitted! Later exploration of the main software manual revealed some 14 pages hidden at the back which are probably the most essential as they give the full Manager operating instructions.

Once fired up and running, the system is really quite intelligent, as it ought to be for the best part of £800! The Management Tools package includes, apart from the Manager, a full set of wordprocessor, data base, spreadsheet and graphics packages. It all looks pretty useful — a common command set helps here — but the restricted time meant that it didn't get used much. All the data is portable between the various packages which means that you can graph spreadsheet data and so on. A much more sensible approach to integration than the all-in-one type of system.

One thing that became obvious fairly quickly is that the GRiD isn't a fast machine. Despite all the emphasis on

the provision of maths co-processor it is only moderately quick for a state of the art 16-bit machine. No BASIC was supplied, and rumour has it that GRiD's own version is extremely tardy so I couldn't do the normal set of benchmarks. However, I doubt if it will win any medals. Part of the problem here is that the bubble memory isn't as fast as one expects; thinking of it as RAM isn't strictly correct as it operates at about the same speed as a floppy.

An instant demonstration of just how slow it is can be had by turning the machine on. For 20 seconds nothing at all happens and then a single graphics character starts flashing in the bottom right-hand corner of the screen. This observation is, perhaps, slightly unfair. Another 20 seconds pass before the Manager's front page appears.

For reasons known only to the previous owner the rather pretty 3-D GRiD logo had been removed from the operating system so you should have something to look at while the system boots. Loading from disk displayed the logo but wasn't any quicker. A real time clock and calendar display occupy the top line while the rest of the screen contains the disk directory and the file form that has to be filled in.

The file form is probably the simplest thing about the GRiD-OS yet by far the easiest to describe. If you have ever used a system which operated a tree structure for its directories — ProDOS, Unix or MS-DOS 2.0 for example — you might recognise the basis of the file form. Each line of the form can be filled in by typing the relevant details from the keyboard but that's doing things the hard way. In the top section of the display is a list of the available options for each of the lines of the form as they are selected.

The **Device** line could have the options 'Bubble' and 'portable Floppy' while the **Subject** line, when selected, would cause the root directory names to be listed. Selecting one of these would then cause the list of files stored under that directory to be listed. Each file, once selected

through the **Title** line, can be of many types and the options for these are displayed by selecting the **Kind** line of the file form. The default option is always inserted automatically in this line which makes it seem somewhat redundant. The final line to be filled in is the **Password** line which, for most needs at least, can be left blank.

Although the structure can be compared to the various previously mentioned operating systems, GRiD have put a great deal of effort into making it as idiot-proof as poss-



ible. A help screen can be instantly summoned at any time by CODE-? (something that works for all the Management Tools as well) so the user is guided pretty well but when things go wrong is's often better to go back to the top of the file form and start again rather than try to sort it out piecemeal.

The system can be remarkably intelligent; load a text file and it fetches the wordprocessor as well. It can also be extremely dumb. Imagine a situation where the text file is in the bubble memory but the wordprocessor is on the disk. If you have booted from the disk everything is fine but if you started from the bubble, it returns with an extremely terse error message because it couldn't be bothered to go and look on the disk! This error message consists of an error number and a short description like '33: File not found' and remains on the bottom line when the file form is re-displayed. I suspect an undiscovered bug.

Formatting a blank disk is an entertaining exercise; it takes six minutes! In fact most of the basic systems operations such as file transfer and data copying are extremely slow indeed

although good on-screen reports are provided. Unlike the Apricot where one can shortcircuit the front end software, it appears that on the GRiD one simply has to put up with it. For the inexperienced user (that's of operating systems rather than computers in general) it does offer a relatively foolproof way to get software up and running although the provision of an optional password facility is not altogether sensible. In fact, even GRiD warn against using it for anything other than essential docu-

ments and files. Once that password has been forgotten, you can't do anything with the file, not even delete it!

SYSTEMATIC

Although the GRiD is a full-blown portable in its own right, it is also part of a system which allows up to 44 Portables and their peripherals to be connected to some 320M of hard disk storage and 15 shared printers or plotters. Furthermore, as the basic system does not include installed software and the portable floppy disk unit is hardly something you would want to carry with you, GRiD have a dial-up software library and filestore system called GRiD-Central. For about £100 a year you can stash up to 500K of data on their mainframe, all communications being handled by the integral modem. Down-line loading of applications software is also a reality so forgetting that vital spreadsheet program is no longer a problem, just dial it up. The previous user of my particular GRiD had been communicating directly with the Mountain View, California headquarters of the company. This apparently trivial piece of information was revealed by the fact that he had left the

last set of messages in the systems bubble memory! The notes included comments on certain problems with the inverse video function and the need for an idiot's guide on how to back up disks with the single drive. Nice reading, Charles!

ALTERNATIVES

GRiD's file compatibility with the IBM PC means that you could achieve a great deal of concordance between an office-based system and the portable machine. GRiD offer their Management Tools package in an IBM format but even using software under MS-DOS would allow a considerable amount of 'take-away' to be achieved. While the data formats may well be the same, most of the industry standard MS-DOS software will still have to be configured for the GRiD: don't expect to plug in your PC programs and have them work straight away.

For the money, the machine seems to be a sledgehammer approach to getting some degree of compatibility with the most common denominator in office systems. Some of the alternative machines that spring readily to the mind would be the family of IBM portable clones; Compaq, Hyperion, IBM's own baby, Osborne's Encore and so on. Although these don't exactly match the GRiD in terms of compactness and portability, they probably

offer a far more obvious solution to the requirement.

MANUAL WORK

Unpacking the machine from its enormous (relatively speaking) carton revealed that someone, somewhere, had held onto the single most important piece of documentation — that which reveals how to get the GRiD system up and running. The GRiD Management Tools had their nice ring-binder manual all intact and the slim blue introductory documents were going to be of obvious help, the inclusion of 'Getting started with GRiD software on the IBM-PC' made me somewhat less than convinced that the Gods were on my side.

Rapid use of British Telecom's normal voice service eventually secured, direct from the UK GRiD office, a new manual. Mind you, by the time this arrived I'd cracked the problem anyway but it was still pretty frustrating to sit there and watch a screen that consisted of nothing but obscure error messages!

The documents are, in general, really pretty good. You could certainly get up and running with little, if any, outside help and should you get stuck, GRiD operate an on-line help service. This does, of course, assume that you've worked out how to get the modem connected up and logged on.

For the more experienced, the back section of the

FACTSHEET

CPU
RAM
ROM
Mass storage

GRiD Compass 1101
£4750

Intel 8086 and 8087
256K (expandable)

16K

384K Bubble memory (acts like a single disk drive)

Weight
Dimensions
Display

4.5kg

38 by 29 by 5 cm

Electroluminescent flat panel
Text 24 by 80

Graphic display 320 by 240
RS232C and RS422 interface
GPIB (IEEE-48)

I/O

OS

GRiD O/S

Modem

MS-DOS version 2.0

1200 bps (Bell 103)

Non-BT approved

Options

Single 5¼" 360K floppy disk

10Mb + 360K floppy disk

File server

Compatible with any IEEE

printer/plotter (eg Hewlett-Packard)

BT approved modem promised.

Management Tools manual is essential reading as it unveils all the secrets (well, most of them) about the way GRiD-OS works. Quite why all this was at the back is unclear; maybe they think it's too heavy for the average user, but without it you may only discover half the things you can achieve. It wasn't until I read through this lot that I discovered that the machine can be multi-tasked, something I didn't get a chance to test but which could be of use in some circumstances.

TO CONCLUDE

It has been said on many an occasion that the average American has a far higher disposable income than his British counterpart. Be that as it may, there is little evidence to suggest that he or she spends that extra money any less wisely. If you are into Lear jets, have a hankering to buy a thoroughbred racehorse at Newmarket or are just mad keen to own a black Porsche 911 Turbo then the GRiD Compass may very well be the machine for you. Like all the above it will give you great pleasure while costing an arm and a leg and yet in reality, provide no better service than a microlight, second-hand mare or a VW Beetle.

If you consider the requirements of the portable computer as an essential element of your buying decision

and are determined to shell out £6,000 on a machine, plus another £2,000 for a single disk drive, you could buy half a dozen Tandy Model 100's together with their disk drive/monitor units and still have change. On the other hand you might want to follow the IBM trail, in which case you could pick up a brace of Compaqs, IBM Portables or the new Apricot Portable and be even less out of pocket.

As a current technology toy the GRiD Compass 1101 is a remarkably heavyweight solution to the problem. Certainly the display was better than that of the comparable LCD when it was launched but we've now got true 24 by 80 LCDs. The idea of using bubble memory has been kicking around for the best part of five years but only a handful of computer manufacturers have taken it through to production; Texas Instruments, Rockwell, Sharp and GRiD and only the latter pair have production portables using it. The machine has, according to reliable reports from across the water, been selling reasonably but I have severe doubts that it can make any significant impact on the UK market. Technology helps but, as the Japanese are just about to demonstrate with MSX, it isn't everything...



Level 9 Adventures are superbly designed and programmed, the contents first rate.

YOUR 64 June 84

✓ Whichever machine you own, if you have the vaguest tendency towards adventure playing then you must try one of these games (unfortunately you'll probably end up wanting to buy the lot!).

Computing Today, August 84

✓ To me, all Level 9 adventures create a remarkable atmosphere because the descriptions sound so life-like. This is where so many other adventures fail.

Crash, July 84

✓ But it's not just the size of the game it's the quality as well that is astonishing ... scenes to fire the imagination.

PCG, April 84

✓ As in all Level 9's adventures, the real pleasure comes not from scoring points but in exploring the world in which the game is set and learning about its denizens.

Which Micro?, February 84

✓ I thoroughly recommend these Adventures, they are excellent value for money. No self-respecting Adventure-addict should be without them. I believe Level 9 are producing a series of Adventures which should be regarded as classics.

Atari User, July 84

✓ These programs run very fast and there are no frustrating pauses. Level 9 Adventures are superbly designed and programmed, the contents first rate. The implementation of Colossal Adventure is nothing short of brilliance; rush out and buy it. While you're at it, buy their others too. Simply smashing!

Your 64, June 84

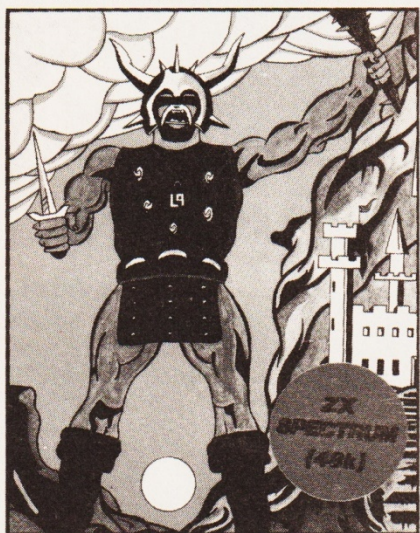
✓ Level 9 — arguably the producer of the best adventure games in the UK — has done it again. LORDS OF TIME is a sparkling addition to its stable of winners.

Acorn User, July 84

✓ (SNOWBALL). This is another imaginative, massive-scaled immensely enjoyable adventure from those experts down at Level 9 Computing.

Your Computer, March 84

Adventure Quest



Level 9 Computing

Adventure Quest is the second in Level 9's acclaimed Middle Earth trilogy, though it can be played by itself.

Available from W H Smith and good computer shops everywhere. If your local dealer doesn't stock Level 9 adventures yet, get him to contact us or: Centresoft, Microdealer UK, Ferranti & Craig, Leisuresoft, Lime Tree, LVL, PCS, R & R or Wonderbridge.

Level 9 specialise in huge adventure games, cramming over 200 locations and a host of puzzles into your micro. We take care when designing games—writing them like stories with detailed settings and sensible reasons for the puzzles. They are solved by inspiration—not luck.



1. COLOSSAL ADVENTURE

The classic mainframe game "Adventure", with all the original puzzles plus 70 extra rooms.

2. ADVENTURE QUEST

An epic puzzle journey through Middle Earth.

3. DUNGEON ADVENTURE

Over 100 puzzles to solve and 40 treasures to find.

4. SNOWBALL

Save the interstar freezer, Snowball 9, in a huge space adventure with over 700 locations.

5. LORDS OF TIME

An imaginative romp through World History.

I ENCLOSE A CHEQUE/PO FOR £9.90 EACH

My name:

My address

My micro is a:

(one of those listed below, with at least 32K of memory).

Contact:

LEVEL 9 COMPUTING

Dept. C, 229, Hughenden Road, High Wycombe, Bucks. HP13 5PG.

MEMOTECH BBC CBM 64 SPECTRUM ORIC 1 LYNX NASCOM ATARI

The computer industry in America is second in importance only to oil. At present, it generates annual revenues of \$110 billion compared to oil's \$500 billion, but it is estimated that by 1990, computers will be number one. **The Coming Computer Industry Shakeout** by Stephen McClellan examines and analyses the computer industry as it is at the moment, and predicts its likely future course. The author is an industry watcher and analyst, and his views on companies in the computer industry and their future prospects are trenchant, and expressed in no uncertain terms. The microcomputer section of the market, which might be the one of most interest to us, is relatively small in financial terms, but is rapidly increasing in importance.

A detailed account of the US computer industry shows that its future is almost certain to hold a considerable shakeout as the industry matures. This is of direct relevance to Britain, for what happens to the American industry happens to us. At least, it does in all sectors except microcomputers, or perhaps 'home computer' is more accurate, for this market is different in Britain. Indeed, it is already having a shakeout of its own.

The computer industry can be sub-divided in many ways: we can split it by mainframe, mini and micro; by companies, which means IBM and the rest; by application areas, and so on. Stephen McClellan examines the industry in all these ways, analyses the contributions to it of the various sectors, and then assesses the contribution and prospects of the companies making up each sector. This shows that the industry is evolving rapidly in almost all areas, having few stable and mature parts. Consequently, it is difficult to establish firms to react quickly to the latest developments. This gives an edge to small, dynamic companies. But as soon as the small companies have made their entry, they have immense problems in making the transition to becoming established members of the industry. A big problem for many is in com-

ing up with their second product. Others take the money from their first success and run.

When it comes to the future, the problem for the companies, and for anyone trying to predict what will happen, is that the industry will change from a hardware-dominated to a software-dominated one. The upshot is that all the companies that are to survive in the industry must, so to speak, run to hold their present ground, let alone to advance. The pressures are enormous, and the shakeout inevitable.

With the author's preface dated May 1984, the book is right up to date. It includes references, for example, to Tramiel's departure from Commodore, and the entry of AT&T to the micro market to confront IBM with their super-micro. To have published a hardback book in both the US and UK in such short order is quite an achievement. Incidentally, the US price is \$19.95 compared with £20.40 here, but we can scarcely complain about pricing at a pound for a dollar with the pound currently fading fast against the stronger currency.

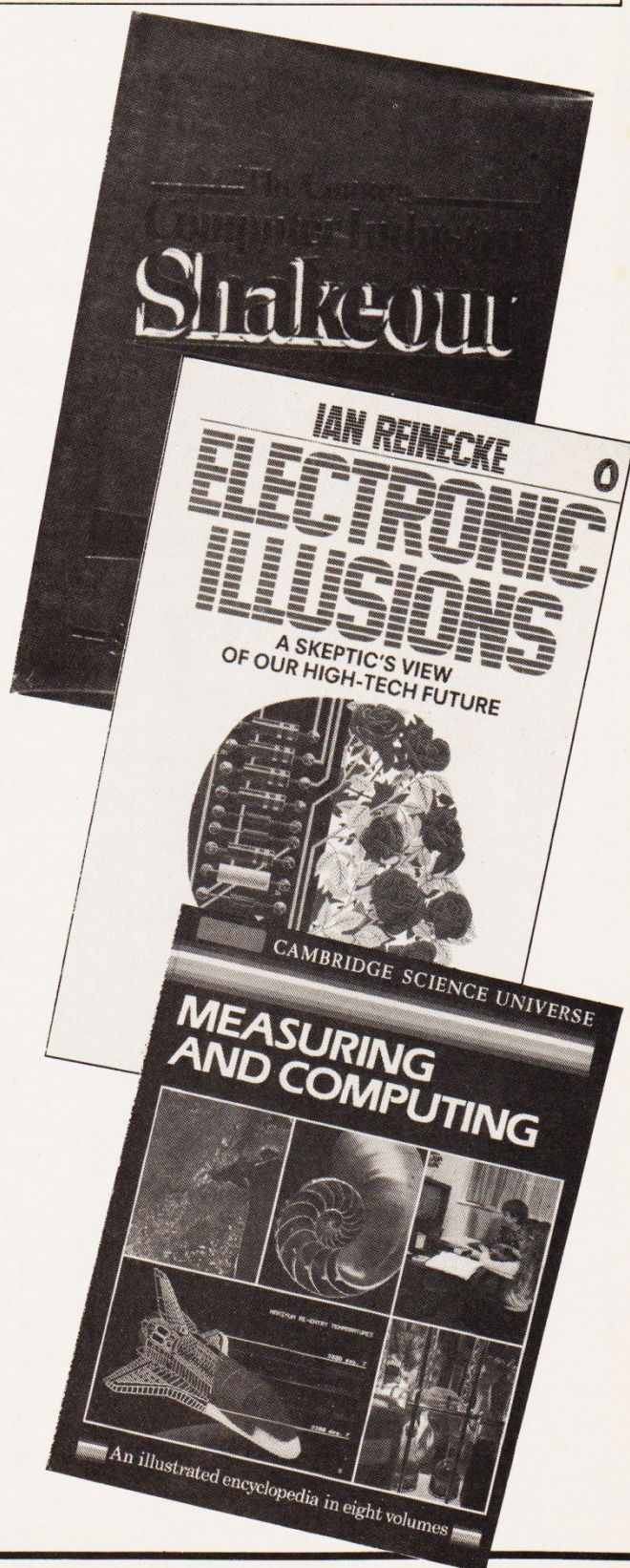
The book is written with verve and authority. The author obviously knows the industry and the technology inside out, but he wears his knowledge lightly with many throwaway remarks about, for example, UNIX and multi-tasking. It also contains many revealing facts and figures. In many ways, it takes the pattern of an American football television programme, with bouts of top-class entertainment interspersed with analysis and all the imaginable statistics. The more telling facts and figures reveal that:

- IBM has 70% of the main-

BOOK PAGE

Garry Marshall

For some interesting and provoking thoughts on the technological world of the future and an illustrated guide to the history of measuring and computing — read on Macduff.



frame market.

- IBM PC sales for 1981 to 1984 were 25,000, 190,000, 700,000 and 3 million respectively.
- Of the two million micros shipped in 1983, 75% were from IBM, Apple, Commodore and Tandy; 150 companies shared the rest.
- Only 5% of US homes have a personal computer.

The computer industry is no longer a one-product industry. Companies produce specialised computers, whether as automated teller machines, systems for CAD/CAM, microcomputers, PBXs, or in any number of other guises. As the information age develops, more and more jobs will involve the handling of information, and workers will not only need specialised computers, but will come to appreciate more fully how to use them for their information-handling tasks. This gives the computer industry its opportunities, but the rapid rate of progress also gives it headaches.

Most companies at present are 'information poor' in the sense that they do not make use of the products of information technology to cope with their information handling. Most offices still contain filing cabinets full of paper from which the retrieval of a particular document can take a long time. Tracking work in progress can be a nightmare

if you must chase a document down the chain of people who are involved in its processing. Digging out statistics is a real bind. 'Information float' in which information is either inaccurate or takes too long to find is a common experience. The deployment of computers can eliminate all these problems.

It is the microprocessor, of course, that has turned the industry on its head. By making it very simple to build a computer, it has brought into existence the 'value added' market sector, OEMs and all, to provide the customised speciality computer systems.

In one of many telling analogies with other industries, the author compares the mainframe computer companies who refused to embrace the microprocessor to the film companies who ignored the advent of the 'talkies'. Many of them enjoyed a similar fate, and the shakeout began. As long as the computer industry continues to develop explosively, it will attract newcomers, and the shakeout will continue until the industry achieves stability, but this is all part of what makes it so exciting.

In all the turbulence, though, it is necessary to remember that there is one rock that remains steady, and that is IBM. Because of its massive market share, IBM systems are de facto standards. It even managed to dominate the personal com-

puter market despite a belated entry with a fairly conservative machine. But this was largely because people buying the IBM PC wanted a proven machine with guaranteed support that could communicate with their installed mainframe (almost certainly IBM).

The section of the book on microcomputers concentrates, not surprisingly, on Apple. Although Apple's success was phenomenal, throughout its rise it was a one-product company. This fact and the difficulty in producing a successful follow up to the Apple II have been the cause of Apple's problems. Lisa, and perhaps even more, the Macintosh have eventually emerged as considerable products, but the very reasons just recounted for the success of the IBM PC spell out another snag for Apple — at present the Macintosh cannot communicate with IBM machines.

The main difference between the US and UK micro markets is in the percentage of homes owning a computer. In the US, micros are mainly bought by companies as work stations and terminals for use with existing installations, and so communications compatibility is a must. McClellan's views on the future prospects for Apple are quite clear.

This book is a really good read, although its £20 price tag may mean that it is better to ask your library to get it for you than to buy it yourself. It throws considerable light on the computer industry and contains many suggestions that could be taken as ideas for new companies and investment. Looked at it another way, it provides a new perspective on all the themes in computing that are covered by the sort of books that are usually reviewed in these columns. To give just one example of this, the Japanese fifth generation threat is examined and dismissed in fairly short order on the grounds of the lack of track record in originality and the comparatively small investment being made.

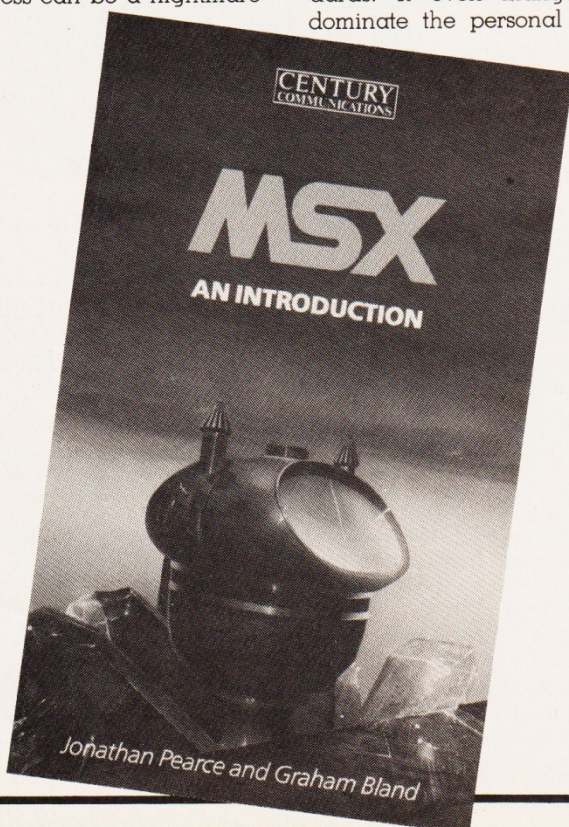
Electronic Illusions by Ian Reinecke is subtitled 'A Skeptic's View of our High-tech Future'. It, too, is concerned with the future impact

of computers, but this time the author is trying to sound a warning against their all-pervading influence. Reinecke places people above computers, and objects to the introduction of computers when they put people out of work, even if the work is unpleasant and dangerous. His objections are encapsulated in a number of questions, some of which follow:

- If computers are good for us why aren't we all benefitting from them?
- If computers are increasing the efficiency of business, why aren't employees all making more money?
- Why do computers constrict our lives rather than enhancing them?
- Why are computers used to constrain rather than increase personal freedom?

Some of the questions deserve an answer while the premises on which others are based are, to my mind at least, dubious. I feel that I do benefit from the introduction of computers in many areas, and I don't feel that my freedom is threatened. On the other hand, I would like to know why more of the wealth created by computers doesn't come to me but, as with all other technological innovations, I suspect that I know where the wealth that is created does go. The author does not admit that the computer is a tool, and that the ways in which it is used are determined by people. Rather, he tends to suspect conspiracies.

One way in which computers can be introduced in a controlled and acceptable fashion is by making sure that we all understand them and what they can do, and that we contribute to the process. This author reveals, and almost admits, that he does not really understand the technology. And despite his doubts about the introduction of computers in many areas, he has no real ideas to share with us about how to modify or prevent their introduction. His account of how and where they are being introduced and are replacing jobs merely induces the reaction that he admits to receiving at the end of a lecture on the same topic from a worker whose job was threatened.



This month's books are:

The Coming Computer Industry Shakeout by Stephen McClellan (John Wiley) 349 pages, £20.40

Electronic Illusions by Ian Reinecke (Penguin) 256 pages, £2.95

Measuring and Computing edited by D. Jollands (Cambridge University Press) 64 pages, £5.95

MSX — an Introduction by Jonathan Pearce and Graham Bland (Century Communications) 166 pages, £7.95

Despite his claims that he is not a Luddite, much of what Reinecke says smacks of Luddism and of the attempt to halt inevitable progress. As a plea from a 'techno-skeptic' the book is a profound failure and I found it irritating. But an irritant can also be a stimulant, and anyone doubting the wisdom of a computer-based future may find that the book strikes sympathetic chords.

For a more optimistic view of the future, there is an excellent example of how computers can be essential to technological progress in the first few paragraphs of **Measuring and Computing** from Cambridge University Press. In shipbuilding 200 years ago, the spars of a wooden boat could be sawn roughly to size and then made to fit exactly by skilled ship-rights who trimmed and shaped them. But the resulting boat might have inbuilt stresses and strains, and there was only one way to find out how it would react to extreme conditions — the hard way! A modern steel ship can now be designed by computer, tested before it is ever built with a program for stress analysis, and then built from plates and beams that have been made in advance to the exact measurements, so eliminating the element of chance.

Measuring and computing forms part of a science encyclopedia aimed at nine to 14 year olds, but it is written in such a way that it is quite suitable for adult consumption. Material is presented in a series of self-contained double page spreads that are well illustrated in colour with a mixture of photographs and drawings. Measurements can appear to be a mundane subject, the importance of which is difficult to appreciate, but this country has a national laboratory devoted to it and, at the most, only a little reflection is

necessary to show that the exact measurement of time, length and weight are very common requirements.

The origins of measurement methods, the need for them and the methods themselves are all clearly explained, with the role played by the computer integrated into the development in a clear and natural way. This is a well-produced and well written book that is sure to be attractive to its target audience and to many others as well.

MSX — an Introduction gives an insight to a topic that should become very familiar if you believe all that has been said about the new standard. After a rather brief account of the MSX concept, the book develops into the usual introduction to BASIC as presented in so many books, but using MSX-BASIC to provide an elementary account of programming, number handling, sound and graphics. The account is competent and the book has the merit of being among the very first on MSX.

However, the authors do rather overstate the MSX case. For example, on the first page of chapter one they extol the values of features such as 'frame grabbing' from a TV signal and the provision of a synthesizer keyboard. These are extra features added to the machines of particular manufacturers, and surely the strength of MSX is in its uniform standard. MSX computers can only exchange software successfully if they are all the same, and although the addition of extra features is probably a better means of selling a computer than sheer weight of advertising, it necessarily militates against standardisation. The way in which the Japanese manufacturers resolve this matter may be a factor in determining whether they make any impact on our micro market at last.



ORIC AND SINCLAIR COMPUTERS

Oric 1 computer 48K £95 (£92) £102.
Oric Atmos computer 48K £171 (£158) £168.
Oric colour printer £134 (£123) £140.
Oric disc drive £304 (£278) £298.
New Sinclair QL Computer £406 (£385) £410.
Sinclair QL Computer 48K (with 6 free programs while Sinclair's offer lasts) £131 (£131) £143.
Microdrive £51 (£50) £60.
RS232 interface 1 £51 (£50) £60.
Limited period special offer:-
Microdrive + Interface 1 + 4 Blank cartridges £102 (£100) £120.
Blank microdrive cartridges £8 (£8) £9.
Interface 2 £20.45 (£20) £24.
32K memory upgrade kit for 16K Spectrum (issue 2 and 3 only) £31 (£28) £30.
Spectrum printer interfaces with cables:-
Centronics £51 (£47) £52.
RS232 £35 (£33) £38.
ZX printer has been replaced by the Alphacom 32 £71 (£67) £77.
5 printer rolls (State whether Sinclair or Alphacom) £13 (£16) £21.
ZX81 computer £45 (£44) £54.
16K ram packs for ZX81 £28 (£25) £30.

COMMODORE COMPUTERS

Commodore C16 £145 (£142) £162.
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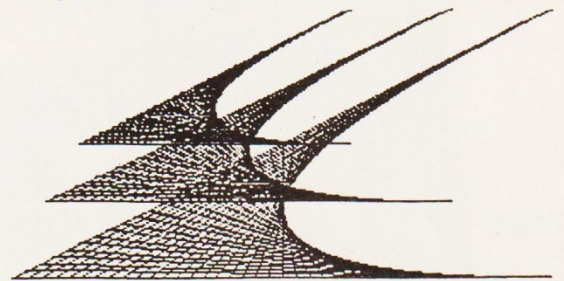
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Since this is a graphics issue, it is practically by definition, necessary to mention IO Research. If you've been to the PCW Show or any of the computer graphics exhibitions over the last couple of years, you may well have seen their stand: not terribly large but packed with goodies. IO are a small company with a big product: examples of their graphics are shown on the front cover.

Pluto is a very comprehensive computer graphics system which is used as a peripheral on an existing microcomputer. Currently IO are advertising their versions for the IBM PC and Sirius, but at exhibitions I have seen the system running from a Nascom and a BBC Micro. Pluto interfaces to the host micro either through eight-bit parallel interfaces, generally tailored to the micro in question, or through an optional RS232 port.

The cheapest system available is a processor card with 192K of memory which allows you to have eight-colour graphics on a 640 by 576 resolution screen. This can be interfaced to a micro such as the BBC and costs only £550. The board is controlled by simply sending commands to it: on-board software does all the

OUT-OF-THIS-WORLD PLUTO

Jeff Brown

We highlight the products of IO Research, a company doing some very interesting things in the field of high-res computer graphics.

clever stuff. Pluto capabilities include line, rectangle, circle and arc drawing, flood fill and pattern fill of complex shapes, colour changing from the extensive palettes, plus 96 built-in ASCII characters and further user-defined symbols.

Further up the range come boards with extra memory (256K or 384K, for example), which allow extra colours and

higher resolution to be obtained. For example, the Pluto boards for the IBM and Sirius can display 16 colours at a resolution of 768 by 288 pixels. These boards use either the 68000 or the 8088, and are able to plot vectors at speeds up to 250,000 points per second. The boards contain their own video circuitry and draw their power from the host system: all that is needed is a high-resolution colour monitor.

PLUTO II

A new addition to the range is the Pluto II, a single-board graphics display system which replaces three of the original Pluto boards and is completely hardware and software compatible with them. You can buy the system either as a bare board or in a case with power supply and cooling fan.

The board itself is 12" by 8" and utilises multi-layer PCB technology. The processor is an 8 MHz 8088 which addresses half a megabyte of memory as standard, giving a 768 by 576 screen. An optional 1 megabyte of memory gives two screens of the same resolution. Two hundred and fifty-six colours may be simultaneously displayed from the palette of, wait for it, 16.7 million shades! There are extra commands available in the ROM giving a total of over 100 high level commands including fast text scrolling and smooth shading. The hardware allows pan and 16 levels of zoom.

If that wasn't enough, a real-

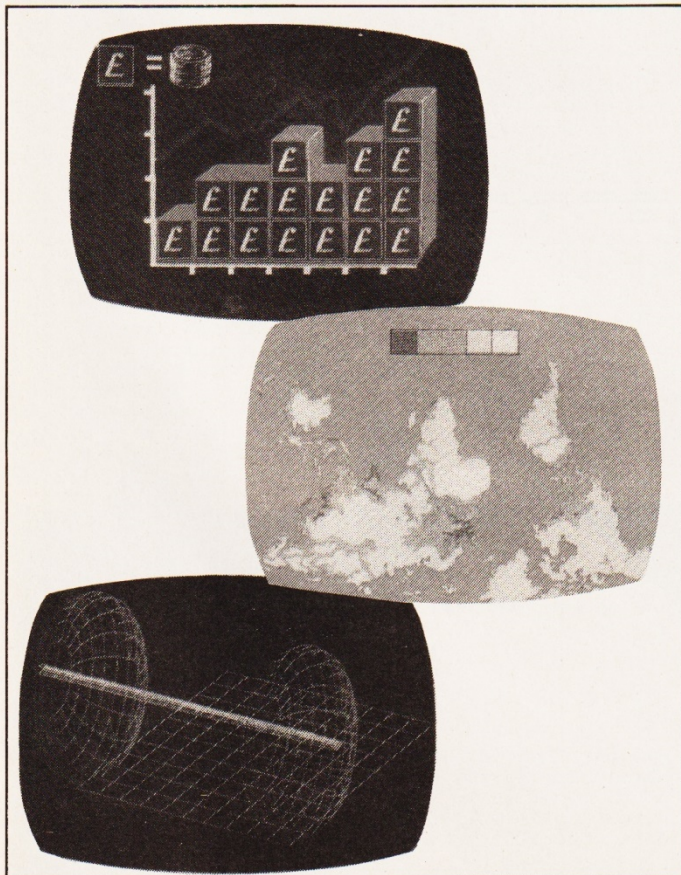
time frame grabber is also available for the system which grabs 50 frames a second. If you should want to display 16.7 million colours simultaneously, three Pluto IIs can be synchronised together to provide a 24-bit system. Not too shabby.

IN USE

You may have seen the Pluto being demonstrated early this year on ITV's The Saturday Show by ex-ASP superstar Chris Palmer, and Lawson Noble of IO. They were using the same system that I've played with at exhibitions, which has a graphics tablet and some very impressive menu-driven software which makes freehand art a pleasure. (I had great fun filling up a landscape with a flock of geese using the COPY function!)

Another application which I've seen is a graphics design program where genuine printer's fonts can be programmed into the system and placed at any magnification around the screen. One day all magazines will be designed like this!

For a company with such an excellent range of products, IO Research keep a remarkably low profile. But if you have any interest in producing computer graphics they are definitely the company to talk to. I have always found them very helpful, and the technology is very reasonably priced. IO Research are at 4 Exchange Buildings, High Street, Barnet, EN5 5FY (phone 01-441 5700).



Computer Aided Design (CAD) has always interested me, but sadly I cannot afford a dual 80-track disk drive, the 6502 Second Processor and the Bitstik (Pity! See our review elsewhere in this issue — Ed). So I turned to myself for help. Drawing Master will not match the power of the Bitstik, but it will allow you to produce drawings which are a match for those done on some commercial software.

You may also include any screens that you produce in your own programs. The program has a SAVE facility that copies the whole screen to disk, (or tape), and to load such a screen outside the main program, simply include the instruction *LOAD "Drawing". Of course, you will have to be in Mode 2 to start with, or the effects produced will be a trifle bizarre, to say the least. Anyone for Dali?

THE PROGRAM

Like all good BBC programs, Drawing Master consists of a group of procedures called from a small main loop. These are described below.

PROCtitle starts by printing a short title sequence in Mode 7 and then prints a list of the commands available, to a small tuneful accompaniment. Pressing any key causes the second set of keyboard commands to be displayed, together with a prompt for the background colour to be input.

PROCinkey scans the keyboard to find out what keys have been pressed.

PROCdraw draws the cursor and a small point which makes up your drawing.

PROCsave and **PROCload** will SAVE and LOAD a complete Mode 2 screen to tape or disk, depending on which you have selected. (Of course, it will take an age using tape!) The screen is not disfigured by system messages as each procedure turns off the VDU while the screen is being moved.

PROCcircle can be used to draw, fill or pattern a circle, while **PROCrectangle** fills a rectangle and **PROCsquare** fills a square.

BBC DRAW

Paul Erskine

This simple program allows BBC owners with an artistic bent to produce Mode 2 screens with the greatest of ease — and SAVE them to tape or disc too.

PROChorizontal and **PROCvertical** are used to draw line segments parallel to the two screen axes.

PROCprinter is a dummy procedure which is provided to allow you to generate hard copies of the screen. You will have to substitute a screen dump routine suitable for the type of printer that you own.

PROCgoto and **PROCmove** are routines that print the text prompts "GOTO RADIUS" and "MOVE TO" on the screen.

PROCmovedraw moves the cursor and draws to any position on the screen.

PROCprint waits until the

TABLE 1

Variable	Function
red\$	Red text colour in Mode 7
back	Background colour
X	X coord of cursor
Y	Y coord of cursor
gcol	Graphics colour
M	Number of pixels the cursor moves
col	Text colour in Mode 2
fill	Fill or draw or pattern a circle
I	Loop variable
J	Loop variable
angle%	Loop variable
P	Loop variable
X2	Store X coord for later use
Y2	Store Y coord for later use
X3	Radius of circle
radius	Same as X3
angle	The RAD of angle%



space bar is pressed and then asks you what you want to print. After you have input the required text, the routine prints it at the last position of the cursor. **PROCprint2** deletes the message "Print :." (provided it was wholly contained on the background colour).

USING DRAW MASTER

The commands available are displayed at the start of Drawing Master and are used as described below.

To draw, fill or pattern a circle, first go to the centre of the circle and press f0 (or Shift-f0, or CTRL-f0; all work but produced different shading effects — see later). Then move the cursor to the radius of the circle and press f1.

To use the move and draw function, first move the cursor to the required start point on the screen, then press the Cursor-Left (arrow) key. This fixes your start point. Now move the cursor to the required end position and press one of the colour keys. Pressing the Cursor-Right (arrow) key will now draw a line to the endpoint in the selected colour.

To add text to the drawing, first move the cursor to the position at which you wish the text to appear. Press a colour key to select the required colour, then press f6, then the Space bar. Now type in the word you want and hit Return. The text will appear at the selected position.

To delete a line, select the



background colour as appropriate, and overprint a new line on top of the old one.

COMMAND SUMMARY

Cursor Movement

Z Left

X Right

: Up

/ Down

Shift speeds up the dot.

Colours:

D Black
R Red
G Green
Y Yellow
B Blue
M Magenta
C Cyan
W White

P Select printer
Cursor-Left (Arrow):
move to position
Cursor-Right (arrow):
draw to position

CTRL-L LOAD "Drawing"
CTRL-S SAVE "Drawing"
CTRL-f0 Pattern circle
CTRL-Tab CLS
Shift-f0 Draw circle

Functions key:

f0 Fill circle
f1 End circle (set radius)
f2 Draw rectangle
f3 Draw square
f4 Draw horizontal line
f5 Draw vertical line
f6 Print word

```
10 REM Drawing Master BBC(B) P.E.
20 ON ERROR VDU6:GOTO 90
30 MODE 7:VDU 23;8202;0;0;0;
40 red$=CHR#129
50 PROCtitle
60 MODE 2:VDU 23;8202;0;0;0;
70 COLOUR 128+back:CLS
80 X=639:Y=511:gcol=1:M=2:col=0:fill=1
90 MOVE X,Y
100 PROCdraw
110 PROCinkey
120 GOTO 100
130
140 DEFPROCtitle
150 FOR J=1 TO 12
160 FOR I=129 TO 135
170 PRINT CHR$ I;CHR$ 141;SPC(5);"Welcome to Dra
wing Master"
180 TIME=0:REPEAT:UNTIL TIME=10
190 NEXT
200 NEXT
210 CLS
220 FOR I=0 TO 1
230 PRINTTAB(0,I);CHR$ 132;CHR$ 157;CHR$ 141;CHR
$ 131;SPC(4);"Welcome to Drawing Master";SPC(6);CH
R$ 156
240 NEXT I
250 PRINT
```

```
260 PRINTTAB(15);CHR$130;"MOVEMENT"
270 PRINT
280 PRINTTAB(13);red$;"Z - Left"
290 PRINTTAB(13);red$;"X - Right"
300 PRINTTAB(13);red$;" - Up"
310 PRINTTAB(13);red$;" / - Down"
320 PRINT
330 PRINTTAB(6);red$;"SHIFT SPEEDS THE CURSOR UP"
340 PRINT
350 PRINTTAB(15);CHR$130;"COMMANDS"
360 PRINT
370 PRINTTAB(8);red$;"f0 - Fill Circle"
380 PRINTTAB(8);red$;"f1 - End Circle"
390 PRINTTAB(8);red$;"f2 - Rectangle"
400 PRINTTAB(8);red$;"f3 - Square"
410 PRINTTAB(8);red$;"f4 - Hor. Line"
420 PRINTTAB(8);red$;"f5 - Ver. Line"
430 PRINTTAB(8);red$;"f6 - Print Word"
440 PRINTTAB(9);red$;"I - Move to"
450 PRINTTAB(9);red$;"J - Draw to"
460 FOR P=1 TO 200 STEP 5:SOUND 1,-15,P,1:NEXT P
470 A$=GET$
480 CLS
490 FOR I=0 TO 1
500 PRINTTAB(0,I);CHR$ 132;CHR$ 157;CHR$ 141;CHR
$ 131;SPC(4);"Welcome to Drawing Master";SPC(6);CH
R$ 156
```



```

510 NEXT I
520 PRINT
530 PRINTTAB(14);CHR$130;"COLOURS"
540 PRINT
550 PRINTTAB(12);red$;"D - Black"
560 PRINTTAB(12);red$;"R - Red"
570 PRINTTAB(12);red$;"G - Green"
580 PRINTTAB(12);red$;"Y - Yellow"
590 PRINTTAB(12);red$;"B - Blue"
600 PRINTTAB(12);red$;"M - Magenta"
610 PRINTTAB(12);red$;"C - Cyan"
620 PRINTTAB(12);red$;"W - White"
630 PRINT
640 PRINTTAB(13);CHR$130;"COMMANDS"
650 PRINT
660 PRINTTAB(6);red$;"CTRL + L - Load"
670 PRINTTAB(6);red$;"CTRL + S - Save"
680 PRINTTAB(6);red$;"CTRL + TAB - CLS"
690 PRINTTAB(6);red$;"CTRL + f0 - Pattern Circle"
700 PRINTTAB(5);red$;"SHIFT + f0 - Draw Circle"
710 PRINTTAB(14);red$;"P - Printer"
720 PRINT
730 FOR P=200 TO 1 STEP -5: SOUND 1,-15,P,1:NEXT P
740 REPEAT
750 INPUT "What background colour (0 to 7) ?"back
760 PRINTTAB(33,10) " "
770 UNTIL back<-1 AND back<8
780 ENDPROC
790
800 DEFPROCinkey
810 IF INKEY(-98) X=X-M
820 IF INKEY(-67) X=X+M
830 IF INKEY(-73) Y=Y+M
840 IF INKEY(-105) Y=Y-M
850 IF INKEY(-1) AND M=2 M=10 ELSE M=2
860 IF INKEY(-87) AND INKEY(-2) PROCload
870 IF INKEY(-82) AND INKEY(-2) PROCsave
880 IF INKEY(-51) gcol=0
890 IF INKEY(-52) gcol=1
900 IF INKEY(-84) gcol=2
910 IF INKEY(-69) gcol=3
920 IF INKEY(-101) gcol=4
930 IF INKEY(-102) gcol=5
940 IF INKEY(-83) gcol=6
950 IF INKEY(-34) gcol=7
960 IF INKEY(-33) col=5:PROCgoto:X2=X:fill=1
970 IF INKEY(-33) AND INKEY(-1) col=5:PROCgoto:
X2=X:fill=0
980 IF INKEY(-33) AND INKEY(-2) col=5:PROCgoto:
X2=X:fill=2
990 IF INKEY(-114) col=back:PROCgoto:X3=X2-X:PROCcircle
1000 IF INKEY(-118) PROCprint
1010 IF INKEY(-115) PROCrectangle
1020 IF INKEY(-116) PROCsquare
1030 IF INKEY(-21) PROChorizontal
1040 IF INKEY(-117) PROCvertical
1050 IF INKEY(-26) col=5:PROCmove:X2=X:Y2=Y:gcol=
=back
1060 IF INKEY(-122) col=back:PROCmove:PROCmovedra
w
1070 IF INKEY(-97) AND INKEY(-2) CLS:GOTO 80
1080 IF INKEY(-56) PROCprinter
1090 ENDPROC
1100
1110 DEFPROCdraw
1120 GCOL 0,gcol:DRAW X,Y
1130 GCOL 0,6:MOVE X,Y:DRAW X,Y
1140 GCOL 0,1:MOVE X,Y:DRAW X,Y
1150 ENDPROC
1160
1170 REM Thanks due to Anthony Robinson
1180
1190 DEFPROCsave
1200 VDU 21
1210 *SAVE Drawing 3000 8000
1220 VDU 6
1230 ENDPROC
1240
1250 DEFPROCload
1260 VDU 21
1270 *LOAD Drawing
1280 VDU 6
1290 ENDPROC
1300
1310 DEFPROCcircle
1320 radius%=X3
1330 GCOL 0,gcol
1340 VDU 29,X2,Y;
1350 MOVE radius%,0
1360 IF fill=0 FOR angle%=0 TO 360
1370 IF fill=1 FOR angle%=0 TO 360
1380 IF fill=2 FOR angle%=0 TO 360 STEP 10
1390 angle=RAD(angle%)
1400 IF fill=0 MOVE radius%*COS(angle),radius%*SIN(angle)
1410 IF fill=1 MOVE 0,0
1420 IF fill=2 MOVE 0,0
1430 IF fill=0 DRAW radius%*COS(angle),radius%*SIN(angle)
1440 IF fill=1 PLOT 85,radius%*COS(angle),radius%*SIN(angle)
1450 IF fill=2 DRAW radius%*COS(angle),radius%*SIN(angle)
1460 NEXT
1470 VDU 29,0;0;
1480 ENDPROC
1490
1500 DEFPROCrectangle
1510 GCOL 0,gcol
1520 MOVE X,Y
1530 DRAW X,Y+50
1540 PLOT 85,X+100,Y+50
1550 DRAW X+100,Y
1560 PLOT 85,X,Y
1570 ENDPROC
1580
1590 DEFPROCsquare
1600 GCOL 0,gcol
1610 MOVE X,Y
1620 DRAW X,Y+50
1630 PLOT 85,X+50,Y+50
1640 DRAW X+50,Y
1650 PLOT 85,X,Y
1660 ENDPROC
1670
1680 DEFPROChorizontal
1690 GCOL 0,gcol
1700 MOVE 0,Y
1710 DRAW 1279,Y
1720 ENDPROC
1730
1740 DEFPROCvertical
1750 GCOL 0,gcol
1760 MOVE X,0
1770 DRAW X,975
1780 ENDPROC
1790
1800 DEFPROCprinter
1810 REM Put your own printer dump here
1820 ENDPROC
1830
1840 DEFPROCgoto
1850 COLOUR col
1860 PRINTTAB(4,0)"GOTO RADIUS"
1870 ENDPROC
1880
1890 DEFPROCmove
1900 COLOUR col
1910 PRINTTAB(6,0)"MOVE TO"
1920 ENDPROC
1930
1940 DEFPROCmovedraw
1950 GCOL 0,gcol
1960 MOVE X2,Y2
1970 DRAW X,Y
1980 ENDPROC
1990
2000 DEFPROCprint
2010 REPEAT:A$=GET$:UNTIL A$=""
2020 COLOUR 5
2030 INPUTTAB(2,0)"Print :";N$
2040 PROCprint2
2050 VDU 5
2060 GCOL 0,gcol
2070 MOVE X,Y:PRINT N$:MOVE X,Y
2080 VDU 4
2090 ENDPROC
2100
2110 DEFPROCprint2
2120 COLOUR back
2130 PRINTTAB(2,0)"Print :";N$
2140 ENDPROC

```


OK, I'll come clean. The original plan was to have AmArt complete, whole and in its entirety in this issue. Unfortunately the two routines listed here, which provide a BASIC fill routine and a versatile arc-drawing procedure, involved such quantities of logical thought and O-Level algebra (most of which I had forgotten) that the whole thing couldn't be finished in time. Nevertheless, you can be sure that the finished product will be well worth waiting for.

ARC DE TRIOMPHE

This routine was a real pain to figure out. The situation is this: given three non-colinear points, draw the arc of a circle that passes through all three, taking the two outer points as the endpoints of the arc. My first attempt involved a calculation using similar triangles, a small one contained within the arc-segment and the other with a vertex at the centre (unknown) of the required circle. Since one triangle was much smaller than the other, and the screen coordinate system has a finite minimum unit length, rounding errors gave fairly inaccurate results. Back to the school exercise book.

The next thought that occurred to me was that I had three known x, y coordinate pairs lying on the circle, and three unknowns: the x and y coordinates of the centre of the circle and its radius. Aha! three simultaneous equations in three unknowns; easy.

ART AND THE AMSTRAD

K. Smith

Two subroutines are provided this month which do clever things on an Amstrad screen. Later we'll add other program segments that will result in a high quality drawing package.

Don't you believe it

The expansions of the equations and final solution were not one of the most enjoyable tasks I've undertaken and a daft mistake the first time round meant I had to do it twice. I'll spare you the gory details but the application of the equations can be seen in lines 1020 to 1060 of the program. Provided the points are sensibly spaced (and next month's cursor routine will make sure of that), the routine is extremely accurate.

Note that the origin is moved to the centre of the circle before plotting takes place. This is recommended by Amsoft because the drawing routines round pixel coordinates towards the origin, so if this is made the centre of the circle then any possible asymmetry is

avoided. The arc is drawn from the first point towards the second point via the third, and since the first point could be either clockwise or anticlockwise from the second, line 1110 makes sure the arc is drawn in the correct direction.

The rather complicated expression in line 1000 is required because the ARCTAN function on the Amstrad only returns an angle in the first or fourth quadrants (between +90 and -90 degrees). Adjustment is needed to produce angles in the other two quadrants.

FILLING YOU IN

The fill routine, on the other hand, is not difficult from the mathematical point of view but needs some fairly

tight logic to make sure that every point in an arbitrarily complex figure gets filled. The approach I took was that any closed shape on the screen consists of a series of horizontal line segments, each one pixel high, with vertically adjacent lines overlapping by at least one pixel. So the problem now is to write one routine to fill any horizontal line segment, and another to identify each segment that has to be filled.

The first one is easy, and is shown in line 2030. The program tests each point along the line segment, moving right, until it reaches the edge of the screen or a non-background colour. Then we simply have to move left along the same line, filling pixels with the new colour, until we reach the opposite edge of the screen or another border.

As we move left, filling as we go, we also test the colour of the pixels above and below the line. When we find a pixel of background colour it must be part of a new line that has to be filled later, so we save the point on a 'stack' (actually an array dimensioned large enough to make sure we're unlikely to fill it) for later attention. The flags tp and bt (top and bottom) have to be set and reset as shown in lines 2060 to 2090 for two reasons. One, when we add a point to the stack we don't need any other points from that particular segment, so tp and bt are set. Two, there may be more than one line segment adjacent to a given fill line so when a border colour is found, tp and bt are reset so that possible further lines are not missed.

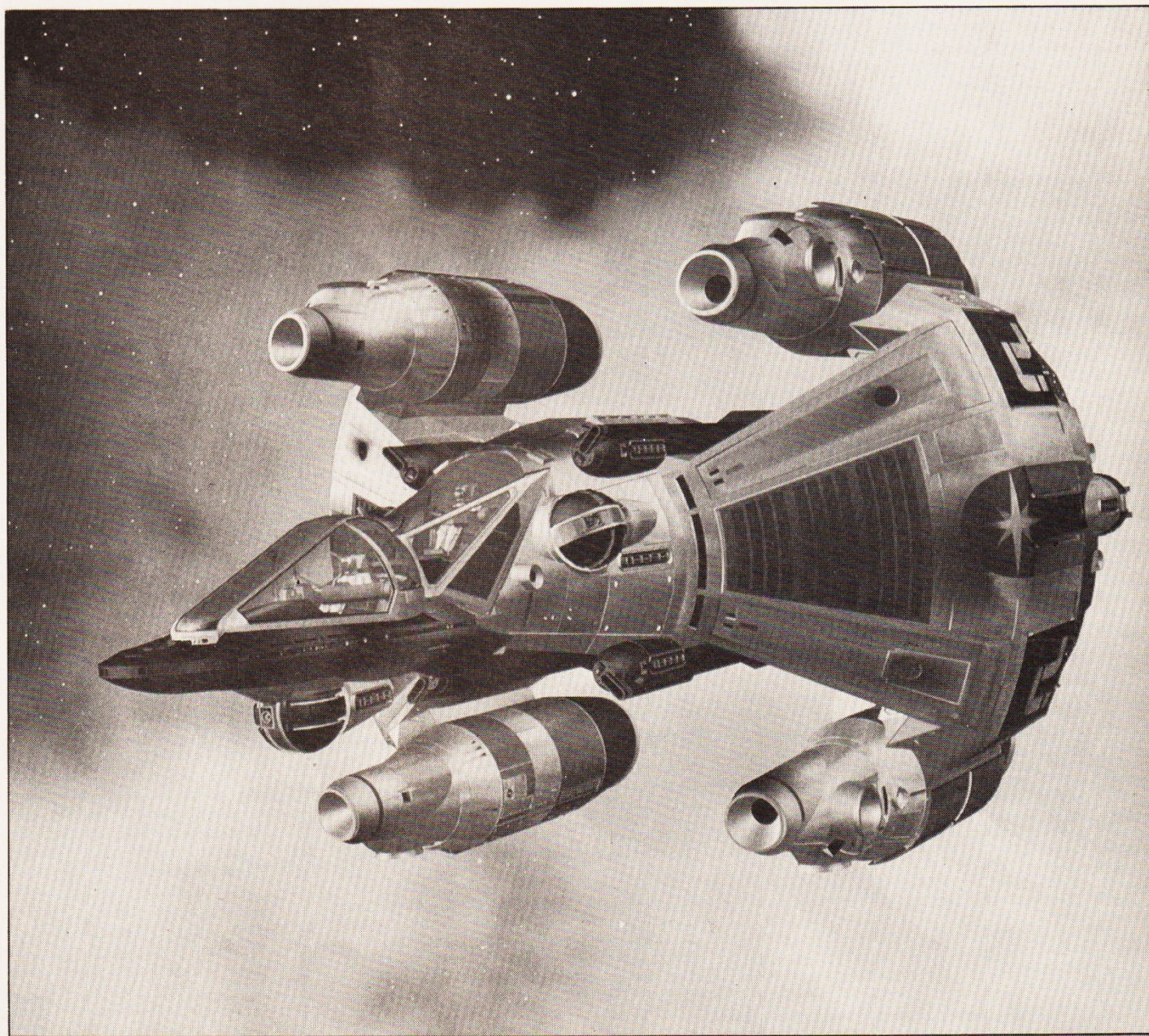
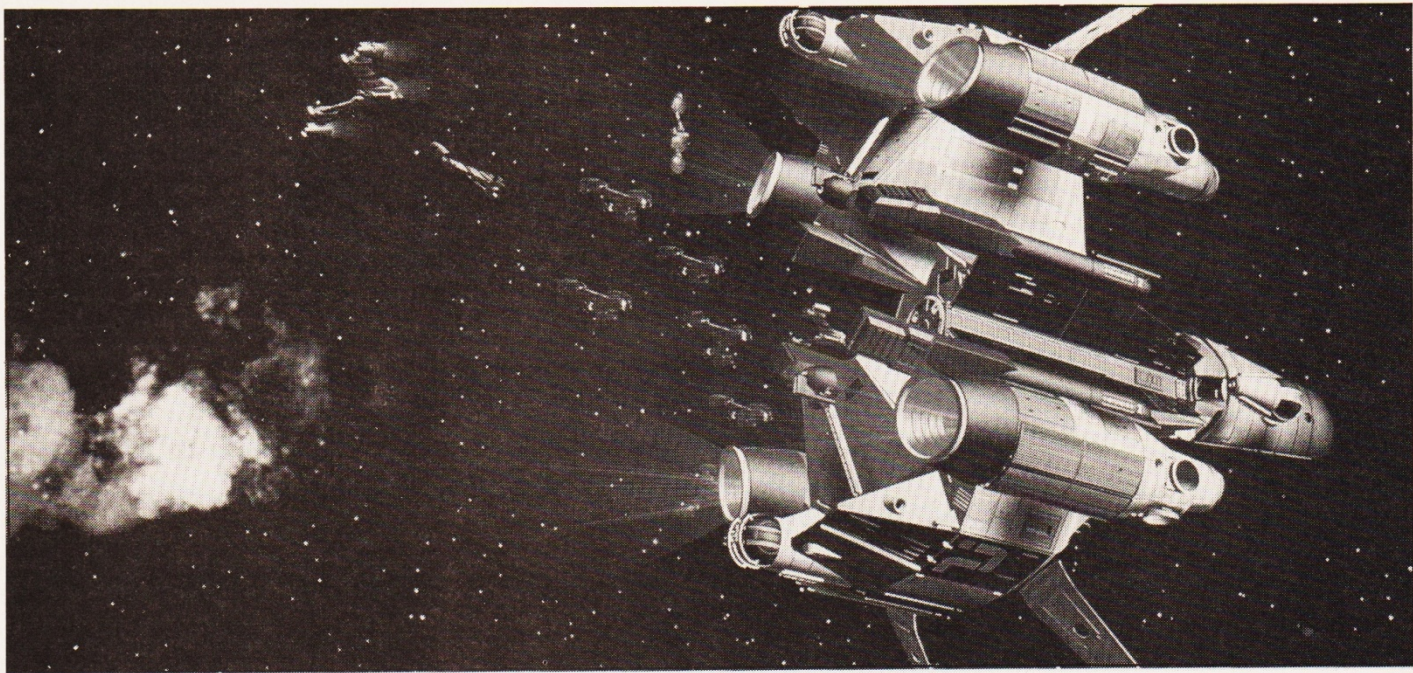
As a test I asked two colleagues to set tricky fill problems. One suggested a double spiral, the other suggested filling around the words "Pangalactic Gargleblaster"! The routine, although slow, succeeded admirably. Not a point was missed, and the subroutine is guaranteed to fill any shape, however complex and even with internal holes (provided the stack array doesn't overflow; you could always test the stack pointer value to avoid crashes, or make the array bigger if necessary).

```

10 DIM st(200,1)
999 REM ** arc drawing routine
1000 DEF FNangle(x,y)=(ATN(y/x)+360-180*(x<0 AND y<0)-180*(x<0 AND y>=0)) MOD 360
1010 DEG
1020 s1=a^2+b^2:s2=c^2+d^2:s3=e^2+f^2
1030 d1=d-f:d2=f-b:d3=b-d:d4=c-e:d5=e-a:d6=a-c
1040 xcirc=(s1*d1+s2*d2+s3*d3)/(a*d1+c*d2+e*d3)/2
1050 ycirc=(s1*d4+s2*d5+s3*d6)/(b*d4+d*d5+f*d6)/2
1060 r=SQR((xcirc-a)^2+(ycirc-b)^2)
1070 ORIGIN xcirc,ycirc
1080 a=a-xcirc:c=c-xcirc:e=e-xcirc
1090 b=b-ycirc:d=d-ycirc:f=f-ycirc
1100 angle1=FNangle(a,b):angle2=FNangle(c,d):angle3=FNangle(e,f)
1110 stp=1:IF angle1>angle3 THEN stp=-1
1120 MOVE a,b
1130 FOR angle=angle1 TO angle2 STEP stp
1140 DRAW r*COS(angle),r*SIN(angle)
1150 NEXT
1160 ORIGIN 0,0
1170 RETURN
1999 REM ** BASIC fill routine
2000 sp=0:st(sp,0)=xcurs:st(sp,1)=ycurs:bc=TESTR(0,0):dx=2^(2-m)
2010 WHILE sp>-1
2020 x=st(sp,0):y=st(sp,1):sp=sp-1:MOVE x,y
2030 WHILE TESTR(dx,0)=bc AND x+dx<640:x=x+dx:WEND:MOVE x,y
2040 WHILE TESTR(0,0)=bc AND x>-1
2050 PLOT x,y,p
2060 pc=TESTR(0,2):IF y+2>398 THEN tp=1
2070 IF pc=bc AND tp=0 THEN sp=sp+1:st(sp,0)=x:st(sp,1)=y+2:tp=1 ELSE IF pc<>bc THEN tp=0
2080 pc=TESTR(0,-4):IF y-2<0 THEN bt=1
2090 IF pc=bc AND bt=0 THEN sp=sp+1:st(sp,0)=x:st(sp,1)=y-2:bt=1 ELSE IF pc<>bc THEN bt=0
2100 x=x-dx:MOVE x,y
2110 WEND
2120 tp=0:bt=0
2130 WEND

```

Listing 1. The arc-drawing and fill routines for AmArt.



One of my most treasured possessions is a copy of a book published in the Fifties. Called **The Conquest Of Space**, it was co-authored by Willy Ley and Chesley Bonestell. Ley provided the text, a series of chapters covering the history of the then infant science of rocketry, and the solar system. Bonestell punctuated the chapters with sets of colour and black-and-white illustrations, magnificent pictures on glossy paper which in many cases looked as if they were actual photographs rather than an artist's renderings. You may be familiar with Bonestell's work — it has been featured in the science magazine **Omni**, for example.

THE REAL THING?

Bonestell specialises in this photo-realistic technique, and the introduction to the book explains how Bonestell's training included such exercises in perspective as working out, and drawing, what a chair would look like if it was positioned at such-and-such an angle to a mirror which was itself leaning against a wall at another angle. This led to Bonestell wondering "What would Saturn look like if the visual angle was this and the rings were inclined thus...", and gave birth to his career as a distinguished astronomical artist.

Yet the photo-realistic technique is not an easy one for mere humans to master: it is generally quite simple for the eye to detect that an image is a painting rather than a photograph of an actual object. The minute detail and infinite range of shading and colour of real life is just too complex to be rendered effectively by paint and brush.

ENTER THE COMPUTER

On the other hand, situations which require very large amounts of data to be manipulated are the forte of computers, so it would seem that they would be ideally suited to producing images that appear to be of real objects. In fact this isn't so, for two main reasons. The first is that the amount of information that makes up a real-life image as seen by the human eye is just so immense

that even computers have a job handling it. Second, even if the computational ability is available, the amount of memory required to store a full gradation of hues at a high enough resolution to make individual pixels invisible to the naked eye has been impossibly large.

As a result, examples of computer graphics tend to compromise in one or other area. **Tron**, a film which was heralded as a milestone in computer imagery, nevertheless employed fairly simplistic scenes where the shapes were kept as regular polygons if possible, and backgrounds were merely flat areas of regular tone. Films such as **Star Trek** have used computer graphics to produce navigational control panel readouts and the like, but as these are often fast animated displays they are limited to wire-frame type images to stay within the bounds of processing power.

In fact, it has been just as easy to tell a computer simulation from the real thing as it has the average artist's impression. Either the resolution suffers, such as the cockpit displays of flight simulators which are animated in real time but have a cartoonlike quality, or the colour range is lost, as in images of vases which feature very accurate perspective and shading but still have an indefinable air of 'flatness' to them. Perspective isn't everything.

LIGHTS, COMPUTER, ACTION

Peter Green

Remember the computer graphics from Tron, the Star Trek films and a host of others? Remember how they looked like — well, computer graphics? A new film soon to reach the cinemas has changed all that. It uses computer graphics to fake reality.

STATE OF THE ARTS

A film which is due to be released quite shortly in the UK is set to change all that, however. Titled **The Last Starfighter**, the storyline is that a certain type of arcade game has been introduced by aliens as a test of good pilot material, and the teenage hero finds that, as the best player around, he is whisked off to defend the aliens' home world against the rampaging baddies. Fairly standard SF fodder, you might think, with the special effects team breaking out the balsa wood and the Airfix kits, but not so. There isn't a single miniature or model of any kind used in the film — every space scene has been generated by computer animation, a total of 25 minutes' worth. As yet I haven't seen the film (the press showing is still a week away), but judging by the quality of the stills it is impossible to tell that models have not been used.

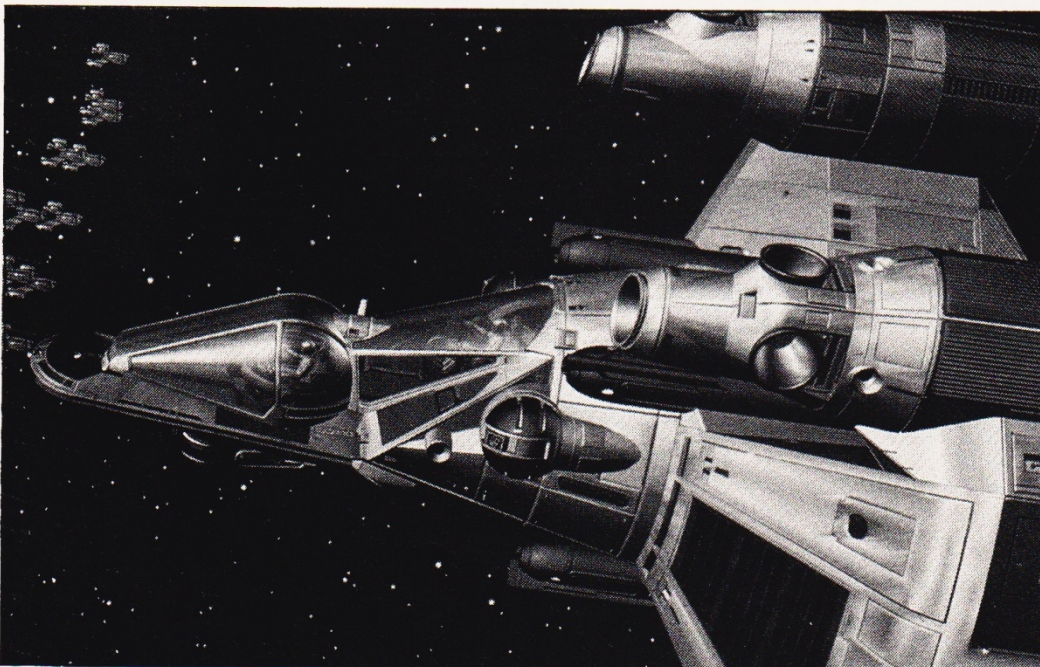
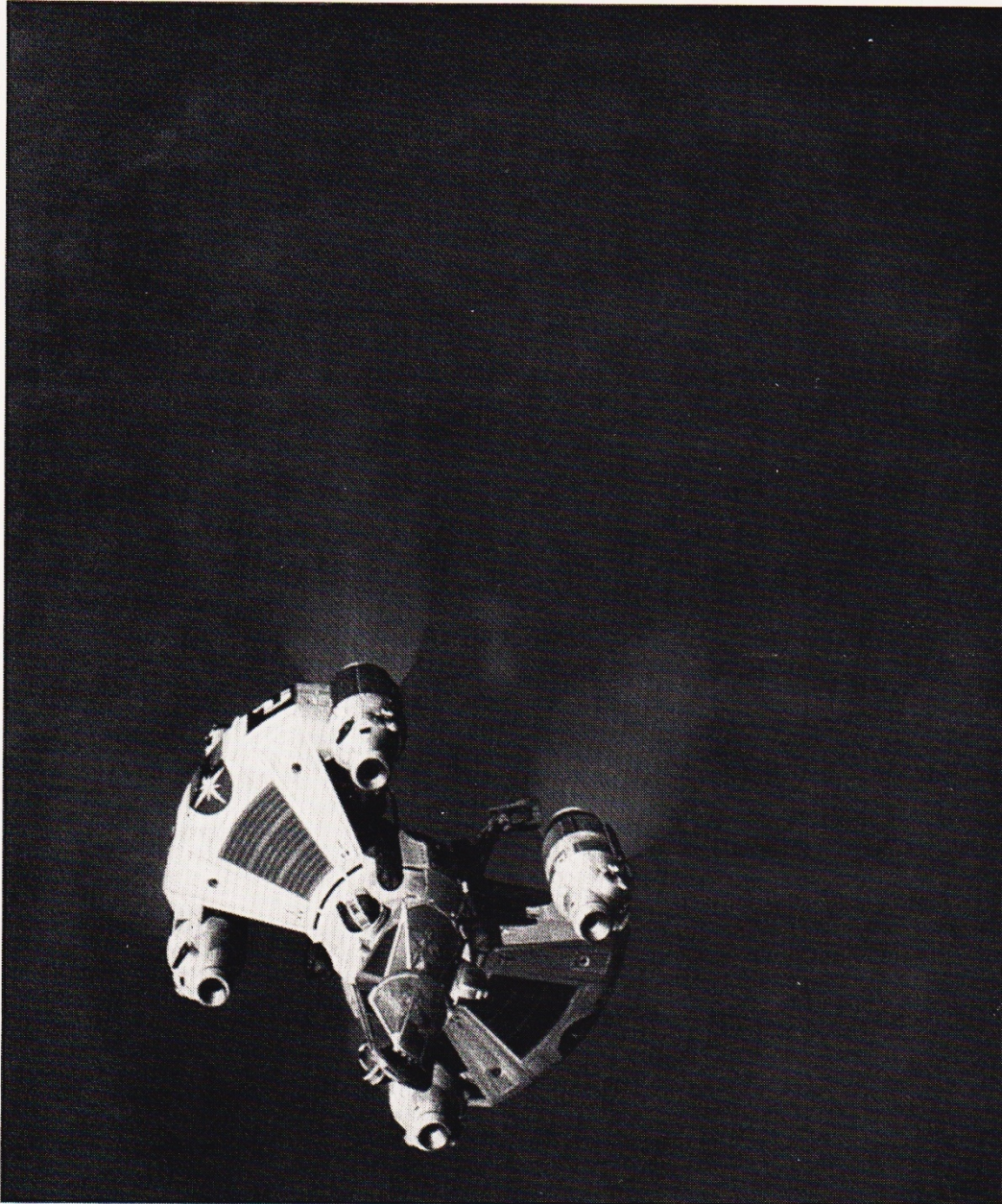
The team behind this extraordinary feat have a long involvement with computer graphics. If you watched the film **Westworld** on BBC2 recently, you will remember how computer graphics were used to manipulate the film to represent the robot gun-fighter's view of life. The two men responsible, John Whit-

panies had told director Michael Crichton was impossible on a motion picture budget, and they received an Academy Award nomination for their efforts. After just over a decade's experience in computer graphics, their company Digital Productions is now producing the definitive state-of-the-art art.

Such impressive work is not accomplished cheaply. Digital Productions produced **The Last Starfighter** on the world's biggest, fastest computer, the Cray X-MP, the successor to the Cray-1. This machine is impossible to discuss without huge numbers of zeros raising their ugly heads — it has a couple of hundred thousand chips inside it, together with 100,000 metres of wire, runs at about 100,000 watts, executes 10 billion machine cycles a second, and costs a hefty \$15 million. DP's rate for **Starfighter** was apparently \$2000 a second for final footage, which comes to a total of \$3 million for the whole 25 minutes, not bad compared to the average science fiction film budget.

THE REAL THING

As you can see from the photographs reproduced here, the sense of realism that the Cray allows is quite impressive. Everything you see started life as a series of co-ordinates entered from blueprints by a digitizing tablet.



STOP PRESS

Since this article was written I have been to see *The Last Starfighter*, and the plot is awful! The closing scenes are so dire I felt embarrassed for the actors who had to speak the lines. But the effects are excellent and anyone interested in state-of-the-art computer graphics will find the film well worth a visit. The closing credits indicate that a video game based on the film is to be released by Atari: it will have to be something special to live up to the film's graphics.

Every surface is represented by straight line segments: it is the job of the computer to smooth out the curves and add the colour and shading based on where the imaginary light sources are supposed to be, and the required orientation of the objects in the frame.

Just as the 'unit' of a two-dimensional picture is the pixel, so three-dimensional modelling of this sort has the polygon as its unit, with the sharper curves requiring more polygons so that a visually smooth effect is obtained. **Starfighter** has incredibly complex scenes, each requiring several million polygons to code. When the Cray has finished its number-crunching for each frame and committed the finished image to film, the resolution of the pixels is greater than that of the grains in the film stock, making it impossible to detect any tell-tale 'boxiness'.

So detailed are the images that the long shots of the Starfighter's cockpit have computer-generated images of the crew moving around inside, rather than combining live-action footage with the graphics. At the time that **Tron** was released I interviewed its director, Steven Lisberger, and he predicted that it would be 10-15 years before people could be simulated. Admittedly this film employs very small figures, but it appears that, like many other predictions in the computer industry, this one was rather conservative. Computer graphics are developing at an astounding rate, and to enjoy the very latest and greatest will cost you no more than the price of a cinema ticket.



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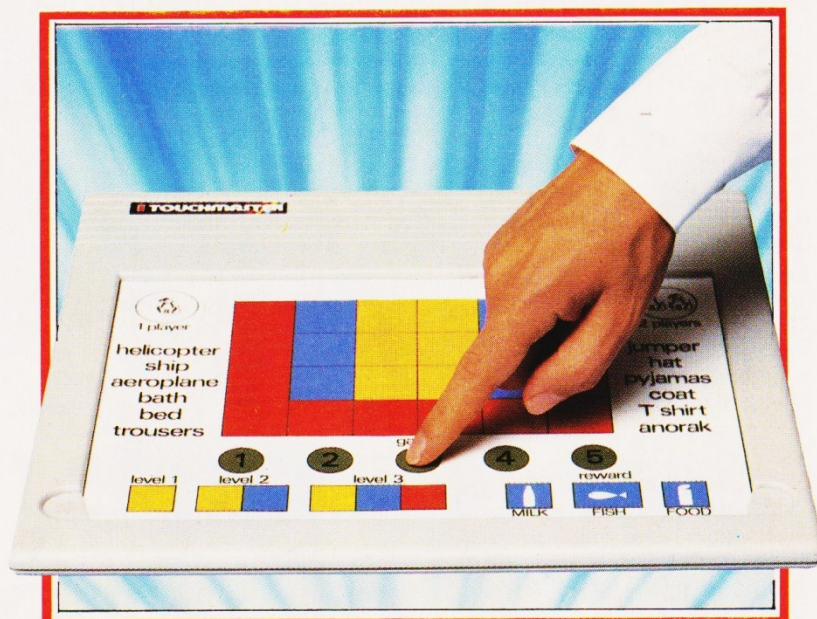
Secondly, to a whole new style of software ("Touchware"), which is not limited by the keyboard.

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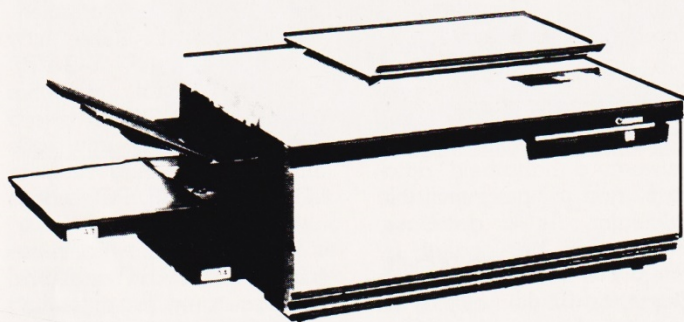
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The idea has been around for quite some time in science fiction stories, and most recently it made its appearance in *The Hitch-hiker's Guide to the Galaxy*. It is the pocket computer, and up till now it has been nothing more than a work of fiction. However, for a couple of months it has not just been possible to obtain such a device, but the asking price is remarkably low considering the development that must have gone into it.

Indeed, the *Hitch-hiker's Guide* is an appropriate example to use, since, like that book, the Psion Organiser's most basic role is that of a hand-held database. Several of us in the ASP offices were quite disappointed that Psion had not taken advantage of the situation and printed "DON'T PANIC" in large, friendly letters on the outside of the case...

THE HARDWARE

From the point of view of styling, the Organiser scores 100%. Measuring 5½" by 3" by 1", the device fits neatly into the palm of the hand, and is sufficiently heavy to give a solid, chunky feel to the unit that inspires confidence. Overall the colour is black, with a chrome stripe around the top enclosing the display. The Organiser has a cover which protects the keyboard and may be slid down to lock in place so as not to be easily lost: a slightly harder tug pulls it off completely so that the battery in the base may be changed.

The keyboard disappointed me a little. It is a six by six grid of small, calculator-style buttons, all but three of which are multi-function. Six sixes are 36: with 26 buttons required for the letters of the alphabet and several others to allow single-key entry into the major system functions, Psion have been forced to make the numeric and arithmetic function keys part of the shifted set. The shift mode is toggled rather than requiring the simultaneous depression of the shift key: this necessary since on a hand-held machine, one hand is never free.

Unfortunately I found it hard to get used to this and was constantly having to backspace over wrongly entered material because I had forgotten to switch shifts. On top of that, the keypad is not QWERTY but laid out in straight alphabetical

order. As a two-fingered typist I found this very difficult to adapt to, and much hunting around for keys took place. However, in all fairness to Psion I cannot see any other way of designing the keypad — it simply isn't possible to fit a QWERTY layout onto a piece of equipment this small.

The display is a 16-character LCD type located above the keypad. The Organiser software is line-based and a line may be up to 200 characters long, so the display is able to scroll horizontally in either direction either under software control or by using the cursor

your fingertips.

The power source is a single PP3 battery: the Organiser's supply circuits generate the many different voltages used from the basic 9V, including the 21V required as a programming pulse by the on-board EPROM blower. The battery life under normal use should be about six months, say Psion.

Note that the EPROMs are not electrically erasable: once data is in the pack it is there for good. The only way to 'erase' some specific record is to electrically 'cross it out', so that it still taking up space but is not

PSION'S FACTS

Jeff Brown

It's been the staple of many a science fiction story, and now it's become a Psion's fact — of a sort. We take a look at the Organiser pocket computer.

keys. A small wheel on the side of the unit allows the contrast angle of the LCD to be adjusted for optimum viewing.

The most revolutionary aspect of the Organiser's design lies on the back of the computer beneath the keypad. Psion have gone to a totally new type of mass storage medium for this sort of product — solid state Datapaks (their spelling) which contain low power EPROMs. Data may be saved permanently by blowing it automatically into one of the two datapaks provided, an operation no more complicated than the push of the SAVE button. Since the datapaks contain little more than a single IC and an edge connector, they are extremely small (smaller than a matchbox) and you can easily carry a whole pocketful around without trouble. At 8 or 16K each (32K ones are on the way) and with data compression techniques allowing almost 11000 and 22000 characters to be stored in each respectively, that's a lot of data to have at

accessible to the software. A datapak may be totally reclaimed by the standard technique of UV erasure: any important data may be saved onto a second, blank pack before this is done.

By removing one of the datapaks and plugging in an RS232 interface, the Organiser may communicate with other micros, perhaps in an office environment or over a modem, or may output its contents to a suitable printer.

A real-time clock calendar is included, but it has no alarm function and cannot be used to remind you of appointments stored in the database. A pity.

SOFTWARE

The basic unit is a cross between a hand-held database and a programmable calculator. As a database, entries may be located by entering a search string: the Organiser will then display all the records containing that string (ie, the search works like

BASIC's INSTR function). For example, the review Organisers came with 8K restaurant guides: enter "W1" and the Organiser will tell you all the eating establishments recommended by Psion within walking distance of CT's W1 offices. A search could also be made on type of food, or opening hours, and so on — however, it isn't possible to do multiple searches and find, for example, all the Chinese restaurants in a given postal district. This is rather poor in a database, and the addition of a POPL datapak (Psion Organiser Programming Language) is no help as it cannot access the database at all. This really needs to be rectified, and soon: rumours reach me that Psion are, in fact, working on this one right now.

While the basic Organiser is capable of fairly sophisticated calculation, these are all of the one-line function variety. The addition of POPL allows much more scope, and Psion already supply utility, science, maths and financial application datapaks containing a host of useful programs.

POPL should be fairly easy for anyone to pick up, especially if they've used BBC BASIC. Essentially it's a procedure-based language using a fairly cut-down subset of BASIC and some new commands which are required by the rather rigid variable naming. A procedure is a group of lines which are assigned a name: including the name in another procedure calls that routine. Just like DEFPROC and PROC, really, except that in POPL all variables (named A to Z) are local to the procedure. Another procedure may use the same variable names as another and POPL keeps the two sets of values distinct.

Obviously there will be times when you need to use a global variable, and POPL has an array for this which is accessed using STORE and RECALL. There are 20 global variables.

Conditional branches may be made using IF...GOTO and the usual relational operators. The GOTO is to a label, which may any valid alphanumeric string such as LOOP1 or HERE. POPL does not use line numbers.

POPL's main drawbacks are first, that it is an analytical language only, for extending the power of the calculator functions, and is unable to



access the database entries; second, that it is snail-slow. I entered a short procedure called PYTHAG to calculate the hypotenuse of a right-angled triangle and POPL took six seconds to perform two

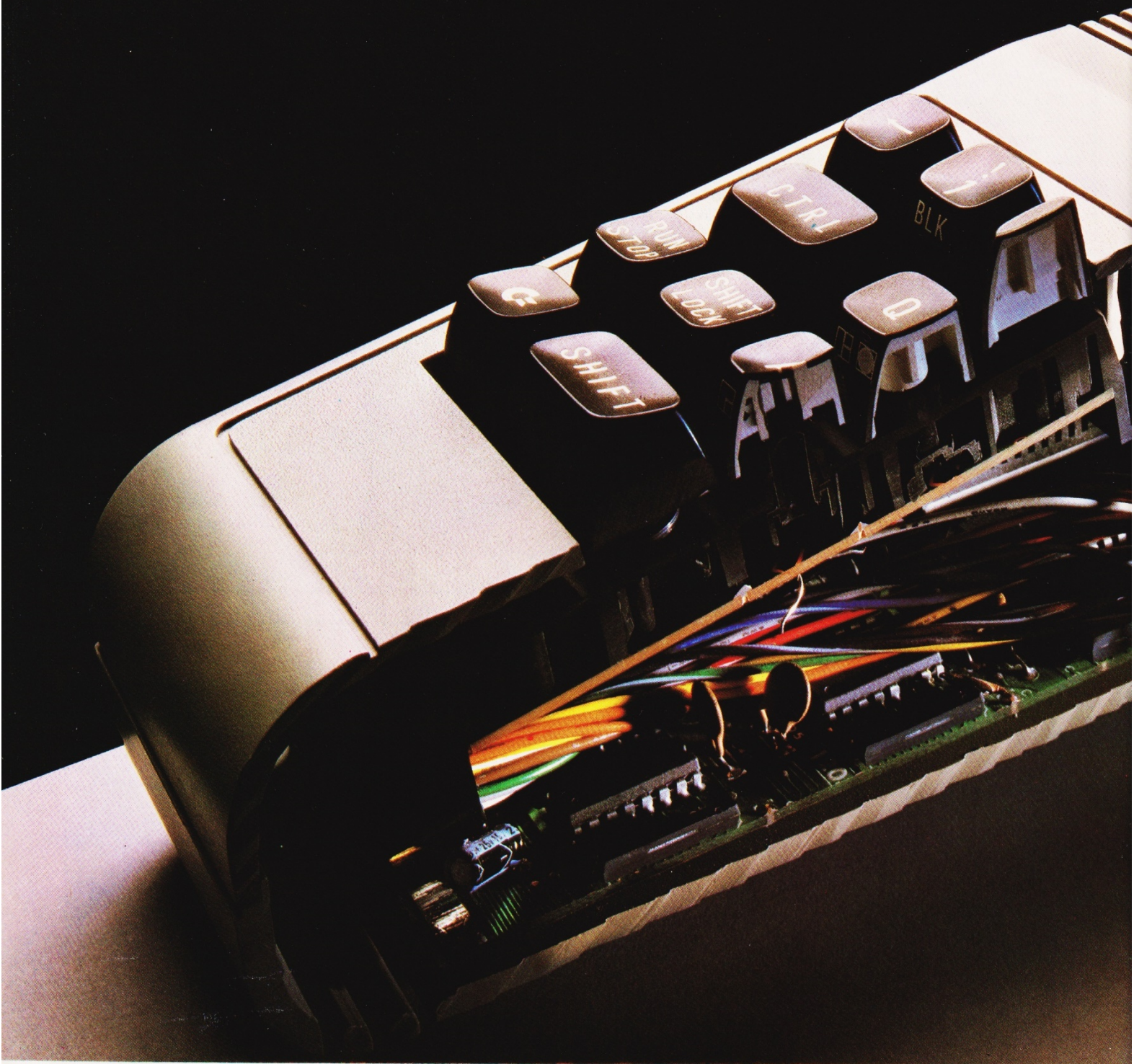
squares, a sum and a square root

CONCLUSIONS

At present the Organiser will sell to its target group of businessmen and students, but

probably more because of its novelty value than its usefulness. Nevertheless, I hear Psion are working on POPL Mark II which will allow full access to the database so that multiple sorts can be made, for exam-

ple, and that will be a product worth having. If Psion can find a way of cramming an alarm function in and wringing a bit more speed out of the processor, then they will have a product that will sell like wildfire.



Are you only using

To play only games on a Commodore computer is like asking Albert Einstein to work out the square root of four.

The computer's brain barely ticks over.

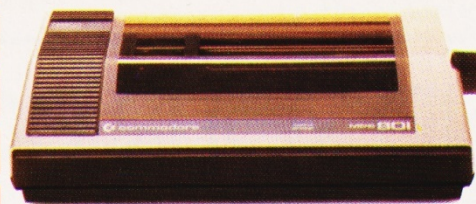
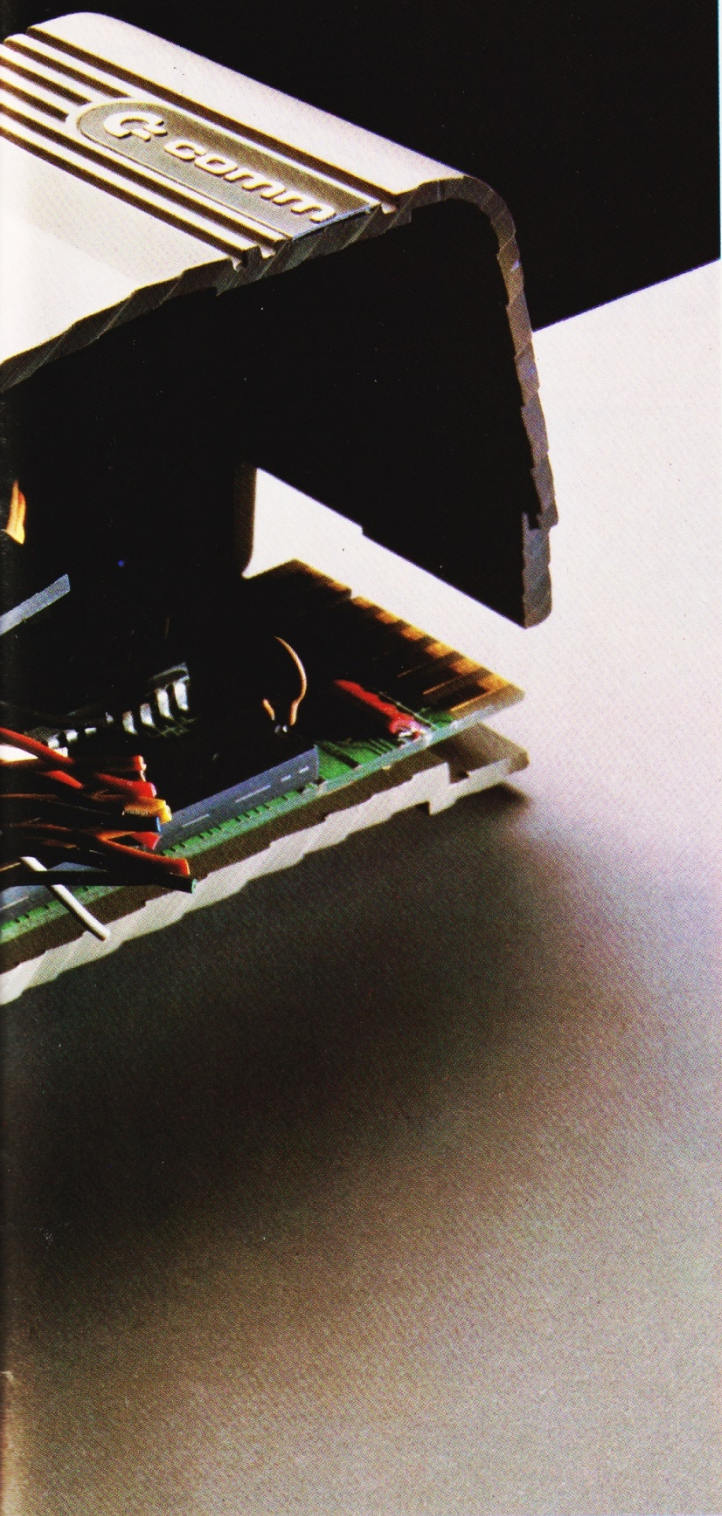
To really stretch it, you need more interesting software programs. For example, record keeping, interactive education, stimulating adventure games or word processing.

And for these you need peripherals.

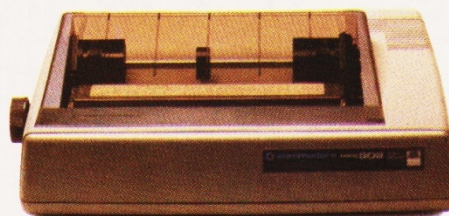
Like a Commodore disk drive, a really fast storage and retrieval system with a vast memory.

Or a Commodore cassette unit, the inexpensive way of loading and storing programs.

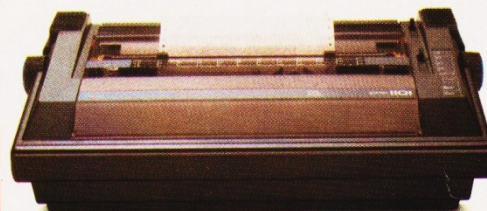
For those who like the idea of text and graphics being more alive and having greater clarity than on a TV, there's the Commodore colour monitor.



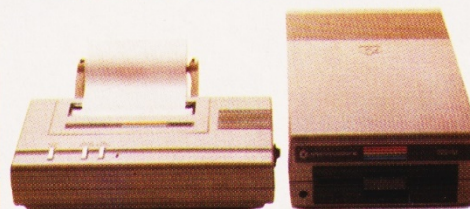
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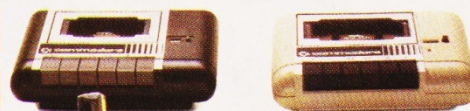


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First impressions of the PCW Show at Olympia 2 last month (September 19-23) were that this was a Serious Business. This was clear from the number of well-dressed gentleman in grey suits who made up the main part of the crowd. Indeed the only un-suited, un-tied (un-ravelled) people in sight were mostly fellow journalists. Of course the first day was Press and Trade only, but even on the first open day the mood of up-market intensity remained.

At the weekend, though, the students turned out in force — overall some 30% of the total attendance was made up of school age and college/university students. Initially they crowded out the

Still, exhibitors at PCW were a mixed bunch. The ground level was mostly occupied by the market-leading personal computer manufacturers. Acorn was there, with their new range of ABCs — Acorn Business Computers. And what a range it is, from the Personal Assistant (6502 CPU, 640K floppy, Econet, green screen, and bundled with View and View Sheet) through to the ABC 310 (80286 CPU, colour display and 10M hard disc) with six options in between.

Acorn are hoping that this range will establish them firmly in the important business sector, though informed pundits expressed disappointment at the poor cosmetics of a range which is plainly

considerable attention. The Show was intended to be the occasion for the launch of the disk drive version, but only one was up and running. The crowds around this were so deep that I finally gave up trying to get close to it. It seems certain that the CPC464 will live up to the prediction of being one of the hottest machines on the market this Christmas.

The Sinclair stand also attracted a good crowd; most were there to see the QL for the first time. Reactions were mixed, though, and several people commented on the poor quality of the keyboard and the appalling load time of the Microdrives.

According to pre-show publicity, Commodore were

ing them all quite anonymous. Commodore's business machines were also on display in an adjacent section of their stand, and it was a bizarre experience to be sandwiched between games players on one side and accountants on the other, catching snatches of different conversations in what seemed like different languages.

Conversations were being held on Currah Computers' stand, too, but the main attractions were the monologues spoken by their MicroSpeech synthesiser for the ZX Spectrum, and the Speech 64 unit running on a Commodore 64.

Like Commodore, Tandy exhibited a mix of business and personal computers, but

IT'S SHOWTIME...

Ron Keeley

If it's Autumn, it must be the PCW Show, Mecca to the hacker. We shelled out for a notepad and a large box of corn plasters and did the rounds of the stands.

games stands, but eventually trickled to the business section where they showed almost as much interest in Serious Computers as they had in the latest arcade game. After all, a Mac or an Apricot has capabilities far beyond those of the average home computer, and they can do some pretty cute tricks, as anyone who has played with MacPaint will tell you!

Yet I couldn't help contrast PCW with the previous computer exhibition at Olympia. That had been the Acorn User show, which had all the cheerful conviviality of Romford market on a fine Saturday morning, lacking only speech-synthesised barrow boys shouting up trade... "Getcha software only five pounds...to you, John, four pounds, alright?"

Perhaps it was the almost total absence of exhibitors catering for the hardware hacker. Software fanatics are pleasant enough, but they do tend to take things terribly seriously. Your nuts and bolts man, on the other hand, often demonstrates a more energetic madness.

intended to compete with nicely styled computers from IBM, DEC, Apricot et al. At least, with such a range, their sales and marketing people will have lots to talk about.

Several other new(ish) computers were on display for the first time, with the Amstrad CPC464 attracting

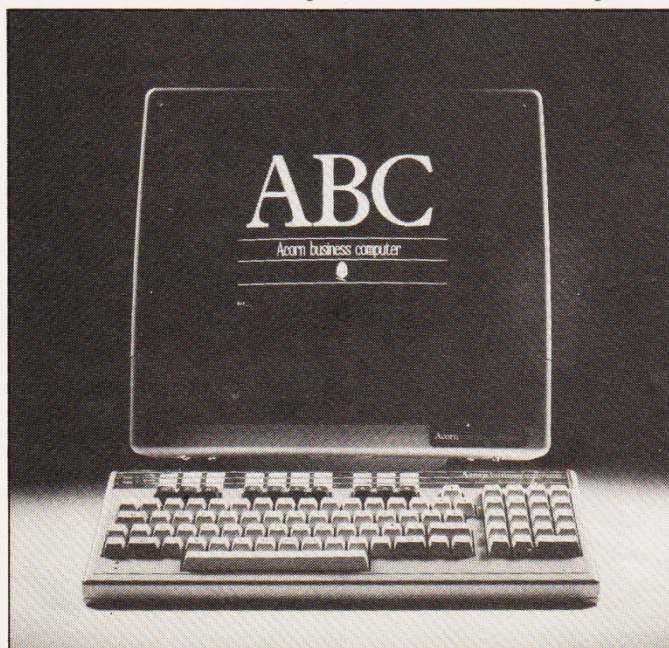
showing their new CBM 16 and Plus/4 computers. The Plus/4, an MSX lookalike, was easy to find, but the Commodore 16 was harder to track down. It is very similar in appearance to the CBM64, and the security plate fitted to their computers effectively covered the name tags, mak-

over at Atari the accent was almost entirely on games, games and more games. This was one of the most popular locations on the open days!

There were some other plug-ons to be found on the ground floor. Seescan's Digital Camera MkII for the BBC Micro was a fascinating exhibit, while Commotion had cornered a section of the Acorn stand to show off their own imaging system for the Beeb, together with their energetic robot arms.

If the mood on the ground floor was generally less than frenetic, the atmosphere on Level 1 was positively sedate; the only sounds the quiet hum of hard disk drives and the low murmur of accountants in deep discussion with their peers.

Here you could check out the latest Apricots, the F1 and the Portable. Both incorporate features that, while basically refinements, add to the attractiveness and usefulness of the machines. The infra-red (cordless) keyboard and mouse are really techno-gimmickery (who can read a screen from across the room?) but are



Acorn's business machine — take your pick from several versions.



Seescan's camera, for a Mode 0 Marilyn Monroe.

nevertheless useful to a point.

Taking the concept of user-friendliness to the limit, the Portable's voice recognition system can replace the keyboard for entering commands, and could be a real improvement with some of the more complicated software packages on the market.

Joining the other scruffs on the Apple stand, I was most interested to see the Super Mac — a Macintosh with 512k RAM instead of the paltry 128K originally offered. The price, however, is far from paltry — it's an extra £800 — though it can be expected to fall as the price of memory ICs falls, as supply catches up with demand.

The other Macproblem — lack of software support — has vanished almost overnight, with a flood of applications software appearing as if by magic. FileVision, a graphics/data base program, was particularly impressive. I was also impressed by the application that Jane Ashton, one of Apples Sales Support team, had worked out for it. This was a complete stock control system for a store or supermarket, laid out graphically as a floor plan complete with stock items in place, but with instant access to all the relevant data such as price, stock levels, sales figures, order dates and so on. FileVision is

available, I was told, from P&P Computer, who weren't at the Show.

Also on display was the new Apple IIc portable, which was styled by the same design consultants who created the distinctive Sony Walkman. At £685 the IIc is over £1000 cheaper than the Macintosh, and some of the software, such as Mousepaint

II for example, is clearly derived from the Macsoft range. And, of course, the IIc runs all Apple II software, of which there is a considerable amount!

The only other heavyweights in attendance this year were Digital Equipment Co. and ICL. Neither IBM, Hewlett-Packard, or Wang were there, nor Com-

paq, Olivetti, ITT or any of the Japanese. However, many — and especially IBM — were present by proxy on the stands of software houses like Lotus, Ashton-Tate and Psion, and with dealers such as Silicon Valley Psion were demonstrating their Xchange suite, and also proudly showing their unique Organiser, which appears to be an overnight sensation. (see our review on Page 41 —Ed)

Some Japanese makers were also represented by dealers or software houses; Icarus Computer Systems had the Sanyo MBC555 16-bit computer, while Professional Data Services demonstrated their accounting and word processing packages on NEC products. One Japan-based company was present in the flesh, the curiously named Microvoice Corporation. You'd expect them to be in the speech synthesis/recognition line, but no ... they make an IBM-compatible called the Mugen, and a portable for business industrial use, the Formula-1.

There were many more dealers and software houses, of course — Anagram Systems, Tabs, Softsel and KGB Micros, to mention a few — but more interesting were the hardware and software support and applications people:



The Commodore Plus/4 — a radical change in styling for that company.

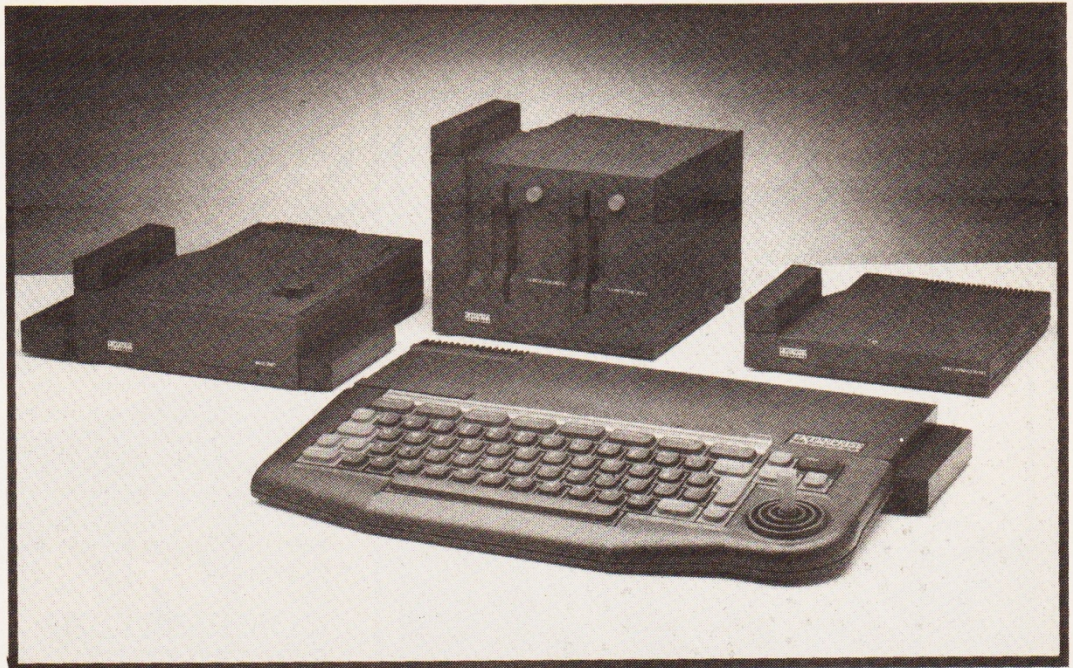
Quest, who supply disc and memory support for both the BBC Micro and the Sinclair QL; Transam Microsystems, who offer design and development services, software consultancy, maintenance and communications in addition to dealer services; O.E. Limited, who design microcomputer telecom-munications equipment (including the ZX Spectrum compatible VTX5000 modem); next door to them was IO Research Ltd, with their Pluto II graphics cards for IBM and Sirius (see page 37); Biodata, who make a modular interface to laboratory instrumentation; and Advance Electronics and Power Testing (UPS) Ltd, both demonstrating protected computer power supply units.

Last visitations on this floor were to BICC-Vero, one of the few 'nut and bolts' companies to take a stand, who were kept busy explaining the ins and outs of their rack systems, wire-wrap systems and connectors, while Mary Pearce looked after the hobby side; and Compuser, a company now to me, who make an extensive range of all British monitors for popular computers.

THE HEADY HEIGHTS

The business section of the Show was interesting, but the action was on Level 3. Here were Oric, putting on a brave show with the Atmos and two new products for it, the V23 modem and a Centronics-standard 80-column dot-matrix printer. They were helpful in answering my queries about Atmosing my old Oric 1, too. Opposite them were Tansoft with their excellent 'Author' text editor program — one that's high on my list of useful and friendly word processors.

Nearby, Memotech showed their rapidly expanding line of computers and peripherals, including the stylish FDX twin disk system, which unfortunately is over-priced for the home computer market. This area of the floor was a little dangerous at times due to the activities of the Heathrow Jets, a local gridiron team hired by Argus



The Enterprise collection looks nice — but when will it finally be on sale?

Press Software to promote their American Football game for the C64 and Spectrum. The Jets were an added attraction to the Show, provided you didn't get caught up in one of their 'plays' (watching them, they looked about as playful as a herd of charging elephants).

Then there was a sight that many pundits thought they would never see — a

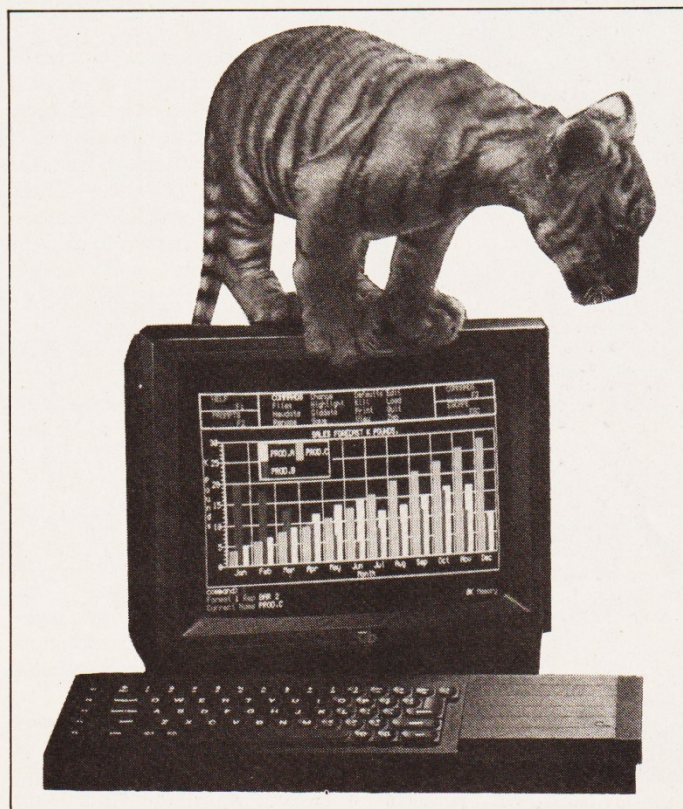
stand boldly marked Enterprise Computers. A measure of the general disbelief was the cynical joke that the computers were connected to a mainframe hidden in the central part of the stand! Jokes aside, the Enterprise failed to impress many people I spoke to, with the keyboard taking most of the criticism.

Kempston Microelectronics were demonstrating

their range of joysticks for the Spectrum, including the Pro-Joystick Interface which comes fitted with a cartridge slot and three 9-pin D-sockets that provide compatibility with almost all games. They had to compete with a nearby stand (it shall remain nameless) who unsocially amplified the sound of their games programs to uncomfortable levels.

The most ingenious and spectacular stand this year belonged to Microvitec. Their range of medium and high-res colour monitors were outstandingly placed in an exotic South Seas setting, complete with bamboo hut and tropical foliage. Centrepiece of this eye-catching display was a bamboo cage in which three three-month old tiger cubs (Microvitec CUB displays — get it?) alternately prowled and slept. At that age they seem just like big pussy cats (even shredding sheets of newspaper, as mine do most Sundays), and the temptation to reach in and scratch behind the ears was almost irresistible. Fortunately Microvitec had taken the precaution of placing the cage out of reach. Equally fortunately the cocktail bar in the corner of the stand was quite easily reached: thank's for the hospitality, gentlemen. I recovered, eventually.

Since MSX is unlikely to make much of an impression this year, it was not surprising



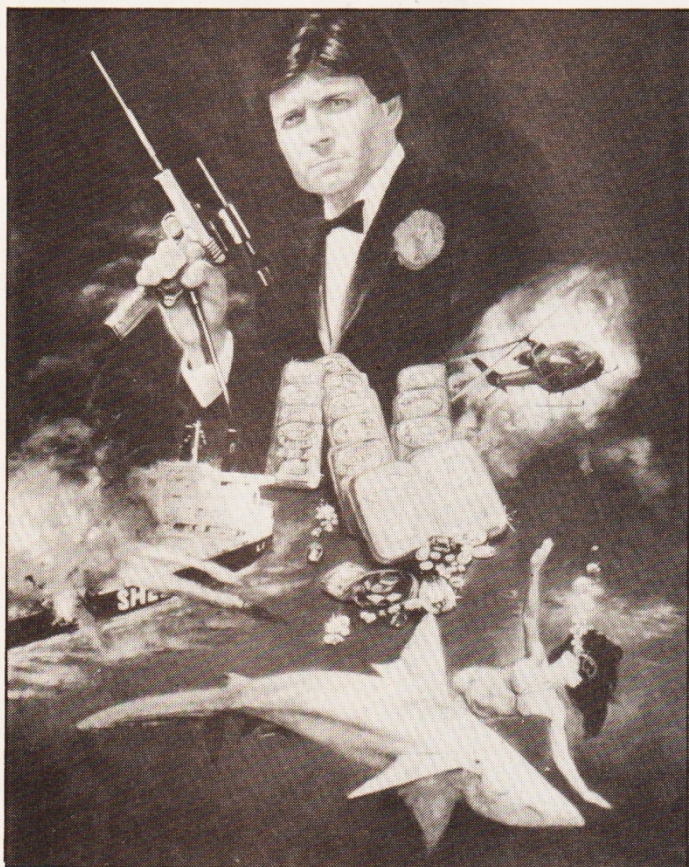
Two of Microvitec's QL-matching Cubs.

Return to Eden



Level 9 Computing

The eagerly-awaited sequel to Level 9's 'Snowball' Adventure is now available.



A rather over-the-top piece of promotional artwork from Domark for their £250,000 Eureka! competition.

that none of the MSX group chose to attend. However Hudsonsoft, Softek International and Stell software were all demonstrating MSX programs.

Book publishers stands — Shiva, Granada, Sunshine and Century Communications among them — were magnets for budding authors and magazine publishers were busy trading in backnumbers and (from past personal experience) fielding complaints from aggrieved readers who had finally become fed up trying to find the "printer's error" in that 1000-line program they'd been debugging for the last six months!

COMPETITIVE SOFTWARE!

A number of exhibitors ran competitions during the show, but the best of the bunch doesn't actually commence until 31st October. Domark's competition is built into their arcade and adventure game, which is called Eureka! It contains five separate adventures together with five arcade games, all set in different historical/mythological periods. The storylines were written by "Fighting Fantasy" author Ian Livingstone, and programmed in Hungary (!) by a team of 20. From the little I could see, Eureka! is a very professional package, well thought out and expertly executed. The 'competition' is to find the clues hidden both in the programs and in the illustrated booklet. These reveal a telephone number, and the first person to dial the secret digits will collect £25,000 cash money. That's some prize!

Few companies at PCW could match that level of hype, but many tried, using the occasion either to launch or to preview new products for the Christmas season. Among them were A&F, Audiogenic, Creative Sparks, Elite Systems, K-Tel, Melbourne House, Micro-Gen and Virgin. No doubt you'll be seeing and hearing a lot more about their games over the next few months.

Educational software was a bit under-represented, I thought, but that has been the story throughout 1984. Still, Hill MacGibbon, Ebury

Software, Longmans, Visions Software Factory and Mirrorsoft all attended, while Tina Dethridge of Widgit Software shared a Mirrorsoft stand to promote a new Mr Men program.

Island Logic previewed their Music System program suite for the BBC Micro. It is "the first" fully integrated music system for the BBC, and consists of an editor, linker, keyboard synthesiser, and printer driver. A version for the Commodore 64 will be available in the new year.

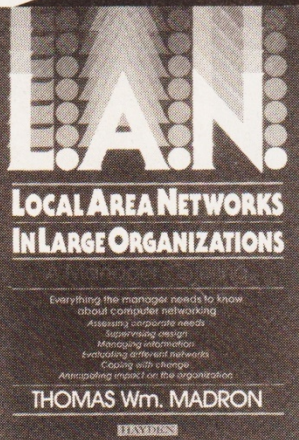
There were, in addition, a few stands I would have liked to have seen, but didn't, and a few more I would have liked to have spent more time with, but couldn't. One of these was Tatung, whose Einstein computer could stand closer investigation. Never mind, there's always next year, when the PCW Show will expand into the National Hall, adjacent to Olympia 2. The organisers consider this to be necessary because, although attendance levels at computer shows are generally falling, PCW is holding up well, with some 46,000 genuine visitors passing through the doors.

IN CONCLUSION

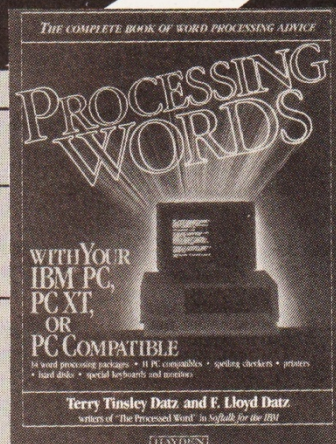
I did find the mixture of business software, games and hardware somewhat peculiar at first. Like the parent magazine, the PCW Show seemed to be trying to be all things to all men. But, by the end of the five days they had obviously succeeded in satisfying most, if not everyone (all credit to the organisers, too, who ran a very smooth operation there).

And at the end it seemed to me that the computer market is not as segregated as some people like to believe: today's 16 year-old games hacker is tomorrow's business software programmer or user, and anyone who has the slightest interest in any form or function of computing must inevitably be drawn to uses other than those that attracted him in the first place. On that basis, the PCW Show will continue to please most of the people, most of the time.

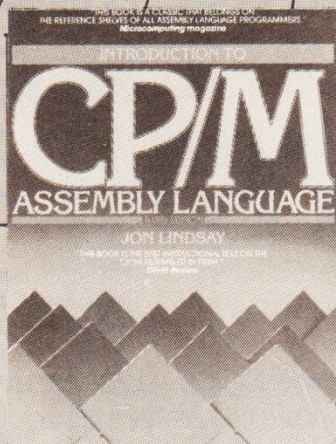
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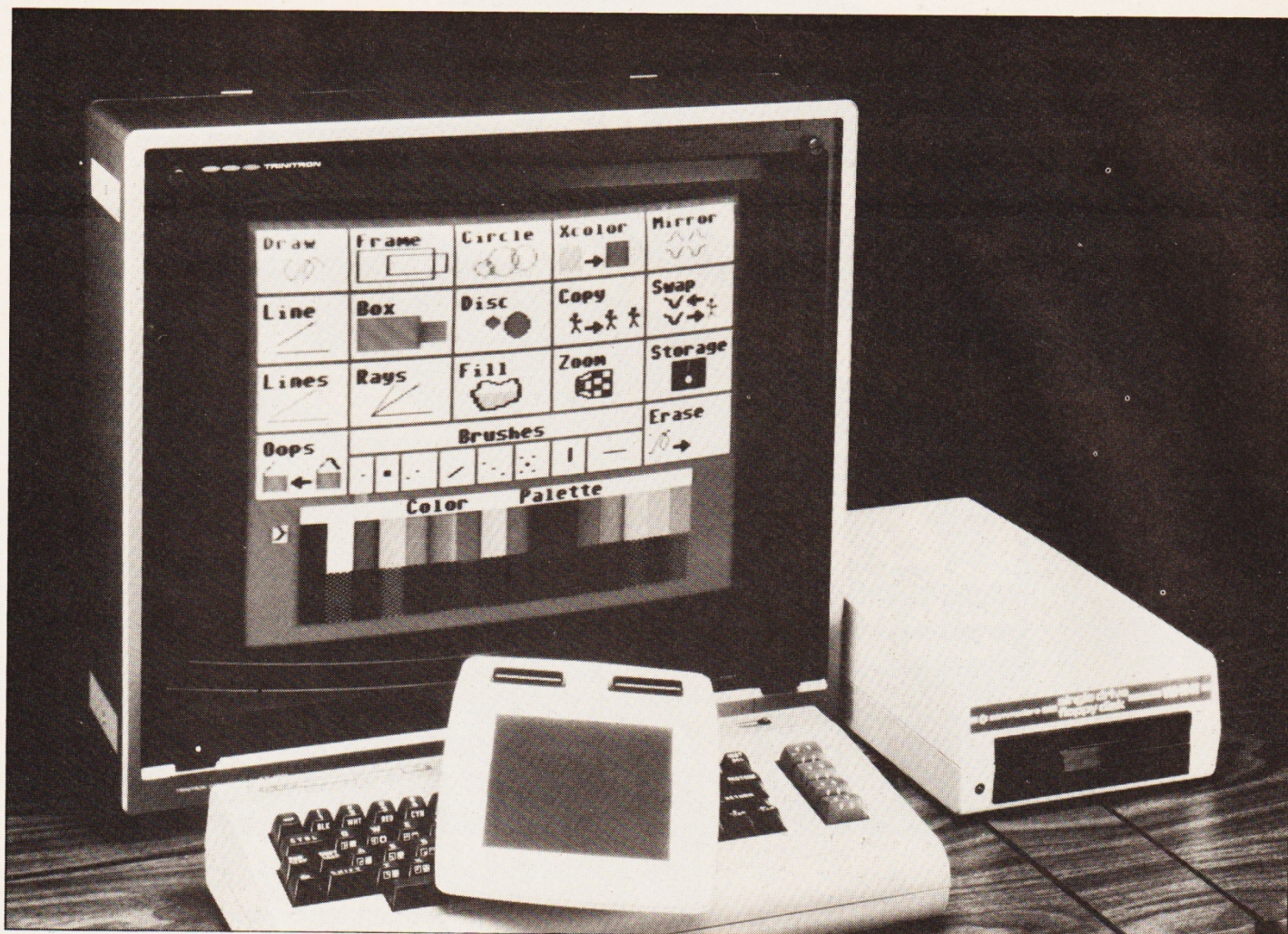
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One of the greatest barriers to a person's use of a computer is the keyboard. It is strange that such an easy-to-use device can put off a lot of people because they think that they are going to have to learn how to type in order to interact with their computer. It's not only adults who face this problem. Young children have difficulty recognising the upper case letters used on most keyboards, as they are taught lower case first.

It is hardly surprising, then, that one of the biggest growth areas inside the personal computer industry, is the design of devices which minimise the need for keyboard interaction. Much favoured for the business micro is the mouse. This is a small device which uses a rotating ball to translate its position on a flat surface into a corresponding position on screen.

The subject of this review, though, is one of the growing numbers of devices favoured by the home computer user as the prime method for avoiding the keyboard: the touch tablet.

TAKING THE TABLETS

Chris Palmer

Graphics tablets, that is. The device in question is simple, remarkably cheap, comes with some excellent applications software and can be easily adapted for other uses. What is the name of this wonder? We at CT are not afraid to lay the Koala bare...

ENTER THE KOALA

One of the most remarkable features of the Koala Pad is its price. At £79.95 it is by far the cheapest touch tablet to reach the market, especially when you consider that this price also includes a highly usable

graphics utility to boot. The main reason for the low price is that it uses a pressure-sensitive surface to register the input, as opposed to the more expensive types which use a system consisting of a grid of wires and a coil attached to the stylus, to register input. The pressure-only system does have advan-

tage and disadvantages. The main advantage is the fact that you can use anything to register on the surface; pencil, biro, even a finger. The disadvantage of this system is that it sometimes requires considerable pressure to register the input.

CONSTRUCTION

The pressure-sensitive pad which forms the basis of the system is housed in a strong molded plastic surround which would easily stand up to considerable punishment in the hands of even the most destructive child. The pad itself measures approximately four inches square and is covered with a hard-wearing vinyl. This is a little on the small side for my liking, more so when you consider the scaling factors involved when mapping a movement on the pad onto a 22" television screen. I imagine the reason for this is to keep the cost down, because the cost of making the pad and the hardware to scan it does not necessarily increase in direct proportion to the size of the pad.

Mounted above the pad are two large plastic buttons. Both of these can be read individually from software and are used mainly to confirm selections made using the pad. A single PCB is fitted internally which contains a single IC and

a few passive components, which together convert the signal generated by the pad into a form which can be read by the computer.

The design of the case is such that, when placed on a flat surface, the pad is angled towards the user so as to fall naturally under the hand. The base is also sculpted to make hand-held operation possible as well.

Along with the Koala Pad, the package also contains a plastic stylus, a manual outlining care of the pad, and the Koala Painter manual and corresponding software.

KOALA PAINTER

One of the prime applications of the Koala Pad has got to be graphics, if only because using the pad is just like drawing on a piece of paper. So it is no surprise that the included software takes the form of a graphics package. And no token gesture this — Koala Painter is one of the best home computer graphics aids I have yet to see. Its design owes a lot

to the work which has been done in producing graphic displays for business micros.

The heart of the system is the main menu. On it there are a series of graphic representations of the main functions which the package is capable of. These are selected simply by moving the cursor anywhere within the box containing the function you desire, and pressing one of the buttons. The contents of the box will now flash as a reminder as to which function is active.

Beneath the screen commands is the colour palette. This comprises 16 solid colours and 16 tones, the latter made by displaying the solid colour as a 'speckled' pattern over the background. Once again, these are selected by placing the cursor of the colour you want and then depressing a button. The background of the menu will change to indicate the colour selected.

The menu also contains a selection of eight brush shapes which can be selected in a similar fashion.

Once the desired option,

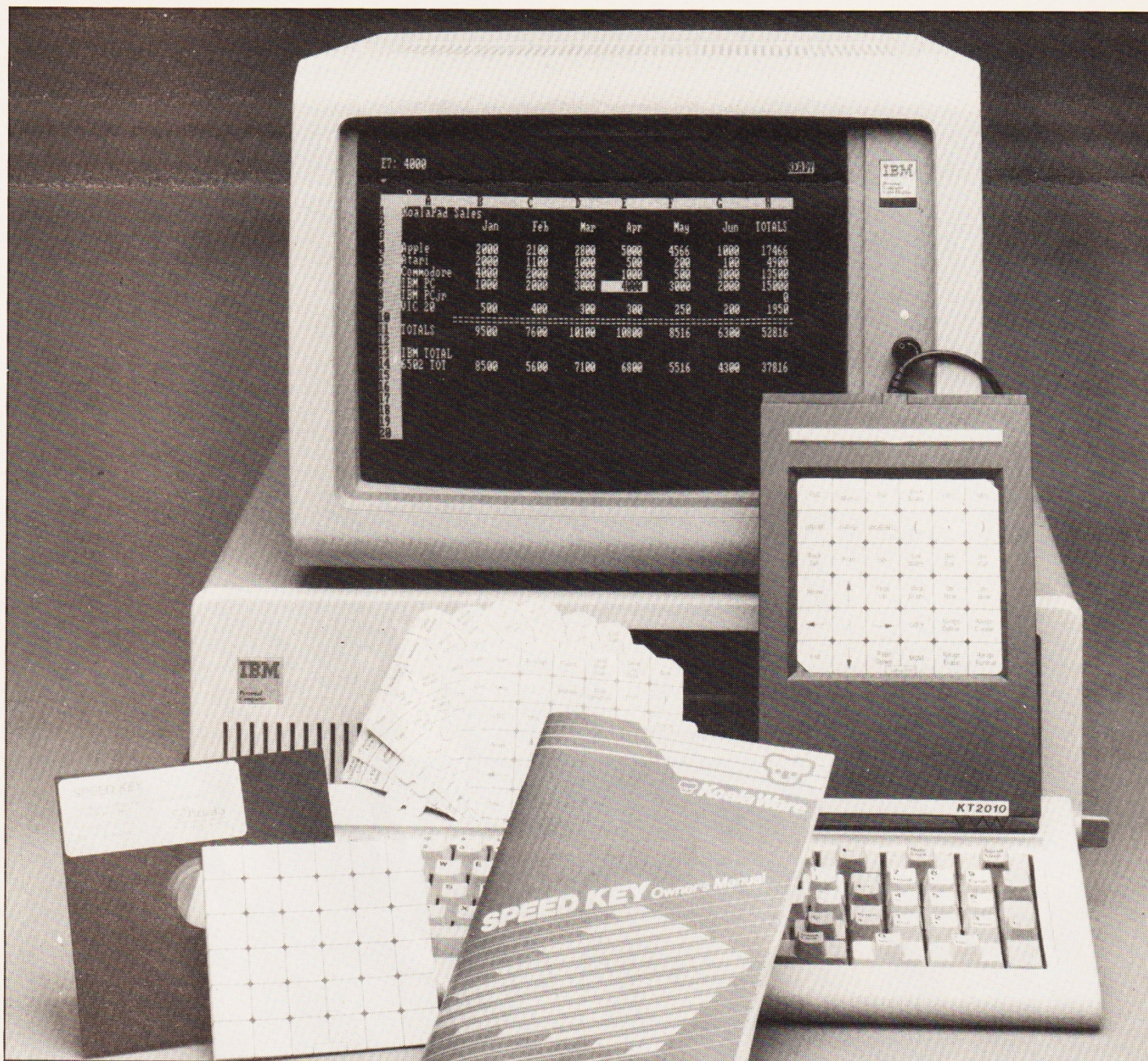
colour and brush shape has been selected you can toggle the display to the actual drawing area. This is achieved by moving the cursor to the very bottom of the pad and pressing the button.

Once the drawingscreen has been reached, any movement on the pad will cause the cursor to move in unison on the screen. Depending on the option selected on the main menu, pressing the buttons will cause the computer to start drawing at the cursor position.

The software functioned surprisingly accurately considering the size of the pad. My only criticism was that there was no provision made for dumping the completed screen to a printer. Seeing that the software is specially written for each make of computer the pad runs with, I would have thought it would be a sensible idea to include a dump routine tailored to the most commonly used printer for that machine. The only way I can see of obtaining a hard copy is to save the picture to disk and then write your own software to retrieve and dump it



Koala Painter on the Commodore 64. Here you can see the on-screen menu described in the text.



The KT2010 Touch Tablet is similar to the Koala Pad in operation but is used with business software.

a task which would be beyond the majority of novice users.

KOALA PAINTER COMMANDS

The Koala Painter package has a considerable number of options available to simplify the drawing process. These function as follows:

DRAW This enables freehand drawing, with the on-screen cursor acting exactly like a pen nib.

FRAME Allows a part of the picture to be enclosed in a box and then moved to another part of the screen.

CIRCLE Enables a circle to be drawn and transported to the desired position on screen.

XCOLOR This command allows you to replace any colour on the screen with another, without the necessity of re-drawing it.

MIRROR Enables symmetrical drawing about two planes.

LINE Allows 'rubber band' drawing of straight lines. The origin of the line can be fixed and then the other end moved until the desired position is reached.

BOX Enables a rectangle to be drawn and filled.

DISC Enables a circle to be drawn and filled.

LINES Allows a series of lines to be drawn, the end point of one becoming the beginning of the next.

RAYS Enables radiating lines to be drawn from a central point.

FILL Allows any shape to be filled with the current colour.

Zoom Enables a portion of the screen to be expanded, thus allowing very detailed work to be carried out.

OOPS Delete the last instruction.

ERASE Erases the entire screen.

COPY Enables multiple copies to be made of one part of the screen to another location.

SWAP Swaps between the two available work screens.

STORAGE Facilitates loading and saving of screen pictures.

CONCLUSION

The entire Koala Pad package represents superb value for money. It is available in versions to fit the IBM PC, PCjr, Apple, Commodore 64 and Atari. Games, utility and education packages are also available for it. One very commendable feature of the package is that no secret is made of the routines used to interpret the pads' output, thus opening the door to your own custom packages.

Finally, if you find that the pad is not sensitive enough for your work, then the software can also be used with a trackball.



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LUCAS MICRO

LUCAS LX

CPU	Z80
MEMORY	64K RAM
LANGUAGE	Microsoft BASIC
MASS STORAGE	Cassette at 300 or 1200 baud Single or twin 5¼" floppy disc drives CP/M 2.2 (supplied) or NAS-DOS
OS	QWERTY, cursor, numeric pad, function keys
KEYBOARD	
INTERFACES	RS-232C, Centronics, interface for 5 Mb Winchester, control bus (see below)
DISPLAY	Monochrome monitor supplied, colour optional
GRAPHICS	80 by 25 text, with user-defined block graphics 392 by 256 eight-colour or 784 by 256 two-colour high-resolution graphics
SOUND	No

Notes. The Lucas LX is a computer which is aimed at the more professional and business users.



SHARP MICRO

SHARP MZ-3541

CPU	Z80A (two), 80C49
MEMORY	128K RAM, 8K ROM
LANGUAGE	Sharp BASIC
MASS STORAGE	Twin integral 5¼" floppy disk drives, total capacity 1.28 Mb
KEYBOARD	QWERTY, cursor, numeric pad, function keys
INTERFACES	RS-232C, Centronics, interface for extra external floppy disks
DISPLAY	Monochrome monitor, colour optional
GRAPHICS	80 by 25 text, 640 by 400 high-resolution graphics
SOUND	Single channel

Notes. The Sharp MZ-3541 is aimed at the businessman. RAM is expandable to 256K, while two disk drives may be added externally to complement the integral pair. Colour is only possible with the optional graphics expansion RAM. One Z80 handles the main CPU activities while the other handles peripheral activities. The third processor handles the keyboard. The availability of CP/M means a ready supply of business software.

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COMMODORE 715B

CPU
MEMORY
LANGUAGE
MASS STORAGE

6509
56K RAM, 20K ROM
Commodore BASIC
No cassette
Single or dual 5¼" floppy disk drives
Commodore's DOS
QWERTY, cursor, numeric pad,
function keys
RS-232C, IEEE 488, memory bus, eight-
bit parallel, cassette port, second
processor bus
Monochrome monitor supplied
80 by 25 text, block graphics
Three channels

OS
KEYBOARD

INTERFACES

DISPLAY
GRAPHICS
SOUND

Notes. The Commodore 715B is the top model in the 700
range of business machines. Although built round the 6509
processor, there is a second processor option (8088). The
machine has been designed to meet IEC specifications. The
black-and-white monitor screen is integral and features tilt
and swivel. The keyboard may be detached.



COMMODORE 64

CPU
MEMORY
LANGUAGE
MASS STORAGE

6510
64K RAM, 26K ROM
Commodore BASIC
Cassette unit at 300 baud
5¼" floppy discs available
Commodore's own
QWERTY, cursor, function keys
IEEE 488 bus, cartridge port, cassette
port, two joystick/light pen ports
TV output
40 by 25 text, block graphics (user-
definable)
320 by 200 high resolution graphics in
16 colours
Three channels

OS
KEYBOARD
INTERFACES

DISPLAY
GRAPHICS

SOUND

Notes. The Commodore 64 is a popular micro with a great
deal of games software available. There is also some
business software, such as spreadsheets and word
processors, available but this suffers from the lack of an 80-
column screen. Graphics and sound have extensive
capabilities, for example eight multicolour sprites and three
channels of sound covering nine octaves each.

xi APRICOT

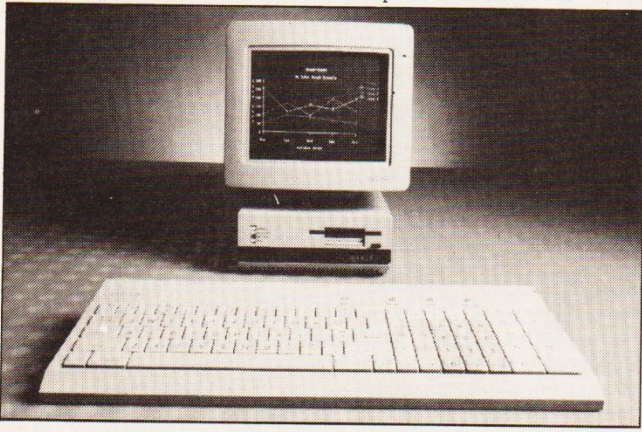
CPU	8086
MEMORY	256K RAM
LANGUAGES	Microsoft BASIC, Personal BASIC
MASS STORAGE	No cassette drive Integral Sony 3½" 315K microfloppy disk drive
OS	Integral 5 or 10 Mb hard disk MS-DOS 2.11 with GSX bundled CP/M-86 (not yet available) Concurrent CP/M-86 (not yet available)
KEYBOARD	QWERTY, cursor, numeric pad, function keys
INTERFACES	RS-232C, Centronics, Microsoft mouse
DISPLAY	Monitor (supplied)
GRAPHICS	80 by 24 text with block graphics 800 by 400 high-res graphics under GSX
SOUND	No

Notes. The Apricot xi is a development of the award-winning Apricot, and replaces one of the latter's disk drives with an integral hard disk, providing vastly increased storage with faster access. Memory may be expanded in 128K increments to a maximum of 768K. The languages and operating systems mentioned above come bundled (except for Concurrent CP/M) and four software tools are also bundled, including an asynchronous package for use with the optional modem card.

APRICOT F1

CPU	8086
MEMORY	256K RAM
LANGUAGES	MS-DOS, Concurrent DOS (Optional)
MASS STORAGE	No cassette drive One integral 3½" 720K Sony microfloppy disk drive
OS	MS-DOS 2.11, Concurrent DOS (optional)
KEYBOARD	QWERTY, cursor, numeric pad
INTERFACES	Infra-red link for keyboard or mouse, expansion slot, RS-232C, Centronics
DISPLAY	TV or optional monitor
GRAPHICS	80 by 24 text 640 by 256 four-colour, 320 by 256 16-colour maximum high resolution
SOUND	No

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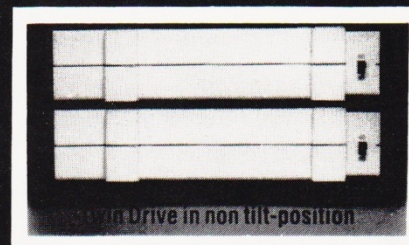
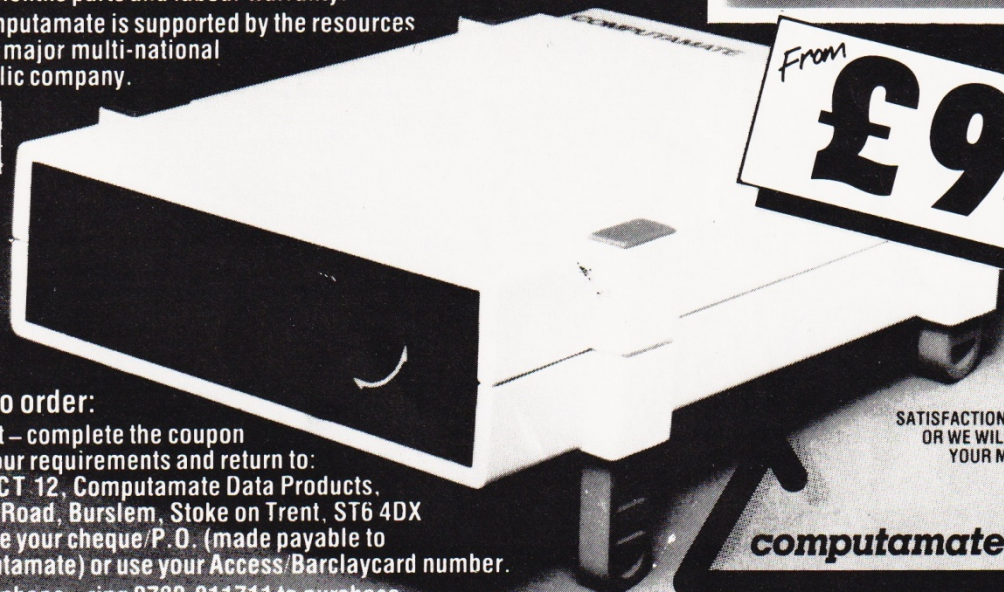
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