

IBM PERSONAL COMPUTER

The much-rumoured IBM Personal Computer was finally announced last month and, just to make sure it really exists, PCW sent David Tebbutt to Florida to conduct the world's first Benchtest and to meet the people who made it happen.

With more than a little help from its friends, IBM has come up with a real stunner of a personal computer and, much to PCW's delight, it has named it the IBM Personal Computer, which must surely remove any lingering doubts about this magazine's title. The system has much to commend it both for serious and fun applications since it can grow from a fairly expensive cassette-based configuration to a full-blown twin disk/colour graphics machine which offers the competition a fair run for its money. It almost goes without saying that the computer is well made, keeping up IBM's almost legendary reputation for quality.

After watching the growing personal computer industry very carefully, IBM finally cranked its own Personal Computer project into action around 14 months ago. The public was becoming aware of the usefulness of these machines and prices were dropping to an affordable level; this was enough for the grey giant and it made its move. By swearing certain key people and companies to utter secrecy, IBM was able to discuss its plans and listen to those who already knew what the microcomputer game was all about. Microsoft, for example, was involved right from the beginning and was able to give a lot of help, particularly with the graphics and sound facilities. Later on, once a design was fairly clear, ComputerLand became involved and advised on aspects of dealer support and training. Sears, Roebuck was approached, too, and was particularly helpful when it came to packaging the products for the retail outlet.

The machine will be sold in America through IBM's own Products Centres, through sales offices within its Data Processing Division (DPD), through ComputerLand's existing network of some 170 shops and through Sears' about-to-be-opened business machine stores. At the moment the system will only be sold in the USA and Canada and IBM will not say when, if ever, it will come to Britain. Since demand is bound to be very high in North America, IBM will clearly have to gear up its manufacturing and distribution quite significantly before we will see any systems in this country.

Hardware

The minimum configuration Personal Computer comes in two parts: a



System Unit, which houses the memory, processor, loudspeaker, power supply and expansion slots and a keyboard, which is connected to the system unit with a six-foot coiled flex terminating in a DIN plug. One or two 5½in disk drives can be installed in the front of the system unit and up to five optional enhancement cards can be plugged into the slots. A monitor or domestic television is needed and, for those without disks, a domestic tape recorder with a DIN connection will be necessary too. IBM supplies an Epson printer as its standard listing device although there's no reason why you shouldn't attach a printer of your own choosing. In use, the monitor would probably sit on the System Unit while the keyboard could be used on a table or on your lap. Two little lugs allow the keyboard to tilt when on a flat surface and they tuck away if you're using it on your lap. The whole design is very pleasing and all the parts clearly belong together.

Everything about the IBM system is designed with a first-time user in mind. The company has gone overboard to make the system as easy as possible to configure and use with one of the main aims presumably being to minimise IBM and dealer post-sale involvement. Two screws secure the top of the system unit and, once removed, it is a simple matter to add memory, plug-in boards or even disk drives. IBM supplies a monochrome monitor with a very steady,

clear display of 25 rows of 80 characters or you may prefer to buy your own colour monitor or even use the domestic TV, each of which gives an option of 24 rows of either 40 or 80 characters. The graphics resolution is not as good in colour as it is on the IBM display. In fact, each character is 7 x 7 dots in an 8 x 8 box compared with 7 x 9 in a 9 x 14 box for the monochrome display. IBM does issue a warning that certain televisions and monitors (not its own) can cause data errors on disk transfers. It suggests the solution is to have the screen at least 12in away from the system unit. In order to drive these colour devices you would need to plug a colour/graphics monitor adaptor into one of the spare expansion slots. This board supports colour graphics — up to 16 colours in text mode, up to four in medium resolution graphics (320 x 200) and black and white in high resolution mode (640 x 200); it also allows you to define 128 graphics characters of your own when using either of the graphics modes. The board is also designed to handle a light pen. Composite and direct drive video outputs are provided to drive a colour monitor but for your domestic TV you'd have to buy an RF modulator as well.

The IBM monochrome monitor is a very high quality 11½in green phosphor device with an anti-glare screen. It gives a rock-steady display with no trace of flickering or that high-pitched whistling

which sometimes occurs. The steadiness is achieved by using a high-persistence phosphor coating which takes a fraction of a second longer to clear than most screens, although I can think of one or two machines which are far, far worse. In normal use it's doubtful that you'd even notice it. The screen displays 25 lines of 80 characters and each character is beautifully formed thanks to the high resolution mentioned earlier. IBM has taken advantage of all eight bits of the character code by adding a ninth bit for parity checking. This means that 255 different characters are offered, ranging from little faces through the standard ASCII set to special characters for foreign currency, mathematics and graphics. A separate byte associated with each screen character is used to describe the character's status — whether it is underlined, enhanced, flashing, non-displayed or reversed. An interesting feature of the character set is that the business graphics — the ones used to display forms on the screen — comprise a mixture of single and double line shapes which makes for very neat and compact form layouts.

The monitor plugs into a monochrome display and the printer adaptor, which occupies one of the expansion slots. If you're using the Epson printer then you won't need to buy an extra card to drive it as it plugs into this same card. If you'd gone for colour then you'd need a separate printer adaptor. There's no reason why you shouldn't drive a variety of displays, or even a variety of printers if you feel so inclined. The standard device is the Epson MX-80 tractor feed machine which has had some soundproofing installed and the wire paper guide sprayed in the official IBM colour. It offers 12 different character styles and (according to the documentation) 64 graphic characters plus nine special characters as well as the standard 96 character ASCII set. It will handle multi-part (up to three, anyway) forms between 4in and 10in wide. You can buy an optional printer stand which is a very neat smoky perspex unit which can store an inch or two deep stack of continuous stationery. It does have the slight disadvantage of amplifying the printer noise so you'd have to trade off noise against neatness. The stand is a rectangular piece of perspex bent back on itself, each half being separated by plastic pillars 3in or so high. This simple design was cooked up by an IBM engineer who felt that the programmers' own design of three or four bricks was somewhat less than elegant. One thing you'll notice from the price list is that the printer comes without a cable — you have to buy it separately at \$55.

The 'typematic' keyboard is a work of art. Offering tactile feedback and automatic repeating on certain keys, it contains every key you could ever imagine using, all in a well-designed unit which clearly owes a lot to IBM's experience in typewriter design. The only thing I disliked was that the shift keys were hard to find because they are located above a couple of other keys. To a non-typist this wouldn't cause the slightest problem but anyone used to a keyboard may experience some difficulty at first. Apart from the standard typewriter keys, it has 10 function keys, some assorted control

keys and a separate numeric/editing keypad — 83 keys in all. The keyboard is a low, flat unit which weighs a surprising six pounds. I found out later that IBM actually put a heavy metal plate in purely to stop it sliding around. It's that kind of attention to detail that characterises the design of this machine.

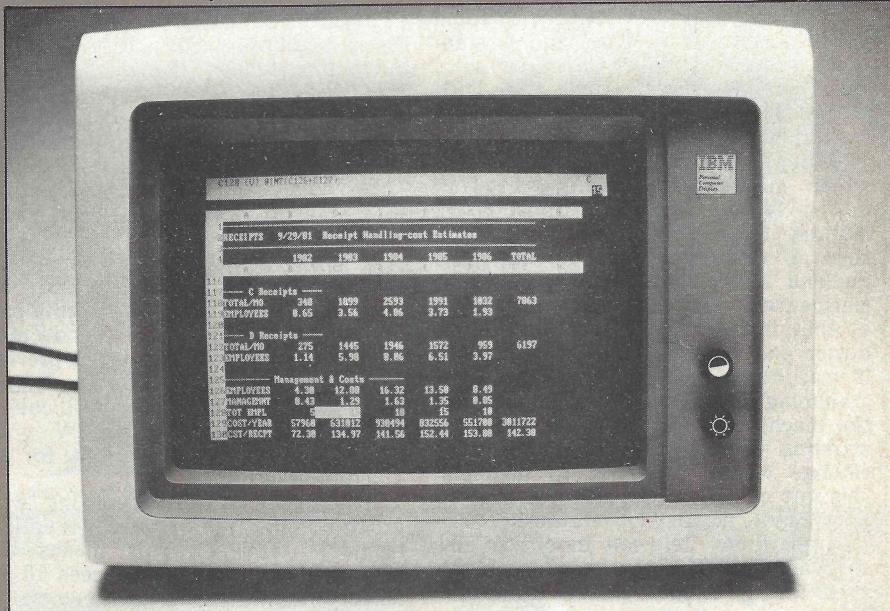
A numeric lock and a caps lock do exactly what you might suspect but when the numeric pad is not locked it acts as an editing keypad with insert, delete, cursor left, right, up and down, page up and down, home and end functions. A touch on the control key and the character functions operate on whole word instead. You will have probably gathered from this that full screen editing is standard. The mathematical symbols appear in their normal places as well as on separate keys so that they can be accessed without the need to use a shift key. Tabbing can be both forward and backward and a 'Prtscr' key allows you to dump text from the screen to the printer. When programming in Basic, you can print most of the commonly used commands by hitting a single key with the 'ALT' key depressed. The 10 function keys are defined to give single stroke facilities such as SAVE and LOAD and you may redefine them by using the KEY command in Basic. By judicious use of the shift, alt and control keys it is possible to access 40 facilities from the function keys. A mysterious key called 'Scroll Lock' doesn't actually do anything.

The Benchtest systems each had two

disk drives horizontally mounted in the front of the system unit. These looked suspiciously like the drives in my Super-Brain although IBM wouldn't confirm or deny this other than to say that it might obtain disk drives from more than one source. Each disk has a capacity of 160 kbytes held in 40 tracks each of 8 x 512-byte sectors. The drives are quite accessible even when the keyboard is pushed up close. A sensible feature is that the disk drives automatically switch off when they haven't been accessed for a second or two.

Tucked away inside the system unit is an 8088 processor which has an internal 16-bit structure, 8-bit data transfer and a 20-bit memory addressing capability. The 8-bit data bus means that the 8088 is compatible with the popular 8080/8085 processors' support circuits while the 20-bit addressing means that the processor is capable of accessing up to one megabyte of memory. An interesting gap on the processor board tells me that the IBM can accommodate an auxiliary processor — a floating point arithmetic processor or a mass memory/large scale communications handler perhaps?

The Personal Computer gives the user from 16k to 256k of RAM plus 4k or 16k of display memory on the adapter card, depending on whether it's for monochrome or colour. Up to 64k is held on the processor board and additional memory in 32k or 64k plug-in expansion boards. Since only five slots are available it would pay to go



The IBM's display: '... each character is beautifully formed ...'



Rear view of the System Unit

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for the 64k upgrades if at all possible. I wouldn't be at all surprised if one of the early announcements isn't an external expansion box to take more plug-in option cards.

Other cards currently available are a game control adaptor and an asynchronous communications adaptor. The game controller will accept two joysticks or four paddles which you'll have to buy from outside. The communications adaptor seems to me to be a complicated way of describing an RS232C/current loop interface which can be driven at speeds between 50 and 9600 baud. IBM intends to provide a subset of full 3270 emulation capability which should excite the odd DP manager here and there.

Working through a typical configuration, we find that a colour/graphics card takes one slot, the printer another and the disk drives another. This leaves two slots free for games, communications and extra memory (up to 64k can be on the processor board and another 16k is on the graphics adaptor). I'd say that this package will suit 99.9 percent of intending purchasers' requirements. The remaining 0.1 percent will have to compromise, buy another machine or wait for an announcement of an expansion box.

Microsoft's Cassette Basic interpreter is contained in 40k of ROM with some fundamental I/O routines and is standard in every Personal Computer sold. Basic enhancements and the Disk Operating System (DOS) are loaded from disk.

Every peripheral is interrupt-driven, which means that when a particular device is not doing anything, it is ignored. Once it has something to say then it interrupts the processor to demand attention. The processor then finishes whatever it happens to be doing at that instant, serves the interrupting device and then gets back to whatever it was doing before. This makes programming much easier and also makes the machine run significantly faster by avoiding 'waiting time'. The Benchmark timings weren't designed to highlight this sort of activity so, although they're fast, they're nothing extraordinary.

Somewhere between hardware and software lies the firmware which is the stuff that gives the Personal Computer its native intelligence before any programs have been loaded from outside. What follows is a bit of a pot-pourri of facilities thus offered.

The first thing the system does at switch-on is to run its own internal diagnostic routines to make sure that everything is working okay. Once complete, the machine 'peeps' through the loudspeaker and allows you to load programs or whatever. It is also internally programmed to react to certain key combinations. For example, if you want to 're-boot' the DOS, the system will recognise a simultaneous depression of the ESC, ALT and DEL keys. CTL with Numlock is a toggle which suspends and restarts program execution while CTL with Prtscr is another toggle which causes an echo to the printer. The keyboard has a 16-character buffer which is

pretty exciting when using the word processor — you have to keep a careful count of the number of times you hit the delete key! This buffer size can be changed but I'm assured that it's a 'non-trivial' exercise.

Software

The IBM Personal Computer is supplied with a Cassette Basic developed by Microsoft and all the other packages are sold as extras. IBM will divide its software packages into the following groups: Professional, Business, Word Processing, Entertainment, Personal, Education, Computer Languages and Software Series. Each is coded with a pleasant colour, mainly pastel shades with the exception of Entertainment which is black. The colour is used on all documentation and packaging for products within that particular theme. While I was Benchtesting the machine, the only products actually available were Disk Basic, Advanced Basic, DOS, EasyWriter, VisiCalc, Adventure, General Ledger, Accounts Payable (Purchase Ledger), Accounts Receivable (Sales Ledger) and (I think) the Communications Package and Pascal Compiler. I didn't actually get to see either of the last two packages in action.

IBM didn't see any point in starting software development from scratch so it went to those companies whose products and people best met its own criteria and together they produced the IBM versions of the packages. Microsoft published the Basics, the Pascal compiler, the DOS and the Adventure game, Personal Software published Visicalc, Information Unlimited Software published Easywriter, Peachtree Software was responsible for the ledger packages and it looks as if IBM devised the communications software. I'll deal with the application programs first.

Visicalc is a hotted-up version of the program we've grown to know and love. It now allows you to edit parts of fields, handle tables and move around much faster than on the previous versions I'd seen. You can also choose between a 40-column or an 80-column display. On the domestic TV you'd almost certainly have to go for the 40-column display.

Easywriter is an interesting word processing package because it is entirely memory resident. This means that individual text files can't exceed 18,500 characters (this Benchtest so far is around 15,000 characters) but to comp-

ensate for this, a linking function allows Easywriter to treat a number of separate files as a single file for reporting purposes. Once I got the hang of it, I found this package quite pleasant to use and I think that many people will find it offers all the facilities they're likely to need. It is possible to move blocks of text around, to do word counts and even to undelete stuff provided you haven't moved the cursor since the delete took place. Even my lovely Spell-Binder doesn't offer the last two functions.

Adventure is the standard Microsoft game in which you have to overcome obstacles in an underground network of caves while collecting as much treasure as you can manage. At the moment the game is entirely textual, which is unfortunate, but I suspect that within the next few years it will be on video disks and, boy, will we have some fun then!

The ledgers are all designed for the American market and are therefore of little use here. All I'll say is that they've been professionally produced and give a good indication of the software standards that IBM is going for.

Basic

The built-in cassette Basic is a superset of Microsoft's Basic-80. It allows you to use all 256 characters, to plot in medium or high resolution graphics, play sounds through the loudspeaker and control light pens and joysticks as well as doing all the things that Basic-80 does. It can handle up to 17-digit precision, full floating-point arithmetic. It does borrow 4k of user memory to operate. If you move on to the Disk Basic you'll find that it uses 24k of memory plus an extra 1.5k if you want to use the communications facilities as well. In addition to everything offered by Cassette Basic, this version allows you to handle disk-based files, to keep track of the date and time, to handle two additional printers and to drive an RS232 port.

The Advanced Basic pinches 29k of user memory, again with an extra 1.5k if you're into communications, and it offers everything the Disk Basic does plus some additional features. This is the one that allows you to handle interrupts from the function keys, a joystick button, the light pen or the communications line. It also includes a graphics macro language which offers statements such as CIRCLE, PUT, GET, PAINT and DRAW. A music macro lan-



The keyboard has just about every key you might ever need.

guage allows you to create music and sound effects quite easily through PLAY statements and musical notation written in English. Since the functions within the macro languages are all written in machine code they operate at very high speeds. The only Basic overhead is the execution of the single statement calling the routine. Some neat effects can be achieved using the graphics macros GET and PUT which handle the transfer of arrays to and from the screen. The trick is to define a shape on the screen, imagine a box around it and define this as a two-dimensional array to be saved. A GET saves the array and a PUT will redisplay it wherever you like. If you PUT an array to the same position twice using an XOR argument this removes the array image and restores the original background. The sequence for animation then becomes PUT to the screen with XOR, calculate the new position, PUT to the screen at the old location (using XOR) and then repeat the process for the new location. Another neat trick can be played if you're in text mode. You can define an active page and a visual page. This means that one screen can be on display while your program is busily changing another page ready for display. Sound, too, offers some potential because, having initiated the playing process, the system gets on with it while you do something else. This means that if you want to play a musical background to a game, for example, then you can, regardless of what is happening on the screen and keyboard.

The first 40 characters of all variable names are significant. This means that the novice programmer can describe the variables in full. After a while, of course, he'll realise how much space is being gobbled up and will then either have to cut down on eloquent names or buy more memory. With 256k I don't suppose that long variable names would be a problem.

Since Microsoft Basic is pretty well the standard these days I think I'll leave you with those few tantalising glimpses of the extra facilities and move on to the DOS.

DOS

No, this isn't the same DOS as on the IBM mainframes. Some people call it PC-DOS just to differentiate but I'll stick to DOS for this article. Not surprisingly, it is similar to CP/M in its range of facilities but to the user it is a whole lot more friendly. For example, if you want to copy files in CP/M, you have to load the PIP facility and then give the necessary instruction to PIP. In DOS you simply type COPY, the file to be copied and the new file name. In PIP it's back-to-front — you have to start with the new file name and follow with the old file name.

Other DOS functions allow you to copy a whole disk, compare the contents of two files or a pair of disks, erase files, rename files, format a disk, list the contents of a disk, type the contents of a file and put the DOS on to another disk. Nothing unusual about that I hear you say. Well, that's true except that all the instructions are near enough in English, eg DISKCOPY.

But then we come to the other facilities: you can invoke batch files,

issue messages and prompts (for DATE and TIME) while they are running and even pause and restart their operation. MODE allows you to define screen and printer characteristics and if you don't like the position of the display on the screen, you can scroll it sideways a column at a time until it suits your monitor or TV. CHKDSK examines the chosen disk and gives a status report. If you name a file AUTOEXEC.BAT it will be executed on boot-up and it can be either a program or a job stream (batch).

DOS will work on a single disk drive system, issuing appropriate prompts for the user to change disks when necessary. Other programs available on the DOS disk are a relocatable module linker, an editor and a debugger. IBM refuses to comment on the likelihood of an Assembler. I saw enough clues to make me think it's a strong possibility very soon. A diagnostic disk is available which allows the user to run his own diagnostic routines, the results of which he can analyse from the descriptions given in the manual. Although I've not covered the DOS in detail, you can see that it provides everything that a user is likely to need.

Looking at it from the programmer's point of view was a little difficult without an assembler. The FCB is in two parts — the first seven bytes act as a prefix to a 35-byte FCB. The first 11 bytes of the main FCB tally with the CP/M version but after that either the terminology differs or the actual contents are different — I can't be sure. They do actually look different to me although they're the same length. I was told that although the DOS has its own entry points, it is possible to use all the CP/M calls as well. It looks as if IBM is making it as easy as possible to convert from CP/M to DOS on the Personal Computer. It will be interesting to see what CP/M '6 has to offer when it comes along.

Documentation

All the IBM documentation is excellent. It comes in a series of colour-coded, cloth-bound three ring binders which fit into matching cloth-covered boxes. If you buy a game or a package which doesn't justify the full treatment, then you get a plastic wallet four of which just happen to fit into one of the boxes I just mentioned. Each box, which can be bought separately, measures about 8in x 2in x 9½in high. In the seven or eight hours I spent reading the manuals, I only found one error and that was in the dealer's product guide. Considering that IBM has only been working on the project for 14 months, I think it's a remarkable achievement. Mind you, I do wonder how many staff it's had wavering away — no one would tell me.

The manuals are very well written and IBM must have really thought about the target audience before writing each document because they start off talking about 4096 chars but by the time you reach the Basic manual it cheerfully uses 4k, knowing that you must have grown accustomed to some of the jargon by then. All the manuals are very clear and seem to cover all the ground necessary. They have indexes and tables of contents and appendices to save you

diving around all over the show if all you need is a quick reference. Error messages are clearly explained with the appropriate actions suggested.

A 'Guide to Operations' and a Basic manual are supplied with the machine. The 'Guide to Operations' includes sections on setting up the machine, operating it, 'Problem Determination', installation of options and how to move it from one location to another. Another example of IBM's attention to detail is the fact it supplies its disks with reinforcing rings and some don't have notches so that you can't accidentally overwrite them.

Who'd use it?

The television advertisement uses a Charlie Chaplin look-alike, presumably to hook every viewer. The emphasis is on simplicity, ease of installation and fun. The music and the voice-over reminded me of the Disney wild-life films where the music changes according to the screen activity and throughout a very friendly voice explains what's going on. In the beginning there's 'Charlie' sitting on a white chair at a white table with a room-sized white box gradually shrinking before his eyes. The narrator says things like 'Once upon a time a computer was the size of a room' and, as it shrinks, he describes how IBM kept making them smaller until you could pick them up. At this point 'Charlie' picks up the machine and takes it over to his table where he unpacks it, assembles it and starts tapping the keyboard. All this is done with grossly exaggerated gestures of course. The final shot is of this rather nice machine sitting on the table next to a vase containing a single rose. Very warm, very friendly, very simple and a bit of fun too. More evidence of IBM's seriousness and attention to detail. There's not a threatening moment in the whole ad.

IBM sees its Personal Computer being used in the home, the office, the laboratory and the school. It goes further and defines its users as small businesses, the self-employed, departmental users, home users and hobbyists. It seems they've covered just about everyone there, doesn't it? I'm not too sure about the hobbyist being able to afford the machine at the moment. All the hobbyists I know are beavering away on low budget equipment with half the fun being to make these puny systems really perform. I'm not sure they'd even be happy with everything done for them. Middle class homes and all the other categories are bang on target as far as I can tell, although in Britain I suspect it would be more likely to sell to businesses, with bulk orders coming from those companies already well into data processing.

All the dealers appointed by IBM will have had to sign a strict agreement which tells them the sort of behaviour that IBM expects of them. They agree not to exaggerate the capabilities of the equipment nor to disparage other people's products. They have to agree to do warranty work regardless of where the machine was bought and they must send two sales and two engineering staff on IBM-run courses. And IBM has the right at any time to inspect the premises and interview the staff to ensure that

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the standards are being maintained.

So, dealers, and readers, if the IBM Personal Computer ever comes to Britain, you now have some idea of what to expect. I hope it happens, but don't hold your breath waiting for it.

Future plans

It's just about impossible to discuss IBM's future plans because they won't tell you anything intentionally. I suspect that an Assembler is on the way and that, if it appears, it's 99 percent certain to come from Microsoft since they've written the editor and debug facilities. The only things I know for sure are that CP/M-86 is undergoing final testing right now and IBM will be looking at the dealer situation again in December to see whether it will be able to supply new dealers if they are taken on board. IBM's attitude is that it's better not to appoint new dealers until it can be sure of keeping them supplied.

Incidentally, CP/M-86 will cost considerably more than DOS and I'm not at all sure that it will be able to support the Microsoft Basics and Pascal which were written to run under DOS.

Prices

Just as a guide, here are some extracts from the IBM price list. ComputerLand stores will almost certainly charge different prices and not necessarily less than IBM.

System Unit (16k) with keyboard	\$1265
Monochrome display	\$345
Matrix printer	\$755
Printer cable	\$55
Printer stand	\$55
Monochrome display and printer adaptor	\$355
Colour/graphics monitor adaptor	\$300
Printer adaptor	\$150
Memory expansions	
16k kit	\$90
32k option board	\$325
64k option board (64k must be on-board before adding plug-in memory options)	\$540
Disk drive adaptor	\$220
Disk drive	\$570
RS232	\$150
Game adaptor	\$50
DOS + Basic extensions	\$40



Pascal Compiler	\$300
Comms support	\$40
VisiCalc	\$200
Easywriter	\$175
Adventure	\$40
Ledgers	each \$5.95

I've worked out that a typical 64k, twin disk, RS232 system with a monochrome display and a printer would cost \$4575 — around £2500 in our money. This price includes the DOS and the Basic enhancements.

rather feel that the whole world and its grandmother will be frantically trying to fill that particular gap.

IBM has paid great attention to the details of the hardware, the software, the documentation, the distribution and support. In a word it's a knock-out. I wish it was on sale here.

Benchmark timings

All timings in seconds.

BM1	1.5
BM2	5.2
BM3	12.1
BM4	12.6
BM5	13.6
BM6	23.5
BM7	37.4
BM8	3.5

Conclusions

It's all been said really. This is probably the most professionally put together system I have seen. Lots of them look good then you find they fall over, or the manual is unintelligible; neither is the case with this Personal Computer. The only thing missing at the moment is a wide selection of packages, but I

Technical specifications

CPU	Intel 8088, 4.77 MHz
RAM	16-256k, plus 4k or 16k video RAM
ROM	40k
Disks	Up to 2 drives, each 160k
Cassette	Accepts user's own cassettes
Ports	Joystick/Paddles, RS232
Screens	Monochrome (green) 25 x 80, Colour 24 x 40 or 80, up to 16 foreground and 8 background colours, 320 x 200 and 640 x 200 graphics. Will drive monitor or domestic TV with appropriate RF modulator.
Keyboard	83 key typematic. Tactile feedback. Auto repeat. 10 function keys (40 functions programmable). Single stroke Basic key-words. Numeric keypad.

