PC_Help

Presents

Understanding the IBM Compatible

or
How to do it yourself and leave me alone
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MODULE 1 - PURPOSE, HISTORY and BIOGRAPHIES

Purpose
Since you are reading this book, you probably fall into one of the following categories: A Build it yourself-er? With very little know how and using only what you already know about IBM Compatible Computers, it is an easy and enjoyable task to assemble an 80486 Machine for a total of under $800. This machine will look like a store model and do everything a store bought system will do, and leave you $200 or more for other pursuits.

The Machine can be built in your spare time in a few days, or over a number of weeks or months, adding the parts as you can afford them and find them at the right price.

In 1987, this author, knowing absolutely zilch about the inside of a computer, over three months of occasional work and with no formal training, originally built a 12 MHz 80286 Compatible Machine with 2048K Memory, a 5 1/4 and 3 1/2 Inch drive, a 10 Meg hard disk, Parallel and Serial Ports, and a 1200 bps Modem. Actual work time was in the neighborhood of 10 hours. There was no test equipment, special tools or mathematics involved. Since that time, I have assisted in the building of many machines. Over 10,000 people have downloaded this book and many have written to me with their success at building. The original machine has been upgraded many times and is on it's fourth owner (and still cookin'). The process itself has become much easier by improvements in the technology. IDE drives that identify themselves to the machine saves HOURS of work. Parts come already jumpered for IBM Compatibles because 80% of the worlds computers are just that. In 1987, that just wasn't the case.

Why build a computer instead of buying it? MONEY and fun. This machine you would build using these instructions would easily go for between $1000 and $1200. Most parts are under warranty, so you are not "stuck" with a computer that does not work. Just have the offending part replaced or serviced.

Compatibility- What makes this process nearly idiot proof is the architecture- everything plugs in or screws together. If you can build a model car with Legos or hook up a stereo, you can accomplish this. When you are ready to upgrade it, it will be a simple task. If you buy a P*ckard B*ll or some such machine, you may find the upgrade path difficult to impossible.

When IBM made the first PC, they were under the gun to produce a unit to Market in one year flat - so, in a move they haven't duplicated since (and they haven't had a hit since), they used off the shelf, standard parts for the hardware. This decision years ago that the MS-DOS PC would be an Open Architecture System gave the world a system that could be cloned and duplicated, and created today's world of almost single standard computing. It gave us all the ability to run with the big boys and made Apple an also ran.

Whatever part it is that you are looking for, it is made by a number of different manufacturers at a number of different price points, and, wonder of wonders- they fit into the same slot the same way. An ABC Motherboard accepts a DEF Controller, which runs a GHI Hard Drive, which fits into a JKL kit, and takes MNO disks.

This book has evolved from a five page general outline to it's present state. As of the version 2, the article includes a short preface so that you can first evaluate the project, followed by lengthier information that you will most definitely need either to narrow down your final buying decision or to support you as you debug your hardware.

Hey, I get lots of notes on the Internet from you guys, and occasional letters, and once in a great while, somebuddy pays for this sucker. I just received a letter from a guy in Slovenia (formerly Yugoslavia). I know it's for real because they got stamps with pictures of roaches on them. No shit. He's dodging bullets and eating UN dehydrated Beets n' Bananas rations and he STILL has the time to learn a little rotten English and send me 10 American Dollars. And he wished me good Carma [sic] to boot. I got this mental picture of some guy on a bullet riddled, cobblestone street with this striped shirt, huge mustache and three days stubble, holding his beanie in his hands and selling his father's watch for 10 American Dollars to send me. Of course, the mental picture is in black and white. Which probably explains the black and white money (just kidding. They were real dollars. I bought a mess of ribs with them.) Carl thanks the guy from Slovenia for the ribs. I thank him for my good Carma. He'll thank me as soon as I can figger out how to send this rag to Slovenia. "That'll be $10.47, Sir..." "But...but...I already bought the ribs!" "Scuse me???".

There is very little to fear in making the decision to plunge ahead with this project. It is very hard to fail as long as you have confidence in yourself, and simply a desire to let the little guy win for a change.

Already Bought It?
Having second thoughts about the power and abilities of what you have? That's OK. You can make the best of what you have for now by learning about what's under the hood in the following pages. You will learn how to upgrade what's on the desk to a truly good machine. You will learn whether or not your machine is true ISA (Industry Standard Architecture) and can be upgraded directly, or if you need to rip out a major part of the system. Don't worry... 90% of compatibles are just that. Unless of course, you bought a P*ckard-B*ll from C*******r C**y or someplace, in which case you have my sympathies. This IS NOT an ISA machine. People are telling me that newest P*ckard B*ll is all ISA. I'll believe it when I see it. Many people waste hours and hours of my time talking about their impending purchase. They sit in my living room, eat my food, play around on my machine, then go and buy one of those aforementioned machines. They deserve them. I get really offended when someone tells me about how much PB is improving. Once burned...

Ready to Upgrade?
This book will help you understand the total machine picture, so that you can decide whether it's best to get a bigger hard drive, add memory or replace the motherboard.

Just Itching to Learn More?
You've come to the right place.

For those of you about to fight your first C:\> prompt, we salute you:

A section for the new user.

Welcome to the world of DOS and IBM. This unique planet is a place like no other you have ever been. Your previous experience with other computer platforms will only be a good leg up on the total novice due to the unique nature of the DOS platform IBM Clone.

There will be sections to follow that are of no interest whatsoever to you. Feel free to skip them, but I urge you to at least scan the contents; you may very well find information that you will want to refer to in a later life.

The message of the book is this: If you ever want to do more than play an occasional game and flounder around the DOS prompt, calling some $50 an hour guy every time you get an error message, so be it. The world is full of guys who call a $75 an hour electrician to hook up a new phone or speakers to their stereo. I would rather spend $75 on a better phone or better speakers, and have the knowledge of how to do it. Many people beg me for a copy of this book, and then, two months later, I talk to them and they haven't "gotten around to looking at it" but have "gotten around to" buying a $3000 piece of crap computer from BigCity Computer Superstore - and they want to know if I will provide them free support (no). Don't waste my time or half a tree. You can do this and it will be fun.

Let's plunge into the subject with a quick look at the players.

Biography and History - A short Industry Overview
Who's Who in Nerddom

Understanding use of the machine has as much to do with the personality of it's developers as with actual technical knowledge. Things are the way they are because the PC was designed by men and women driven by other than normal business pursuits. Let's meet a couple of key players who actually were responsible for it's development:

Bill Gates - Computer's Elvis. I fully expect him to die one day while performing some obscure physics experiment (Video Physics lectures are Bill's idea of relaxation) and the BBS's (Bulletin Board Systems) of the world will tout his survival in hiding, coding mysterious viruses for decades to come. From a future Cover of InfoWorld Weekly: "Gates Spotted in Janitors Uniform at Comdex!" or "Gates and Mysterious Alien Fathered My Baby in Bizarre Runtime Experiment." He will join the ranks of Hoffa and Hitler. Bill Gates, of course, began and owns Microsoft, the company that provides the premier Operating System for the PC, known as MS-DOS, recently supplanted by Windows 95, MS's first GUI Operating System. PC-DOS Version 1 wasn't written by Gates, it was written by Tim Patterson of Seattle Computing, who sold it to Microsoft for $50,000. Bill has made billions of dollars from this 50 grand investment, and Tim Patterson now works for Gates. MS-DOS wasn't even marketed as a separate product until well into Version 3.

IBM Small Systems Group - First, it is important for you to understand that IBM didn't WANT PCs to be great. They wanted them to be adjuncts to RISC and Mainframe Computers. Every advance in PCs makes another hundred Mainframes obsolete. IBM makes a hundred bucks or thereabouts on each PC sold. They make mega thousands installing and supporting each Mainframe (an average 70% Margin). It took them until 1993 to figure out that mainframes aren't coming back. Duh.

Way back in the 1970's (a millennium in Computers), IBM had made a few attempts at coming out with a personal computer. As stated above, it was a project that they were, by it's nature, at odds with. Couple that with, according to many, the IBM way of doing business in the great heyday of Corporations, which is that the Corporation, not the product, was the goal; forming the right committees and wearing the right tie were business objectives - putting a product out to market was a necessary annoyance. Having no great enthusiasm for the project, some IBM committee that was under pressure to produce a progress report gave Boca Raton an ultimatum: produce a PC within one year or perish. Perish in IBM parlance means that your group will be broken up, you will have a less than perfect performance review, and you will have to move again. IBM = I've Been Moved. Since no right thinking person wants a poor performance review, these stalwart men hitched up their gray trousers, straightened their striped ties, and went grudgingly about giving the world a PC. Certain of it's failure (real computers are mainframes, after all), the group was even allowed autonomy; having autonomy at IBM is akin to eating pork on a Muslim prayer rug. Unencumbered by the usual IBM flowcharts and Business Plans (spending six months designing a fancy report with all the right typefaces and just the right amount of linen in the cover telling everybody what you are going to do just as soon as you finish writing this plan) the Boca Raton'ers (between the golf course and the Fifties Dance Committee meetings) decided that since there was no way to produce the proper paperwork AND design a machine in the allotted time, that they would build the machine from already produced parts and use their time how they knew best, having meetings. Well, they still needed an Operating System. No one in their right minds at IBM was going to give one line of code to these upstart lepers. "Can you imagine! I spend my whole career producing software code that adds leap year day to Payroll Accounting Run Modules on the IBM Big Mama VII, and these outcasts want me to write an assembly routine for a desktop toy! The nerve. I got just 7 months to keep my nose clean and I'll be a grade 8b, which means that Mary can get that Sun Porch she's been dreaming of. I'm not risking my Career Development Path for those bozos. Just thinking about it made me late for lunch. Now all the Big Blue Plate Specials will be picked over."

So the Boca Raton Merry Men set off on a quest to find an operating system, much like Bilbo Baggins set off to find the King Under the Mountain. They met many colorful characters along the way and had many adventures that they faithfully set down in their Daily Planners. Although they had no trolls to fight or elves majik to light the trail, they

eventually reached the Western Shores and what they hoped would be the end of their quest. The IBM'ers needed a 16 Bit operating system, and the alchemist who held this secret formula, called CP/M, (Control Program for MicroComputers) was supposed to meet with them on his magic mountain. Our heroes in Navy Blue arrived at the appointed hour, with their famous disclosure document in hand. IBM had (or has) a curious document that we can call the "Playing with the Big Boys Agreement". It states, more or less, that anything they learn from you can be used as if they had thought of it; anything you learn from them you must keep secret forever. A Magic Scroll indeed! Well, it seems that the owner of the Secret Formula was off flying around the countryside in his private plane that he bought with money made from the Digital Corporation (remember the Rainbow, old timers?), it being such a fine day and all, and his wife, who was relegated to keeping both feet on the ground, or at least on the desk and to answer the phone, consequently wasn't in the mood to sign anything. It was still too early for lunch, so the Big Blues flew north to cry on the shoulder of Bill Gates, who with his partners in Nerddom wrote Programming Languages for various PC upstarts. Bill and his partners had gained fame by writing a program on streaming paper for the Altair, arguably the first PC, which not only added 2 + 2, but actually came up with the answer 4! Bill "knew of somebody" who had written such an Operating System, called PC-DOS. He promised his best efforts to secure it, handed out Kleenexes and lint brushes and the boys went home happy. Gates' minions promptly called Seattle Computing and bought PC DOS 1.0 for the famous $50 grand. By the way, Gates was furious at this spending of hard earned capital. PC DOS was now owned by Gates 'n Co., and licensed to IBM. IBM has the only rights in existence to market their own version of MS DOS called IBM-DOS (currently version 7). In classic IBM, it doesn't work and is overpriced.

The third and final puzzle piece was the code to hook the off the shelf hardware and the bargained for software together; it was called the BIOS (Basic In Out System) which was produced in house (good for you, boys!) and burned into EPROMS. The IBM PC was born, everybody got good performance reviews and... you guessed it, were moved to other groups. Bill became a billionaire, Seattle Computing has sued Bill, Bill hates IBM and you and I got some good, if not great hardware and some bad, but not terrible software out of the deal. I haven't gotten closer than 15 feet to William R. Gates III, but I'll tell you this. Bill is the Tom Edison, the Henry Ford of our day. The man gave us this revolution, whether he meant to or not. And my hat is off to him. I do admit to disliking the scrubbed to glowing Microsofties that run around in their purple banlons at COMDEX and such, but, just maybe , I... choke... wanna be one... nah, I'd get canned.

The Steves, et al
Steve Jobs and Steve Wozniak built a computer in their garage to show their friends in the local computer club how cool they were. They called it an Apple. Their friends thought it was way cool so the Steves decided that building lots of Apples would be more fun than flipping lots of burgers. Now these guys had good business sense; they built a good product, kept the trade secrets to themselves, hired good people, paid them well and kept them happy, and totally and miserably failed to capture the PC Market. Clear?

Why didn't they call it the Burger? Why am I telling you all this? Do you care? The Apple didn't quite begat the MacIntosh. Steve Jobs was working on a project called the LISA, which got him so busy that he didn't notice that a bunch of hardware geeks in the other building were working on a project called MacIntosh. MacIntosh took it's basic concepts from Palo Alto, a research group funded by Xerox, which produced a concept called "windows", a device called the "mouse" and a printer called a "laser jet". Xerox didn't produce any of this stuff, they only paid millions to develop it. Isn't this a fascinating business? Do we wonder why the japanese think we're totally nuts? Anyway, LISA was a hideous mess, so Jobs took credit for the MacIntosh, which was so cool that Bill started snacking on it, picking off the mouse, the GUI, and, most of all Windows.

Oh, yeah. Steve Jobs subsequently built and crashed an empire by the name of neXt, using hundreds of millions from guys like Ross Perot. The state of the art manufacturing plant eventually produced a machine that was largely ignored. Customers would look at the features, look at the hardware... then look at the price and say "neXt!" Cool case, though.

And an honorable mention to:
Lots of folks deserve mention here, but the one that must be mentioned is Mitch Kapor; Mitch made computing worth the money by making sure Lotus 123 was on as many desk tops as possible; without the spreadsheet, there is no way that the Desktop PC would have been justified as a necessary business expense; the PC would have given way to the Word Processor. With Lotus 123, businesses saw a way to make every accounting type account faster and make more money. Letters don't make money because they are on a PC, but numbers do. Mitch got out of Lotus years ago, and now he's doing a little thing called the Internet, which is doing for the Modem what Lotus did for the PC. Mitch is a nice guy who even answers his E-Mail! Let's not forget Andy Grove, the man behind Intel. Despite the early 'dirty silicone dilemma'

(great story!) and current Pentium conundrum, Dr. Andy gave us the Intel 80XXX family of CPUs, which made this whole revolution possible.

The PC is Born

The IBM PC Clone is a machine that exists because IBM used off the shelf parts that anybody could buy, and, in order to get it to the Market on time, used an Operating System that wasn't exclusively theirs. The world, therefor, was given, quite by accident, the most incredible gift since the Internal Combustion Engine - a personal computer in a Free Market. Had Boca Raton been given the proper time, direction, funding and corporate belief in the project, they would have produced an IBM only machine, captured a small percentage of the Market, and you and I (or at least I) would be shut out of freely participating in this technology. The IBM would have been another Apple. You need memory for an Apple, you go see an Authorized Apple Dealer, who tells you that you can pay the price or stuff it up your floppy. You need memory for a Clone, you go to a Computer Show and let the dealers yell each other's price down till the profit margin is as low as the dealer can go and still go home with Cookie Money, and you buy your memory at fair market price. Excuse me for being hokey, but this truly is the greatness of America.

That ends your Introduction to Personal Computers. I'll bet I'm the only writer you have ever read that has the ability to digress before he progresses.

MODULE 2 - OVERVIEW & FAQS

A Quick Hardware Overview

Here is the copy of an actual computer ad. Below it is a quick and dirty summary of what the jargon means. Reading this book and referring back to it will make these ads make sense to you

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                    VESA LOCAL BUS
                    486DX2/66 MHZ
                    80486DX266 CPU
               4MB RAM plus 256K Cache
                   1.2 and 1.44 FDD
                   210 MB IDE HDD
               32bit VESA Local Bus 1 MB
          14" SVGA Monitor .28DP 1024 x 768
                  101 Key Keyboard
           DOS 6.22 (or 5.0), WIN 3.1, Mouse
               ZIF Socket - Pentium Ready!
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80486DX266 CPU - This computer is based on an Intel 80486DX CPU chip (the heart of the computer) whose speed has been doubled from 33Mhz (it's rated speed) to 66Mhz, but only for internal operations (it won't make your hard drive or video run faster). This is currently "top of the line" reasonable for home systems. There are suddenly lots of players in this Market. TI, CYRIX, AMD, etc. Expect to pay a 10 - 25% premium for Intel.

4MB RAM plus 256K Cache - There is 4 Megabytes of Random Access Memory built in. DOS uses the first 640K (64/100 of a Megabyte) for programs, the next 360K for loading programs high (out of your way) and 3 Megabytes of XMS (which smart programs like Windows use to hold stuff in extended memory while you aren't using it). 4 meg is OK, a bit skimpy for a 486DX. 256K cache is a memory speeding scheme. Certain operations which are in line for the CPU to work on will stand in line in the Cache rather than main memory having to fetch them - which is hence freed to do other stuff.

1.2 and 1.44 FDD - 1.2 Meg capacity 5 1/4 inch floppy drive and a 1.44 Megabyte capacity 3 1/2 drive. If you want to drop ANY option, drop the 5 1/4. It's dead. RIP.

210 MB IDE HDD - A 210 Megabyte Hard Disk Drive, used for storage of programs and data - IT IS NOT MEMORY. A megabyte is 1,024,000 bytes. A byte is akin to a word in a book. 8 bits make up a byte. A bit is akin to a letter in a word. (OK, OK, so I'm simplifying...) 1K is 1,024 bytes. A page of text is about 1K. 210 Megabytes is 210,000,000 bytes plus (somebody took my calculator). Windows 3.1 takes 5-25 Meg of hard drive space. 210 Meg is an OK size drive, but increasing to a 540 Meg drive is no big expense. IDE is the "format" of the hard drive - stands for Imbedded Drive Electronics. This is the current standard. High end systems will have SCSI drives, and used systems will have MFM or RLL. IDE is fine. ZIP drives (removable 100 Meg disks) are coming on strong.

32bit VESA Local Bus 1 MB - The Video Card in the system is VESA Local Bus - It has three connectors at the bottom. The first connector is 8 bit (OK for a serial port card) , the second is the 16 bit connector (OK for normal AT class cards) and the third, extra connector is 32 bit, which gives it priority with the CPU. It doesn't have to wait in line behind the floppy drive formatting a disk. It communicates with the CPU directly. This board has 1 Megabyte of Memory of it's own, so that the image going to the Monitor is pre-processed so the CPU doesn't have to do it.

14" SVGA Monitor .28DP 1024 x 768 - This is a 14" (just like your TV is 20" or 27") Super Video Graphics Array Color Monitor. Super VGA means it shows lots more colors and lots more information than standard VGA. The difference is akin to the difference between a color picture in the newspaper and an actual photograph. 1024 X 768 is the maximum resolution - there are 1024 pixels (dots) across the screen and 768 dots up and down. There is more information and colors than you would have at standard resolution, 640 across and 480 up and down. .28 is the dot pitch - the smaller the dot pitch, the clearer the picture. A .39 Monitor will ruin your eyes. Everything appears cloudy.

101 Key Keyboard - BigFD. All keyboards that meet standard for 80286 and up are 101. This is akin to Ford saying all of it's cars are equipped with a 360 degree round steering wheel. Avoid BTC keyboards. Spend an extra 20 bucks for a Focus. I think BTC stands for Better Type Carefully. Brand new keyboards may have Windows 95 keys also.

To test a keyboard, forget 'click' - hit the keyboards A-S-D-F keys simultaneously with your left hand fingers three times. If the keyboard bends, jumps, skitters, moves or otherwise shows itself to be the piece of crap it is, move up. IBM and Compac make great keyboards. A used keyboard from an obsolete IBM PS/2 is a great buy. (You will need a three dollar adapter).

DOS 6.22 (or 5.0), WIN 3.1, Mouse - They are providing the operating system - MS DOS version 6.22, or, if you are one of those ninnies who hates the latest and greatest, they'll give you 5.0; they are also providing Windows version 3.1 and a mouse.

Pentium Ready! - means that you can swap out the 486 chip with a 586. You won't want to. Trust me. Would you swap out the 4 cylinder engine in your 1989 car for a 1994 8 cylinder engine or buy a new car? An Overdrive processor will cost you almost as much as a new motherboard and CPU.

ZIF is zero insertion force. The CPU is clamped rather than forced into the socket on the motherboard using a lever that makes the whole thing look suspiciously like the paper cutter you use in work. It also works great as a guillotine for roaches. This whole schlemiel is put here at your expense in case the day ever comes that you need to pop out the CPU.

All of the points above are covered below in much more depth.

Up to date FAQS about IBM Compatible PCs

Okay, having taught night courses in this stuff for a few years, lets jump right to the FAQs.

1) What the hell are FAQ's?
Farnum Andrew Quilimork - who invented a list called Frequently Asked Questions. You will find these as you browse Bulletin Boards n stuff - such as 'ProComm 2.8 FAQ's'. Farnum has retired on royalties made from this scheme.

2) What's an IBM Compatible?
This term loosely refers to any machine that conforms to the ISA (Industry Standard Architecture) [8/16 bit] and EISA (Enhanced Industry Standard Architecture) [32 bit] standards. You should be able to pick up any hard drive, floppy, modem, printer, CD Rom, etc. that says "IBM Compatible" and plop it in, much like you should be able to plug any toaster in any outlet. Some companies produce machines that claim to be IBM Compatible but accept their own components only. Classically, P*ckard B*ll is the most notorious. Their products are priced slightly lower than other brands, they spend a lot on advertising, and they foster 'loyalty' by making their products so that you have to buy P*ckard B*ll parts. Memory may be soldered on the motherboard, the modem may plug into the motherboard directly, the controller may be on the Motherboard, etc. This causes problems when you want to switch out the Modem to get above 2400bps, etc. You want a true ISA machine.

3) How do I tell if it is not an IBM Compatible?
Ask lots of questions before you buy. If you are reading this book just to get smart before you buy, you should shop for at least two weeks and eventually buy your first machine from someone local with a good reputation. It's a real tough call to

buy your first machine from a catalog. Look at the back of the machine. The Video (TV), Mouse, and printer SHOULD NOT PLUG IN AT THE BOTTOM OF A DESKTOP CASE. Imagine a compass. Imagine that you are looking down at the top of the case. The Video, Mouse and printer should be in slots which run Northwest to about North, vertically about halfway up the back of the case. The Keyboard should plug in about due North. The Power should plug in at the NorthEast corner. That is because the standard ISA Motherboard has bus slots, keyboard connector and power connector in the same place every time, so that your peripherals will fit into a standard case the right way. This will become hugely important two years from now when you 'just gotta have more speed'. If your machine isn't standard, it's yard sale time. Instead of a $500 motherboard and CPU, it's $2500 all over again. Adjust these hints for a Tower. You should still be able to orient the slots and the Keyboard connector by placing the Tower on it's side. DEMAND to know whether the parts are ISA. Do not shop name brand computers. Shop name brand PARTS. My brother recently went on a job where the customer had 'drop kicked' has PC. Seems that after one hour on hold with Tech Support, followed by a recording telling him that he would be called back within a day, the arrogant techie informed him that his computer couldn't be upgraded because the memory was soldered in place. He drop kicked it, sending the 5 1/4 drive through the case and shearing off the simms. How do you upgrade a PB computer? Drop kick it.

4) How does the CPU fit in all this?
CPU's (Central Processing Units) are divided into what we can call families. Lets take for granted you want to run MSDOS on an IBM Compatible ISA Machine. This describes 99% of you. You need a CPU which is capable of running MSDOS.

ISA CPU's
Dominated by the Intel series, consisting of 8080,8086,8088,80286,80386xx,80486xx Pentium and Pentium Pro. The bulk of IBM Compatibles have Intel CPUs. AMD, TI and Cyrix make Intel clones with names like AM486DX2. IBM itself puts out a line with names like 486SLC which is actually a hopped up 486SX. This is the classic line for running MS-DOS and it's licensees. IBM makes a licensed and altered flavor called IBMDOS.

Intel type CPUs can run other operating systems, such as XENIX (Unix). CP/M, etc. You would not be able to put in an Apple boot disk and run an Intel machine. DEC tried to put out a CP/M and DOS machine in the Rainbow, but it was a frustrating, hideous mess, and DEC priced it's parts and upgrades ridiculously high.

Apple/Macintosh CPUs
Dominated almost exclusively by Motorola. Series including 68000,68010,68020,68030, 68040 and 68060. They run Apples and Macintosh's. Macintosh compatibles were not allowed to spring up, and Apple controlled the pricing. The Mac does more elegant Desktop Publishing and is easier to learn, but very limited in that cheap software and hardware upgrades are practically non-existent. There have been kluges in the past to allow MSDOS to run MAC and MAC to run MSDOS, but all have been problematical and very slow. The current series of Macintoshes based on the 68040 is the last line for Mac, which will be abandoned for Power PC. Apple has made arrogant moves before, shipping machines that did not run earlier generation software, or died in infancy (the LISA, which was abandoned for the Mac). The Mac is being replaced by the Power PC, and there is a new generation in the works.

Alpha
The first Alpha shipped in 1992, and is a high performing CPU. It is used in high performance servers and Mainframes made by DEC. You won't see your kid on one of these playing DOOM.

PowerPC
IBM and Apple got together in 1991 with Motorola when they were both pissed off at Bill Gates (Microsoft) and Andy Grove (Intel). The PowerPC CPU line includes the 601 (50-100mhz), 603 (for portables and laptops), 604 (servers) and 620. All are built on 64bit RISC architecture. Apple revised it's entire hardware strategy and has put out Power Macintosh and Performa models that run a Macintosh System 7 Operating system which is capable of running MSDOS and Windows "boxes". Personal experience says that most functions run almost as well as an Intel PC, but communications are problematic and iffy. If your intent is to run Macintosh stuff 90% of the time and occasionally use a Windows product, the application seems stable. IBM on the other hand, has floundered and blustered and sound-byted it's way nowhere, changing major parts of their PowerPC platform at the same time they claim to be shipping. It looks at this writing that a beta PowerPC OS/2 will ship with some major functionality pieces circumcised. In the future, IBM has promised us, there will be a single DOS-Macintosh PowerPC platform. Yeah, right. So far Apple has delivered. Unless the architecture is going to be opened up to the extent of PCs (it won't), pass.

5) I hear ya knockin but you can't come in...How to I get into the BIOS without knowing the key combination?

If all else fails, pull out your controller card and reboot. The machine will say "Hey you idiot, you pulled out the controller! Press F1 to enter setup". Who's the fool now, fool? Similar results can be had by removing a legal number of SIMMS (8 down to 4 or whatever).

6) What is Windows 95?
It is the much delayed upgrade for Windows 3.1 and replacement for MS-DOS. Earlier, Windows95 was going to be a big break from the past, leaving 286-386 and DOS users out in the cold until they could afford to upgrade to 32 bit hardware and applications. Microsoft is trying to back pedal enough to allow most of our old software and hardware to work, however poorly, at the expense of some of the functionality of a true 32 bit operating system. It's a hit. A disappointment in some ways, but a hit. You whould buy Windows 95 if you are willing to work through the normal bugs of any version 1 release. There may not be a driver for your Major Teddy's CD-Soundcard kit for some time. There will be glitches and bugs which will be worked out by 1.1. I was a beta tester and suffered through the worst of them before the fixes were released. See my FAQ on Windows 95 installation elsewhere. Should you buy it? I wouldn't run without it, but I'm a geek... I like solving glitches.

7) I get a lot of memory errors - do I need a bigger hard drive?
No (whine). Please understand this now and forever more - There is Memory - Random Access Memory (called RAM) installed on the Motherboard which loads stuff to and from the CPU, hard drive, floppies, modem, etc. A hard drive has SPACE just like a cassette tape has SPACE. Unfortunately, since the beginning of computing, stupid books and articles have referred to hard drive memory (John Dvorak is STILL doing this). Memory indicates that anything in it disappears when you turn it off - like your memory will erase when you are dead. Like the original digital TV's - when you turned them off on any station, turning the set back on took you to channel 2 - it had lost it's memory. To solve Memory errors, you must deal with the RAM - 640K low ram, 640-1024K UMB ram, and extended RAM - 1024 to 16,000K+. ROM is Memory with a memory - some form of power, usually a battery - lets it remember your disk drives, date and time, hard drive size, etc.

8)Oops, what do I do now? (MS-DOS)
OK, so before I read that, my computer said 'not enough memory', so I deleted the files on my hard drive; now it says "non-System Disk or Disk error when I try to boot up.

You need a boot disk.

Find a friend who knows about DOS and computers and get some help. Almost everybody does something like this at least once. The boot disk should contain the system files, undelete, SYS, format and F Disk. The mistake is usually in the panic reaction to it. DON'T PANIC! Do nothing until you determine what is wrong. First, get your hands on a boot disk. Second, swear you'll have one at the side of your machine forever more. Boot from the disk. Go over to C: and try to do a directory. If you can, you are in pretty good shape. Try to go to the DOS subdirectory. If it is still there, and has lots of files, you are in real good shape. Copy COMMAND.COM to the root and try to boot from the hard drive. If you can, read up on undelete and unformat commands and good luck. All you did was wipe out the root directory, and all you have lost is those files, including COMMAND.COM and your start up files, but not the hidden files (IO.SYS, MSDOS.SYS). Now you know why they hide them.

If you still cannot boot from the hard drive, but can read other sub-directories, you have managed to erase MSDOS.SYS and IO.SYS. Running the SYS command from the DOS directory might put you back up. If not, running SYS from a floppy might put you back up. If you do manage to boot from the hard drive, run some DOS commands (like formatting disks, etc.) to see if you get Incorrect DOS Version messages. In that event, the restore has caused a mixed DOS version. You need to reinstall DOS from the floppy disk set as soon as possible. Don't do any real work until then. At the end of your fix, search the drive for copies of COMMAND.COM, EMM386.EXE and HIMEM.SYS and only keep the versions which match the version in the restored DOS subdirectory.

If all else fails and you cannot read from the hard drive after booting from disk, get help from a nerd. You need to run Fdisk, and if it reports OK, reformat the disk. If it cannot read the disk partition, you are in for a low level format and partition job. Get help here - you cannot use most shareware low level formatters on today's drives.

9)My mouse doesn't work since I added a modem, and, for that matter, neither does the modem.

They are camping on the same IRQ, or com-shift has occurred. Read the relevant section in this book and reset your COM ports accordingly.

10)What are bits and bytes, and why should I care?
Remember your old math class when they taught binary math? Well, you didn't care then either. Everything a computer does is based on 0's and 1's, because a computer cannot think... it can only interpret on and off (the abscense or prescence of current). Bits (on-off switches) get together in groups of 8 to form bytes - humans get together in groups of 8 and call it a Mormon marriage - never mind. Anyway, these bytes make up numbers and letters, e.g. 0000 0100 is the number 4, and they add a ninth bit that is like a political officer from the KGB in 70's Russia - it's job is to report any deviant behavior of the first 8. This is called the parity bit. A 3 1/2 HD diskette holds 1.44 Megabytes, or roughly 1,440,000 bytes. So if a letter or number is one byte, that disk can hold some 1,440,000 characters of data, such as a document.

11)Why is my 9600bps modem only downloading at 1200bps?
Because they use the same stupid letters for two different things. Your Modem is 9600 bits per second, and the download rate reported by Zmodem and your com software is in BYTES per second. 8bits x 1200bytes per second = 9600 bits per second. If your modem AND the other guys modem are advanced enough, you may be able to use compression and bi-directional transmission to speed this up.

12)I tried to move my hard drive to another machine, the Auto detect IDE worked, but the drive won't run. Why?
Because the drive reports it's DEFAULT parameters to the BIOS, not the ACTUAL. Go back to your old machine and read the Cylinders, Heads and SPT from the old USER settings, and put them in manually in the new SETUP. Write the numbers and HD capacity on top of the drive in indelible Marker for the next time.

13)Auto detect didn't work
1 - It's not an IDE drive (manually configure)
2 - The cable is backwards (is power plugged in?)
3 - Try unhooking the data controller cable, reboot, wait through the errors, go into setup, rehook the cable and try again
4 - Make sure it is set properly for Single, Master or Slave.

14)I'm getting bogus, ever changing numbers in CMOS Setup - or - I got cute and changed some CMOS stuff.
First, print out or write down the current CMOS settings, especially for the hard drives. As a last resort, on most machines, if you put a jumper over pin three and four of the battery connector, turn the machine on and off and put it back to it's original position, the CMOS will reset and you can start over. See your manual.

15)I put a password into my AMI BIOS, now I can't get in!!!!!!!
Send me five bucks, then read on. 99% of these calls turn out to be a FAILED password setup. If you don't follow directions to a T, the password resets itself to the DEFAULT rather than NO PASSWORD. The default password is AMI.

MODULE 3 - BASIC PARTS

The Basic Parts

There are a number of items you will need to get started if you are building a machine and they are easily obtained. All compatibles have the following components:

*A Case
*A Motherboard (w/CPU and BIOS)
*A Power Supply
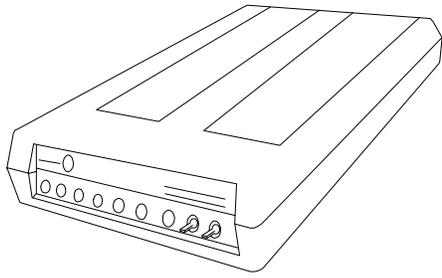*A Keyboard
*A Monitor
*A Disk or Hard Drive (I/O device)
*ROM [Read Only Memory] -the basic instructions
*RAM [Random Access Memory]- your work space
*Controllers

The more useful options are:
A second Disk Drive or a Hard Drive;

a Modem;

a Mouse;
a Printer.
The extras include
a Sound card
a CD ROM
Stereo Speakers
Aa scanner

PREFACE

This article started at 5 pages. It has turned into a book. That's good in that I'm passing along lots and lots of information that will save you days or weeks of trouble and lots of dollars. It's bad in that the technical jargon may turn you off. It shouldn't. The actual building process is something you absolutely should be capable of doing. Here is a one paragraph summary of what you will be doing:

You will buy a case, install the motherboard and set a few jumpers per the documentation. You will fill some empty sockets with memory chips. You will put in a few cards and hook stuff up to them. You now have a computer. You will turn on the machine and tell the computer about the stuff you have added. That's it. Really. The balance of this article is to help you decide which monitor, drives, etc. to buy, and then gives lots and lots of advice for avoiding pitfalls along the way. Each of these pitfalls caused me heartaches and headaches. I pass the solutions on to you so that you may avoid the problems. There will, in all likelihood, be a debugging period. This is normal for any high tech project. You very likely will not get every jumper right the first time, unless you are one of those people born with a horseshoe up the butt.

If you want to cut to the skinny, here is a short list of the parts for a recommended system:

You may, for $500, buy the following in one morning at a computer show-

A baby tower case with power supply, an 80386DX motherboard, 2 meg of 1 Meg chips (18 chips) or 2 SIMMS, a 512K VGA Card, a Mono VGA monitor, a hard floppy controller, a 5 1/4 and 3 1/2 disk drive, a used 100 meg hard drive and an AT compatible keyboard.

Buy what you can afford and solve the problems as you go along. It's just a logical process.

I have assisted many, many people in building machines, and there are basically two types. The first takes my advice, begins the building process, and takes the time to read and develop the common sense knowledge necessary to finish this project and learn a heck of a lot as they go. The second group wants me to be their brain, build it piece by piece for them, and never crack a magazine or a book. I'll say it just one time: YOU HAVE TO READ TO GET ANYTHING OUT OF THIS PROJECT. If you do, you will be AMAZED at how easy it is.

Step One Buy a Magazine! (!?!)
An indispensable tool is Computer Shopper Magazine, published Monthly and available everywhere. It lists the CATALOG prices for everything you need, in all the various options. If you have three weeks to wait, you will get the absolute best prices on whatever new and current you want (see Computer Shows for the exception). Otherwise, you will have the basis for comparison for shopping elsewhere.

Spend an entire evening reading this magazine cover to cover- it is equivalent to an entire College Course in 6 hours. Your head will be stuffed with new information and insights.

A Brief Description of Your Buying Options; advantages and disadvantages.

Computer Shows

Held around the area by different Companies- watch the local paper Business Section and the back of Computer Shopper Magazine. Careful buying is the watchword. Buy all your Cables and miscellaneous parts here. These shows are getting harder and harder to find. It's getting too tough to make a profit. It is ABSOLUTELY worth a 60 mile drive to buy at a show to build a system. You will be in an environment where if a product can be sold at a $2 profit for $20, Harry will undercut Chen and sell it for $19.

Ask lots of questions about other pieces from information you gleam here, from Magazines, and from Books you run across. Knowledge is Power. They will mislead you to make a sale- but won't make any patently false statements. My purchase of a 3 1/2 Disk Drive was a great buy until discovering from the Panasonic Technical Department that it won't run in Motherboards made after 1985! But the Dealer mailed me a refund. Do be careful and do plan to fight someone who doesn't want to give you a refund.

No doubt, you are taking a calculated risk. I am on my fourth bad Motherboard from one guy, but generally get very good parts at these shows. They are, for the most part, name brand parts new in the bag.

Catalogs

As stated before, the main drawback is the wait; and don't forget that you have to add shipping and handling costs to the price. Invest the dollar to call the Advertiser's Technical Line and ask questions: is this Hard Disk Controller MFM or IDE? Is it 8 or 16 bit? (don't get thrown by this jargon- you will learn it quickly. It's analogous to asking Is it Front or Rear Wheel Drive? 4 or 8 Cylinders? Someone who never drove a car would be just as thrown by those questions.)

I have had a real nightmare dealing with a Mail Order house in Texas. We were up to 4 bad shipments before we called Computer Shopper, who laid down the law to the turkeys. An exasperated president called the day after we called Computer Shopper and said "What do you want?" We told him, and we got it. Air Freight. Free. Most houses in Computer Shopper are very reputable. Just be careful, and call the tech line and ask lots of questions. If they have no time for you, you have no money for them. Do remember, though, that the parts are cheap because they are operating at a small margin. Don't expect them to spend the day teaching you how to build a computer.

Discount Store

Some Discount Computer houses need careful watching, too. We have a local dealer whose prices can't be beat, but the product he sells to schmos like you and me are usually the parts that didn't work when he put them into a system. He sells them over the counter because it's more time effective than troubleshooting the part. He knows that 75% will come back, giving him an easy RMA and the buyer will figure out what is wrong (wrong jumper, bad partitioning) with the other 25%. So he gets free troubleshooting.

When buying a piece that may take two or three times to install right- such as a Disk Drive- the extra money to buy from a local store may be worth it. Questions like which pin is this jumper set on to make this Drive B and High Density? is tough to answer AND make a profit if you are a Catalog Dealer. Make your decision based on how comfortable you are installing the part. The best source of all is the sales and repair place you now use for work. Making friends with your Service Rep gets you into the back room- where all the Used but working Parts are kept (and can be bought!!) Where do you think all the parts went when you upgraded your AT to a 486 at work?

Computer City, a division of Tandy (yeah, Radio Shack) does a decent job at generally decent prices. But it's not the place to buy parts. If you decide to give up and buy a system, this place is not the worst. But buyer beware! Make sure you have read this article thoroughly and know what to look for. A better choice might be a medium sized chain like PC Warehouse, who has yet to give me a bum steer. I had two Acer Monitors in a row go bad in 90 days - he replaced both and switched to Panasonic.

Computer Store

BIG Companies get BIG prices having slick salesmen who frown knowingly at your questions. They don't want you to buy a part-they want you to buy a System. Most of the big guys are out of the retail business, because business people in this country live by a dual standard. They will buy from the big guys at work and pay triple price, but get a discount for themselves. Once the ComputerLands of the business world figured this out, they went corporate.

Your first buy:

The Case
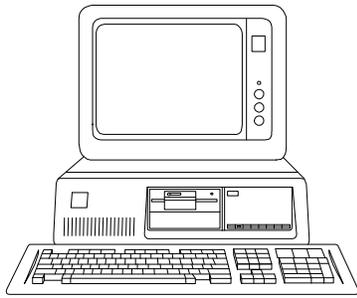
The XT

An XT style Case Allows for an 8088 based Motherboard or a Baby AT- most motherboards will fit in here. Most will take ISA components. If you want to make this a long term learning experience, this case can't be beat for being easy to get "under the hood". The ultimate is a "flip top" XT style case.

The AT Case

The "true" AT Case has become a dinosaur. It's a BIG case designed for an AT size Motherboard. Every motherboard I have seen in years fits into a Baby AT configuration, and the new AT size cases have provisions for fitting a Baby AT board. You would want to pick this case if you have saved money by purchasing a full size hard drive that will not fit with two drives in a smaller case.
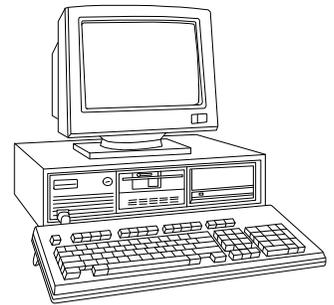
The Baby AT(Aw...isn't it cute??)

Uses a Motherboard sized to fit in an XT size case. My original choice. Most AT parts (except a full size Motherboard, full size Power Supply (XT size) and some old 16 bit cards fit in here.

Absolutely DO NOT BUY "ultra slim line" and such cases. If a standard peripheral won't fit, you are headed in a woefully wrong direction. I have recently seen some jet black systems. They are now available to be bought case only. Why are computers white?. Why not paint the case mauve? What do you care? S'matter of fact, I recently did that. Painted my case my fav'rit flava, cherry red. Looks cool. You still don't care.

The Tower
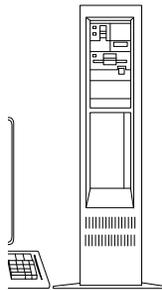
Sleek, elegant, and powerful looking. Used a lot for Servers, as it has extra bays for multiple hard drives and CD ROM's. It stands vertical instead of horizontal. The Power Supply is usually bundled with the case.

The Baby Tower

This article just keeps getting longer. This item is practical and pretty reasonable priced. I picked mine up with power supply for $129. They now go for about $35-60.

Expect to pay $25-80 for the case, up to $125 for a tower case with Power Supply. Buy with confidence from a computer show or catalog. Hard to mess this one up. Look for reset button, turbo button, turbo led light, hard drive light. The "digital display" on some cases is incredibly hard to configure for the novice. Save this feat till later if it looks intimidating. Brush up on yer binary math.

Tower cases are different in one way - the power supply switch is usually wired to the front of the case rather than being on the power supply. I mention this because it is the one circumstance where you will find 120 Volts inside of the case, and on some poorly designed models, the connectors are bare. So if you see a switch on the front of the case, be careful inside UNLESS THE POWER CORD HAS BEEN COMPLETELY DISCONNECTED!

In any event, the case must be large enough to handle standard add in cards. If it won't, you got problems.

Installation

Install the small speaker and LED's (light emitting diodes) and lock, if any, on the case. The speaker may get annoying. It is loud. Radio Shack can help you install a little switch to turn it off and a headphone jack for private listening of the annoying beeps. You need to mount these so that the wires don't pull out when you remove the case!

What are all those damn wires in the case??????

Don't Panic. Here's an overview of the most common.

Speaker:
Two wires coming from the speaker. Terminates in a 4 hole socket. The two wires will hook up to the "speaker" pins on the Motherboard. Plug this in even if you have a sound board to be added at the end of building. Reverse the wires if you don't get a beep when you turn on the machine. You may have to modify the four hole socket or move a wire to make the speaker work. This can be frustrating. Two little tiny alligator clips hooked up to the speaker wires and run directly to the pins on the Motherboard may be the easiest way to debug this. It is important to hook this up early in the process to hear error beeps in the debug process. The operative pins are One and Four. The speaker jumper goes one of two ways - don't try connecting to pins two and three or something... for some dumb reason, one of the unused inside pins is +5 volts, and will fry the speaker.

Reset:
Two wires that plug into a set of pins by the same name on the Motherboard. The pins may be located back by the keyboard connector. Why? I don't know. Ask somebody else. This is what will cold reboot your machine when you push the RESET button on the case. Hook it up early. If you are working with a used power supply, remember that the PS is the weak link in the system, and for a good reason - you want the $30 power supply to fry before the $500 Motherboard. Banging the power switch on and off 40 times while you are building is not good - think of the switch as having x number of uses before it fails. Hook up the reset switch and cold boot with it rather than the power switch. I remember one time when I was working on a customer-friends computer to make $15 adding a 3 1/2. About the fifteenth time I threw the switch (we had cable problems) the power supply died. Even though I ran to my supplier and replaced the power supply at cost, he and his two other friends never called me again, and to this day their lips curl when they talk about me. Use the reset switch.

Turbo:
When you push the turbo button on the case, your machine will toggle between high gear (say 66Mhz) and low (say 33Mhz). Plugs into a set of pins by the same name on the Motherboard. You will want to be able to slow the machine down when you are trying to trap an error.

Turbo LED:
 Two more wires. This will, when wired properly, light up the Turbo light on the case when the machine is in high gear.

KeyLock:

This may be in combination with the Turbo button above. Allows you to lock out the machine with a key. Also plugs into the Motherboard.

Hard Drive LED

This is usually plugged into your hard disk controller to blink whenever there is hard drive activity. You will eventually depend on this light to tell you when long operations are actually proceeding when you suspect the machine has frozen. Also lets you watch for "thrashing". If the hard drive light is constantly or near constantly flashing when you are at work on the machine, the machine may be desperately trying to keep up with the workload when memory is low by copying unused in-memory stuff to the hard drive to make room in conventional memory. It means either

You need to install more memory
or
Your machine is not configured well. Becoming a smart user is learning how to tweak your machine to make it run smooth. Just remember: if your hard drive is thrashing, a power outage could be a disaster.

Power Supply:

Two large white plugs and five or more medium size white plugs. These are the leads from your power supply. (The black wires go together!) The two large ones hook onto the Motherboard, sending main power to the system. The five or more smaller ones are the power for internal devices such as disk drives, hard drive(s), CD ROM, etc. One or two very small leads off of the larger ones are power connectors for 3 1/2 inch drives.

CPU FAN

Two wires leading from a miniature fan sitting on a big chip. This is your CPU fan - 486DX2-4 and Pentium Chips have heat problems. This fan is necessary - if it gets blocked or unplugged, the CPU will crash after it heats up.

Watch where your wires end up... recently I opened a machine that was having overheating problems. It turned out that the bundle of above described wires (speaker, etc.) had "landed" on the CPU cooling fan, and was holding it still. You may want to take some baggie ties and hook the wire bundle out of the way. Ask my brother.

Label these wires before you dis-assemble the unit.

The Motherboard

Now you have a real decision to make- once you make it, you have decided on the basic Architecture of the Machine and there is no turning back. You now need to decide whether to buy a 8088, 80286, 80386DX, 80386SX, i486DX, i486SX i486DX2, i486DX4 Pentium (80586)75, 100 or 133Mhz, one of the new clone CPUs or the Pentium Pro (P6). Buy with or without Local Bus or PCI. Buy with or without Cache. Don't worry about the Motherboard being "Pentium Ready" or such nonsense. When you are ready for a new CPU, you will be ready for a new Motherboard. Trust me. Many Manufacturers of Motherboards. Buy whichever one you choose with the highest MHz rating you can afford.

Mini Glossary # 1 CPUs

8080 -
1979 - .33 MIPS (Millions of instructions per second) The original Intel CPU. Pre IBM. 8 Bit. CP/M operating System

8086 - 8088 -
The original PC and XT. About 4.77 MHz. Turbo at 8 MHz. 8 bit. (8087 Math Co-processor) The technology is now as passé as Leaded Gasoline.

80286
1982 - 1.2 MIPS The original IBM PC-AT 10 - 15 MHz. 16 Bit with eight bit functionality. (80287 Math Co-processor). Cannot use XMS memory. Wastes resources. Forget it.

80386 SX
Crippled 80386 Chip, supposedly upgradeable to 486. Yeah, and you can upgrade a fart to a methane power plant, too, but it's still just an exploding fart. (80387SX Math Co-processor).

80386DX
1985 - 5.5 MIPS Bill Gates wanted IBM to use this chip in the AT. Made too much sense. 20 - 40 MHz. 16 bit with 32 Bit access. (80387 Math Co-processor) Becoming more obsolete each day. Newer software and peripherals just demand too much. You are going to have to buy the same peripherals for a 486, so why not go 486DX?

80486SX
A 486 with the Math Co-processor disabled. Like a four slice toaster with two openings covered over.

80486SLC
A 486SX chip that has been hopped up by IBM. Not, repeat, not a DX chip.

80486DX
1989 - 20 MIPS A chip way beyond MS-DOS and it's limitations. 33Mhz to 50 MHz. Faster than everything else in the system, basically sits around a waits for the 8 megahertz bus to send something. Just starting to really come down in price. The price was kept artificially high for two years or so while Intel was fending off competition.

80486DX2 -
Ai Caramba! Just what the average Joe User needs... another CPU spec. Ok, you got yer 486SX, which is a 486DX with no Math Co-processor. Now you got yer 486DX2, which employs a clock speed doubler to make a 486DX25 run like a 486DX50. That is, inside the CPU Mondo Condo, Danny Data and his friends are partying at 50 MHz. Danny discovers that he needs to go out for more beer. He opens the door and steps into a world running in slow motion (25 MHz). He rides a 16 bit data bus just like the old folks. Danny has to wait in line for beer just like the rest of his 386 friends. He even has to squeeze through some 8 Bit cards to get to the store. (Danny's a 32 bit kinda guy). He goes home, and from the moment he passes the doorman and through the revolving door, he's partying at light speed again. Which just makes the beer go faster, I guess. The lowest standard, because the price is now so reasonable. Approaching $139 for Motherboard and Clone CPU.

486DX4
So if the DX2 is a clock doubler, then the 80486DX4 is a clock foupler, er, quadrupeler, right? WRONG! It's a clock tripler. Don't ask me. I failed calculus. I think that a 486DX4/100 is actually a 486-25 at heart.

Make sure if you buy a Clone Chip that you are buying a true DX chip.

Pentium -
1993 - 112 MIPS
(latin for Penthouse Pet of the Month). 70, 90, 100 and 133 MHz. For those of us who just have to know the last digit of Pi before dinner. (Pi should be saved for after dinner. Sorry). The all new, improved CPU from Intel released in 1993. Why isn't it called the 586? Intel found out in it's court battles with Cyrix and AMD that the number "486" cannot be properly protected as proprietary. It will be much harder for Cyrix to get away with putting out a Cyrix Pentium than it would be putting out a Cyrix 586.

Pentium systems are selling like crazy, driving down the price of the 486. Know what? The typical DOS application can't use the power of a 486 much less the Pentium. The 486 is a great buy... The Pentium was made to compete with SUN Microsystems and Mainframes. It uses technology the PC will never ever use while running MS-DOS. There are big things coming which will make you want to replace the motherboard in 1996.

80286,386,486,286SX,386SX, 486SX Clones.
AMD and Cyrix and some other guys are making clone CPU's. Be careful! They have played games with the numbers in the past. Make sure that 486 is really Intel 80486 DX compatible. IF it says 486DX2/80, you are safe. If it has funky letters mixed in, beware.

The future:
P6 Pentium Pro - 1995 - 250 MIPS (est.)

Time out: A word about the BIOS
For whatever board you buy, you must be aware that next to the actual processor the most important consideration is the BIOS, so it deserves it's own blurb.

The BIOS (Basic In-Out system [ooh baby])

One or two chips for the machine and maybe a separate one for the keyboard. You want the newest BIOS possible, and that can only be determined by plugging the motherboard in - the copyright year on the chip itself is not accurate. A good question to ask: Does the BIOS support multiple custom hard drive entries? Secondary Master and Slave IDE drives? One User Setting Entry does you no good if you have 2 IDE drives you want maximum space from. What is the date of the BIOS? Award, AMI and Phoenix all make BIOS chips, and they upgrade them constantly. Mr. Mail Order is all too happy to unload a Motherboard with an old BIOS to Mr./Ms. NewBuilder. I'm not an expert on BIOS chips, but will pass along that American Megatrends (AMI) is my BIOS of choice. The power and options of your BIOS can make your life easy or unbearable when you go to upgrade.

The BIOS was a development that happened in the early days of PCs. Since all IBM parts in the IBM PC were off the shelf, the machine itself was easy to duplicate. The Operating System, bought by Bill Gates from Seattle Computing for $50,000 and re-sold to IBM and everybody else to the tune of $30 billion or so (nice ROI, Bill!) was no problem to get. It was the part in between that was tricky - making the machine talk to the software. IBM had that sewn up in their own little hardware scheme, so some enterprising nerds had to go and write the interface and burn the instructions onto chips, called CMOS (Complimentary Metal Oxide Semiconductor). The first, second and third attempts were less perfect than DOS 4.0 or the IBM PC, Jr., believe it or not, and it has taken them years to get it right. Get a BIOS that identifies itself at boot up time as being a year or less old. DON'T buy a Motherboard with a BIOS dated (not on the chip, in setup!) as being from the 1991. Buy it only if he will give you a $45 allowance towards new BIOS chips.

The PS2 line of IBM

The PS/2 line of IBM and early Compaqs needed a "set-up disk" to get to the BIOS. Every time you added an option, and option driver had to be added to the set-up disk. Once you got a 162 error, you were stuck in a loop to BASIC until you came up with a reference disk with the right added option drivers. Good luck. Most IBM owners don't have the foggiest idea where their set-up disk is. COMPAC and IBM have now both gone to on board BIOS set-up. Please know and be able to tell the technician how to get into setup for your BIOS. Not knowing makes you look really, really dumb. It is usually a key combination that you press during boot up; on AMI it is usually (ESC), on Phoenix (Ctrl-Esc), on new COMPAC's it's F10, etc.

Installation:

The Motherboard fits into the case with screws and set-offs. Very easy to assemble. Many Motherboards come with instructions. My first one didn't. If not, take out of a library or buy a book, such as How to Build an IBM Compatible and Save a Bundle by the late Aubrey Pilgrim.
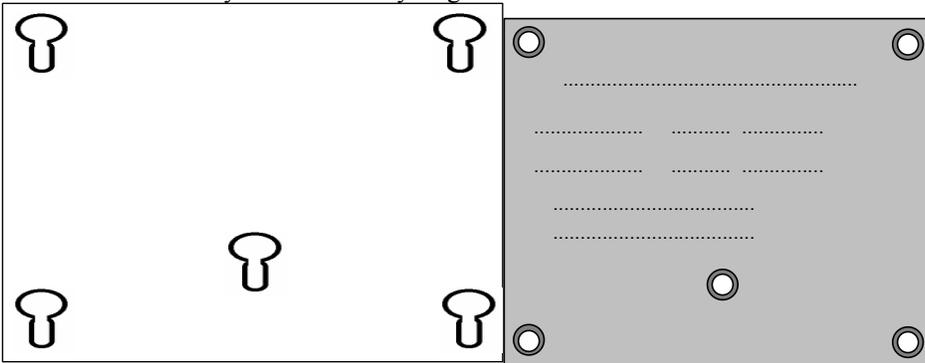
Bottom of case w/ keyholes for Motherboard   Underside of Motherboard w/ standoffs

After putting together many of these things, here is my recommendation for how to proceed. place the Motherboard on a towel. Follow the manual if you have it and set the jumpers and dipswitches as you think they will end up. Decide where each connector (Turbo LED, Turbo switch [don't confuse the two], power light, reset, etc.) is going to be hooked. Install Memory per the Motherboard book. Put standoffs on Motherboard. Slip it into the case a few times on a trial run before you commit. NO drives or other peripherals should be inside the case yet. You need unobstructed room. Set the

Motherboard, on the towel, very close to the case's power supply. Hook up the power supply connectors to the motherboard, the keyboard plug, the speaker, and the Video Card (hook up to the monitor). You will need to arrange everything carefully, and turn on the power. Make sure the memory counts off and the CPU is identified correctly and turn it off. If memory and CPU look correct, you are ready to install the Motherboard. If they are not, you don't have to diassemble the whole thing. Re-seat the Memory, check jumpers, etc. and try again. Unhook the power supply connectors. Pulling the Motherboard in and out of the case is not smart. If there are any metal standoffs on the case, you could scratch through the circuitry on the bottom of the board. I usually leave the foam backing on the Motherboard when I am orienting the board to the case and placing standoffs. Take off the foam just before you commit. When you are satisfied that the board is oriented correctly, hook up the speaker and any wires you decide will be inaccessible once the drive bays cover them, slip it in and gently move it around, letting the standoffs find the proper holes. Handle this Baby with CARE. LEAVE it in the plastic wrap till you are ready to install. Put the little white plastic set-offs on the board, not the case. The white standoffs will slide into keyholes on the case; gently prod them around until they are all in the keys, then work the Motherboard gently down into the case. Don't get frustrated here. This is not easy. If you get mad and try to force it, you will be sorry.

Some old cases have metal tabs that stick up from the floor of the Case. Before placing the Motherboard over one of these tabs, see if you are going to use it for anchoring the board. If you can see the hole in the metal tab through a standoff hole in the motherboard, use it to anchor the motherboard. Otherwise, take a large screwdriver and push it down. The Motherboard has many exposed metal surfaces on the bottom, and one of the most common 'no start' problems with machines is due to Motherboard grounding to the case. Many times I'll put electrical tape over the rails on the bottom of the case to avoid contact with the bottom of the board.

Back to the standoffs: get a long shaft, small diameter screwdriver to help prod the standoffs into the keys. There will be one or more places for a screw to attach the Motherboard to the case. If the screw fits right in, the Motherboard is properly seated. Touch the Metal Case before touching the Board. Practice inserting the Motherboard twice before actually putting it in. Visualize how it is going to slide in. Don't mess it up here! The Motherboard's keyboard connector should line up exactly with the keyboard connector hole in the case.

On Getting Fried

Now is probably a good time to talk about Electrical Safety. I wish I had a black and white classroom newsreel with a bunch of dweebs in Hard-hats you could watch, but MultiMedia presentations are, at this point, still mostly baloney. So, you'll just have to read this, and, IF you have the Word for Windows version AND you have a sound card, and IF that sound card is configured correctly, PC Help is proud to present the first multi-media component of Build Yer Own. To hear yourself being fried to a crisp, double click below:

PC Computing consists of 5 and 12 Volt circuits. Taking a full jolt from a Video Card can hardly be felt. Don't worry about getting shocked working on the computer unless you do something very, very dumb or you are very, very unfortunate. You can, however, by not being careful damage the components. The only three places I can think of that you are likely to get fried are

1) Sticking your hand inside of the Power Supply - that would involve getting past all kinds of safety stuff. Don't do it. Avoid the switch area of tower. It is easy to forget that there is 120 volts going to this switch WITH THE POWER OFF.

2) Opening a Monitor Case. Don't do it. There is lots and lots and lots of pain and possible death waiting for you in the back of a CRT. I make my brother open monitors.

3) Sticking your tongue or some damn thing in the power cord. Don't do it.

Turn off and unplug the Computer before working inside.

LEGAL TYPE DISCLAIMER FOR THE ABOVE PARAGRAPHS:
Because I tell you it is very hard to get shocked working on a Computer, that doesn't mean you can't do it. Some fool will always find a way to get around safety precautions, get themselves hurt, and sue somebody. I am not responsible for injuries, damages or monetary losses due to use of the material in this article. Take all proper and reasonable safety precautions.

VLB Motherboards

Okay, this is one of those places where your Eight bucks are well spent. You did send me $8, didn't you? Cases are designed to hold full size Motherboards. Motherboards are getting smaller and smaller. The case has three rails to hold the Motherboard in place. Your new Motherboard only falls across two, leaving the last third hanging a half inch in the air. Therby lies the rub. You install a VLB video card and VLB I/O card, everything works great, then two weeks later Uncle Spitz (who you did the upgrade for for free because your Aunt Trembelina lent you her car ten years ago) calls and tells you he has a) no video or b) Hard Drive controller failure. When you get over there and pop off the top ("Yes, a coke would be nice"... "No, I just ate"...) the hard drive controller and/or video card has worked up out of the third VLB slot enough to stop contact. Hopefully he hasn't done anything stupid trying to fix it. Push it back down into the slot and you'll get a call next time the weather changes (expansion and contraction). This time, do what I do. Gather the following

A chopstick
Elmer's (TM) Glue
A piece of doubleside tape

Cut three peices of chopstick one half inch long. Place one vertically and glue the other two parallel along the base so that it looks like an inverted "T" with two tops. Place it under the Motherboard so that it holds the Motherboard up under the 32 bit card. Adjust size with sandpaper as necessary. Don't put too much upward pressure on the board. The purpose is to keep it from pulling down away from the card. Put the doubleside tape on the case floor and the "T" on top of it. You've built a bridge that will keep the card in the slot.

Back to the Motherboard installation...
Plug the Speaker leads and the Power/Turbo LED's on the Motherboard as indicated. If they don't work when you fire it up, reverse them. Set the jumpers per the instructions.

Jumpers
I told you this is exciting reading...

If you are installing a used Motherboard with no manual, don't flip any jumpers except as a last resort. If you have the manual, read it and decide where jumpers will be and change them before you put the board in. Some things to keep in mind:

If the CPU and Motherboard were bought together, the jumpers are PROBABLY set correctly. Ask when you plunk down the money. You still should definitely check the jumpers before putting power to the board. Read on.

The most important jumper is CPU voltage. AMD is now making 3 volt CPUs and it will become a trend. Three volt CPUs can run faster because they generate less heat. AMD says that the same speed in a 5 volt package would actually fry the circuits together. Make sure of the voltage of the CPU and set that first. Next, set the jumpers for CPU speed. There may be two or three jumpers relating to this. The trick here is to remember that a DX2/50 chip is a 25 MHz chip, not a fifty. A DX2/100 is a 50. Set speeds based on the external rated speed of the CPU.

Err on the conservative side for jumpers. Set the VLB Wait State to 1 instead of 0, and change it later when you are feeling adventurous.

Read slowly and carefully. It all makes sense. If you don't know what difference changing the jumper will make, don't change the jumper. There are lots of jumpers on lots of cards that are already set for IBM Compatible machines. Changing the jumper could change the I/O address, change the voltage input from 5 volt to 12 volt, or a hundred other things. Don't flip a jumper if you don't know what it does.

MCA (Micro Channel Architecture)

(cool graphic)

And now a word from Big Blue....
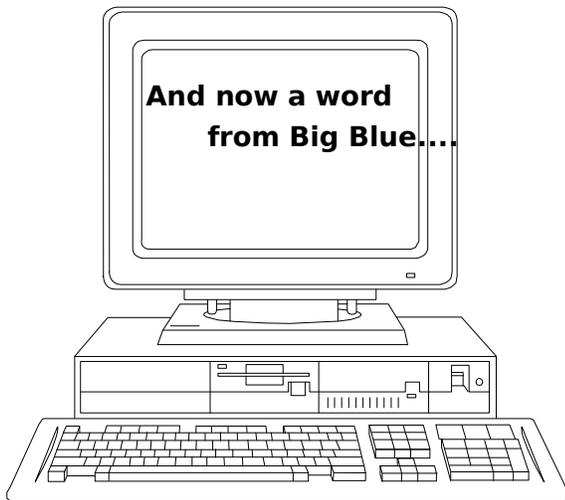
IBM wants yer money. They came out with Micro Channel for two reasons: 10% to improve the computer, and 90% to destroy YOUR ability to build your computer with inexpensive, readily available parts.

We ignored it, it went away. Makes every card you bought Useless (notice the capital U) by changing the socket that fits into the Motherboard. Boo Big Blue. Micro Channel is now officially dead. The technology has been used for such things as the connectors for local bus. IBM doesn't want to be left out of the rotten, expensive machine market however, so they have introduced the POWER PC. There is no software and no useful hardware, but IBM gave out some really spiffy ballpoint pens and T Shirts at Comdex. Hey, they have their priorities straight.

Just think! You can now buy a machine with no operating system or software, and hook it up to O/S2, IBM's operating system that doesn't work, either! It's such a mystery that their stock went down 66%.

Hey! Sombody just came out with a 486 board that fits in an old PS/2! Now you can spend $400 to make your PS2/30 obsolete for ANOTHER four years!

Their partner, Apple, has put out some pretty decent hardware and software in their version of the Power PC. IBM bought Lotus. The new version of their spreadsheet will be called 12(to be continued).

Architecture
ISA,EISA and MCA
ISA is Industry Standard Architecture. If you buy parts and build a system that is ISA, you will be a happy person forever. Or at least a reasonably close facsimile. Make sure your case is big enough to hold the Motherboard, standard expansion cards and drives. Make sure your Motherboard has plenty (5 or more) expansion slots. Some machines have a hard/floppy/I/O IDE Controller, an Internal Modem, a Scanner Card, a Video Card, a Tape Backup Card, a CD ROM Card, a Sound card and a network card. That's eight slots right there. EISA is a newer standard that follows ISA close enough that you can use regular expansion cards. With EISA, you have more control over the set up process from the Set-up screen. For example, you could switch COM1 and COM2 devices without opening the machine. MCA stinks.

Local Bus
This is a scheme developed by a bunch of Manufacturers that allows Video and/or I/O to directly address the system and output and not have to stand in line behind everybody else. Video and Hard Drive access time are your two worst enemies. Listen carefully here. Increasing CPU speed may not make your system run faster. What matters is how fast the Video and Hard Drive operate. It is said that a system can't exceed 33 MHz no matter how fast the system purports to be. The eight bit slot on the motherboard still runs at 8 MHz. So pay attention to Video Speed and Hard Drive Speed if you become another Nanosecond cutting freak.

VESA Local Bus and Intel Local Bus (PCI) had a brief, intense warfare. VESA has become the standard for both Video schemes and Local Bus Architecture for the current crop of home class 486's. PCI is more often found in higher end machines. Intel's scheme is supposedly better in more powerful systems. At COMDEX, they showed some motherboards which had both VESA and IntelPCI. I wouldn't know which is better because I haven't really tested Intel. Maybe I start charging $24.95 for this rag, then I can buy some decent equipment. But then I'd get as self important as Phil Katz (Phil snubbed me at Comdex). Nah... I like me. Most new Motherboards come with local bus, which adds a third slot to standard cards. Here's a humble drawing of a Motherboard showing the CPU, the BIOS, Memory, the Power Connector and the Bus slots. This is all you will need to know for general knowledge of the motherboard.

Typical Local Bus MBoard

VESA LB Slot

16 bit slot

CPU

8bit slot

Memory

Power Connector

BIOS Chips

8 bit card   16 bit card   VESA LB card
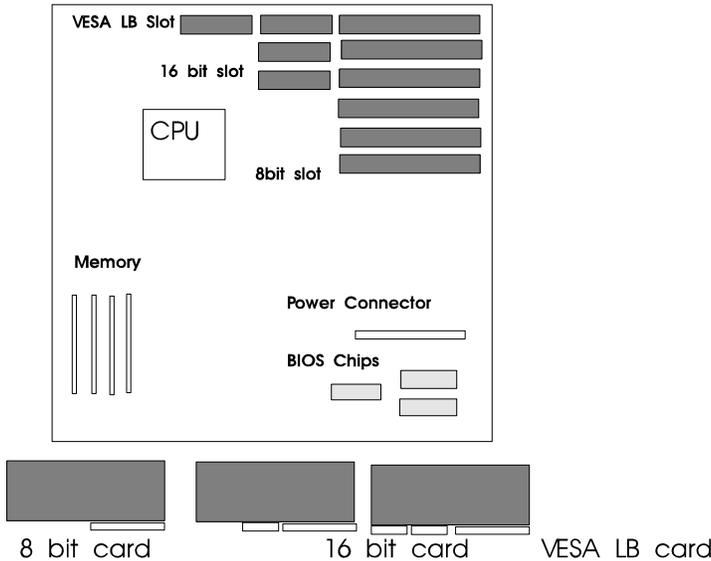
Those of you with a text only copy of this book will just have to imagine all the cool graphics you are missing out on until you send me eight bucks for copying and shipping.

Pentium Motherboards (PCI)
PCI has become pretty much standard on Pentium motherboards. It is a single connector that looks suspiciously like a microchannel slot. It takes special PCI cards. You will find extra stuff in your BIOS to control these cards, and extra jumpers on the board. My discussion of these new features with technicians who build PCs every day say leave them at their default. They are overkill for the capabilities of todays machines. New buzz acronyms are DREQ, DACK, EPP and ECP. More as I get into technical details next version.

Some standards have changed on the Pentium Motherboards - those functions which remain the same on nearly all PCs have been built into the board to free up slots for more exotic equipment. Most likely, you will find the IDE and Secondary IDE on the motherboard, as well as the floppy controller, printer, and COM 1 and COM 2. Great idea. As long as everyone adopts the same conventions, we can buy with confidence.

Cache Memory
Cache is used a LOT in PCs referring to different things. SMARTDRV is a software CACHE. There is cache internally in 486DX and above CPUs. A third method of cache is the on board cache you know of as the 256K Cache or 512K cache in the advertisements for computers. Cache means the same in any context: I will hold the last few instructions (SMARTDRV) or the next few instructions (CPU Cache [internal cache]) and the external cache. These are chips either soldered to or plugged into the motherboard in a bank, usually in the SouthEast corner of the board, where it's inaccessiblility is rarely a problem. These are very fast chips which pre fetch the next instruction(s) for the CPU so that the CPU does not waste it's precious time going out and looking for the next request by an interrupt. They are usually in the range of 20-30 Nanoseconds, compared with DRAM memory (SIMMS) which are 70-150 Nanoseconds. They are usually long and skinny and have values like
8K 8x9 64K
32K 8x9 256K
64K 8x9 512K
128K 8x9 1 Meg

The faster method is write-back. If your CPU is seizing for no good reason, back it off to the second method available in the BIOS, write-through. "The effect of cache is to reduce the wait states needed by DRAM" according to Wan Foo Chan of the Motherboard Writers Benevolent Association.

L2 Cache
I mentioned L2 Cache and pipeline in the same breath to a tech friend of mine today, in preparation for this humble version of UTIBMC, and he make a face like he was having an especially painful bowel movement. Nuff said. Put yer hard earned cash into a faster Video board.

Power Supply
For an AT, you should go 200-250 Watts. The higher the wattage, the more junk you'll be able to stuff inside. I chewed up two 130 Watt Supplies. Buy from a Catalog or Discount Store. Power Supplies are the most often repaired item. Don't buy it used. They go up. Pay $20-40. Most cases nowadays come with the power supply. You want them to go up. Why? Because a voltage spike that finds it's way through your surge protector (a piece of junk, most likely) should fry the power supply before it gets to your $700 Motherboard and CPU, right?

Installation
Slips into the case via two slots at the front of the supply, then screws to the Case. Has two plug-ins to the Motherboard. (May be marked P8 and P9. On old motherboards, the trick to inserting them is to angle the plug back and slide forward and down at the same time. Newer connectors are usually easier. Make sure the black wires are next to each other when you plug them in. The Power Supply also has 2-5 or more plugs to go to Drives and such. The little one goes to the 3 1/2 inch drive. Except for that one and the ones for the Motherboard itself, they are all the same. Make sure it comes with a Power Cord! If not, it's a cheap item ($3 at a show).

You will be tempted to check your installation and turn it on for a second. If you do, you will hear a series of annoying beeps as the Motherboard comes to life, finds no Monitor, Controller, Drive or Keyboard and not so promptly bails out. You should hear a gentle whirr from the Power Supply. If you see sparks or smell ozone, shut it down (quick!) and start over.

Module 4 Ummm, uhhh... oh yeah, Memory!

The Memory
THE place you will have to do some digging. Think of Memory as a commodity- the price fluctuates day to day, and when you ask for a price, the dealer will likely pick up the phone and call some Chip broker for the latest quote. Seriously! This is due to 1988's chip shortage, 1992's Korean Tariff, 1993's factory burn out in Singapore. Any dinky factory that burns down will drive the price of memory up by $3. This is a global economy, folks. Prices have come way down, but, like gold, some dealers kept the highest price. PLEASE buy from a Catalog or a Show. Compare prices. Be patient. A national software chain sells 256K chips for $19.99. Pay $1 at a show.

Mini-Glossary #3
Memory and Speed
MEGAHERTZ - The speed rating of the CPU. An XT was 4.77MHz. An AT was 10 MHz. A good 386 board is 33Mhz. Combines with other parts of the system to determine overall speed. HIGHER IS BETTER.

NANOSECONDS - Memory Chips are rated in Nanoseconds, an infinitesimal measure of time. 60 Nanosecond chips are faster and more expensive than 70. Two years ago, 120 Nanoseconds was about standard. The range now is usually 60-70-80. LOWER IS BETTER.

DRAM, SRAM - Dynamic Random Access Memory is what all clones except old COMPACs use to make up the Memory in your machine, measured in Megs. Don't confuse this with Megabytes of Hard Drive Storage. Individual DRAM chips are going out of style. Your new Motherboard probably uses SIMMS, which put 9 chips on a single board to make 1 Meg of Memory (a 1 X 9) that takes less space and is infinitely easier to install. Why 9 1Meg Chips to make 1 Meg of Memory? 8 1 Meg lines to the CPU plus 1 for parity checking equals 1 eight part Memory bank. 1 X 3 DRAMS are confusing. Suffice to say that it is 9 1 Meg Chips, stuffed into a three chip package. There are 4 x 9 SIMMS, which puts 4 Meg on each SIMM. The more Memory you stuff on a SIMM, the more Memory will fit on your Motherboard. Older SIMMS and DRAMS came in 64K and 256K sizes. Buy no smaller than 1 Meg increments. Why? A 256K DRAM or SIMM is as useless as last week's Lotto Ticket when replaced, which you will want to do almost immediately. You

just throw them away or stuff them in the drawer with your mood ring. SRAM is used in CACHING, a scheme employed by better Motherboards to speed up the machine. HIGHER IS BETTER.

There are 30 and 72 pin SIMM slots. Thirty pin gave way to 72's a few years back, but so many people complained that most boards are now what is called hybrid and have both 30 and 72 pin slots. The manual will tell you what combinations are "legal" in your motherboard. There are special considerations based on how the board is wired. For example, you can put a so called "double sided" SIMM in 72 pin slot 0, but on many motherboards you must then leave

A three Chip SIMM

slot 1 empty. Why? Because there is a RAS signal for each memory bank, and a double sided SIMM uses both RAS signals for the two slots. A double sided SIMM is usually 2 Meg (one meg on each side) or 8 Meg (four meg on each side.)

EDO Ram is a brand new especially fast RAM.

Numbers you will see...
1 x 9 A one meg SIMM based on 9 chips, 30 pin
1 x 3 A one meg SIMM based on 3 chips, 30 pin
2 X 9 or 1 X 9 DS A double sided one meg SIMM, equals 2 meg, 30 pin
4 x 9 4 Meg 30 pin

1 x 36 as above, but a 72 pin SIMM
4 x 36, etc.

Parity
To save $$$, a lot of memory on the market now are non-parity - that is, they ignore the ninth parity bit. You may find one meg SIMMS with two chips instead of three, or eight chips instead of nine. If your motherboard runs okay with non-parity, so be it. You won't know until you plug it in. It may auto-adjust for non-parity, or give you a parity error on bootup or soon after (scary looking error!). If it does, there may be a setting in the BIOS to accept non-parity.

What is important to know is that you can't tell much about a SIMM by looking at it. The memory dealers at the show have a little machine that they plug SIMMS into to identify them. If THEY can't tell by looking, that tells YOU not to buy your Memory on the streetcorner. You may be able to tell the Nanosecond rating by looking at the number carefully. The number may be something like 514400N-08 or TC5110000AJ-80, both indicating 80 Nanoseconds. What you cannot tell is if the SIMM will work in an IBM Clone. Give yourself a way to return the chips if they won't work, or if the combination won't work. You cannot, for example, put some IBM type SIMMS in clones (I got two of 'em). You cannot put 2 four meg thirty pin SIMMS in most banks of four on motherboards (some you can). You can't mix three chip parity and non parity in the same bank (usually). You will usually see N or NP indicating No Parity at the end of a number on the SIMM if you look closely. The one I'm looking at right now is a Samsung two chip non parity one meg SIMM with the number KMM5810000BN-7 - 70 Nanoseconds and non parity. Works in new motherboards but not older ones.

WAIT STATES
If the CPU runs faster than the Memory Chips, the CPU must go into a WAIT STATE and twiddle it's thumbs while the Memory Chips finish what they are doing. If your machine locks up on boot, one thing you can try is changing the WAIT STATE in Set-Up from 0 WAIT STATE to 1 WAIT STATE. Here's a cool little formula to determine the WAIT STATE of your finished system (not including Cache): 1 DIVIDED by the MHz of your CPU TIMES the number of banks on the Motherboard TIMES 1000 tells you the Nanosecond Speed of the RAM necessary to run at 0 Wait State. For Example: a 386-33Mhz CPU on a Motherboard with Bank 0 and 1 filled. What Nanosecond RAM Chips do I need to run at 0 Wait State?

1/33 X 2 x 1000 = 60.61 or 60 Nanosecond Chips to run 0 Wait State.LOWER IS BETTER

RAM
Random Access Memory. If you have 4 Meg of Memory, you have 4 Megabytes of Random Access Memory. Don't fool yourself into trying to run Windows Enhanced with less than 4 Meg. You'll spend all day watching the hard drive thrash. HIGHER IS BETTER.

ROM

Read Only Memory - Stuff that gets remembered when the power is turned off. Don't worry about it. It's there. It is backed up by a Ni-Cad battery or a big Watch type battery. In the case of Ni-Cad, the machine may lose it's CMOS settings (hard drive type, time, date) if the machine left off for more than two weeks. You can buy Lithium back up batteries to charge the Ni-Cad. A recent problem bore this out. The guy left the machine off for three weeks, then called and said the hard drive settings n' stuff were gone. I told him to hook up a back up battery. The machine would still lose settings overnight. Here's why: Once the Ni-Cad discharges, it needs to run with the power on for a full day to recharge WITHOUT A BACKUP BATTERY ATTACHED. Weird, huh?

SIPPS

This is a mercifully short lived attempt at putting DRAMS in packages. It gave way to SIMMS. SIPPS are 9 DRAM chips soldered to a circuit board, with wires sticking out of the bottom that fit into holes on the Motherboard. A hellish arrangement.

SPEED

Memory speed is measured in nanoseconds. The LOWER the number, the faster the chip. Usual values are 60, 70, and 80 Nanoseconds, with 100 Nanoseconds and 120 Nanoseconds going out. Believe it or not, many vendors charge the same price, what ever the speed. You can usually have one bank of 80 and one bank of 100 or 120, but cant mix them in the same row. The machine will operate at the speed of the slowest bank. LOWER IS BETTER.

How much Memory? Windows 3.1 - 4 Meg. Windows 95 - 8 Meg. DOS only - get a life.

At boot up time, the information in ROM is copied to the area above 640K because RAM runs much faster than ROM. See the difference by going into setup and diabling all Shadow RAM. Machine runs like your momma.

Above 1 Meg is Extended or Expanded. Expanded Memory (also called LIM for Lotus, Intel, Microsoft, the consortium that approved it) used to be more useful, "paging" in and out in 64K chunks to imitate regular Memory, usable in Lotus 123, CAD programs and not much else. A few of the old Memory boards use Static RAM chips. Expanded Memory was usually bought on cards that plugged into a bus slot. Memory is typically on board the Motherboard these days via SIMMS, and is handled via a software device driver called an XMS Manager. 99% of all new Software is written with XMS in mind. The program turns over control of Memory to the XMS Manager, who either negotiates with DOS or does an end around to avoid DOS. The upshot is, the Driver sweats keeping the program running and not you. DOS 5 and up comes with EMM386, which handles both simulated Expanded (ram) and Extended (noems) emulations. XMS only works full function in 386SX and up. Windows, being the hog that it is, uses a Hard Disk Swap File to further keep you running without out of memory error messages. Keep at least 2 Meg available on a Hard Drive for Windows Swap File to use. Memory errors in Windows 3.1 are usually related not to memory itself but by a finite amount of RESOURCES allocated to the machine. Each DOS program that starts eats a percentage of the resources allocated, doesn't return it when it terminates, and when you reach 30% or less, it's goodbye to Jane. Time to re-boot.

If you have never installed chips before, take apart something old, like a radio or answering machine that no longer works (every house in America has a broken answering machine, I think). Make sure it is unplugged (of course) and find an IC chip (described above) (one that's in a socket, not soldered in) and insert a small screwdriver under the chip as far as it will go without force. Pull up gently. Stop. Go to the other end of the chip and repeat. Slip the screwdriver a little further in. Pull up gently. That should do it. If you can't pull it out, there are IC extractors available very cheap (and very expensive. I had to buy a $60 one for special job) at electronics stores. Repeat until the chip comes out. Removing chips is a developed art. I still break them, and the genius manufacturers couldn't be bothered to key the chips to only go in one way. Put it back in. Repeat this a number of times.

Go ahead and, with help if needed, install the SIMMS. There is a notch on one side of the SIMM which keeps it from installing backwards. Slide the SIMM into the slot on the Motherboard on an angle. Push gently until it feels well seated, then pull up on the SIMM until you hear a satisfying little click. Visually inspect the SIMM to see that it sits straight and even in the slot, then move on to the next. A few older motherboards do not have a lever arrangement to hold the SIMM. Instead, it pushes straight down into the slot. These are not fun to work with.

CACHE MEMORY

All newer Motherboards have slots for Cache Memory chips. Most times, the Cache is pre-installed, but a super bargain Motherboard may just have the empty slots. This is relatively cheap memory to install, and works by pre-fetching the next instruction for the CPU. The CPU can concentrate on the job at hand, much like a surgeon is much more efficient if he/she doesn't spend valuable time looking in drawers for a retractor, but instead has an assistant to fetch instruments. Cache speeds the overall efficiency of the system. Usual values are 64K, 128K and 256K Cache. Higher Cache sizes are rare in 486 boards, as tests show that the return in efficiency is low.

Don't confuse this with CPU INTERNAL Cache. Higher CPU chips have an internal cache to handle more than one instruction at a time. You cannot physically add or remove internal cache.

Module 4 - I/O Devices
Keyboards, Floppy Disks, Hard Drives, CD's n' such (I/O devices)

An I/O device sends (in) or recieves (out) instructions to/from the CPU. A keyboard is an INPUT only device (yeah, except for the little lights).

The Keyboard
May be bought refurbished from a store. You MUST buy an Enhanced 101 keyboard for a 286 or higher. Old XT's used a different processor, even though the connector still fits! The enhanced has some neat extra keys, extra Ctrl and Alt Keys, and F11 and F12. Some keyboards are switchable from XT to AT. Pay $20 (used) to $100 (fancy extras). Avoid keyboard companies that consist of three letters, the first of which is a B. Focus is a good brand. Look for a nice click when you press the keys, LED's for NumLock, Caps Lock and Scroll Lock. If you want a GREAT keyboard, get a used IBM. They do make the best keyboards for some reason. If you do, you will need to get an adapter to the bigger size clone style plug. Available at most computer stores. Compaq uses the same (almost) smaller plug. Make sure the adapter works with the Compaq keyboard, if that's what you have. Some have trackballs built in. The trackball will die after 6 months, but, then again, so will a $100 trackball. New keyboards have extra "Windows 95 keys" just like the Apple has Apple keys. Now I know why they say Windows 95 = Mac 1989.

   Installation:
Has a round plug. Plugs into the back of the case.

Other Standard I/O
Before you can load a program or save a file, you need to put it someplace semi-permanent. This is because when you exit a program or turn the computer off, everything disappears! Lost forever. Gone. Quicker than Ross Perot. You need a device or devices to save work to a floppy or hard disk. Get at least a 3 1/2 High Density. Make the 3 1/2 the "A" drive.

   Installation
You need a board. Read the rest of this article before deciding.

You need a hard/floppy or floppy controller. You need it to be MFM, RLL, SCSI, IDE, Enhanced IDE or ESDI for the Hard Drive. Make sure the controller you buy is proper for your Hard Drive and make sure it is 16 bit if you are building a 286 or up. VESA local bus controller cards can speed the system, but I'm no big fan of these because there are too many competing "Standards" and more than once I have pulled a VLB card out and replaced it with a 16 bit. Ploblems instantly disappear.

The Controller
The typical card is the IDE paddle card which handles the following: Two IDE hard drives via one cable with two connectors. Two floppy drives via one cable with two connectors. Two serial ports and one parallel ports plus a game port. All for about $12-20. If the IBM Clone had never come to be, you can bet the card would cost $149.

Floppy drives: Hook up the cable to the IDE card, matching pin one on the card with the side of the cable with the red stripe. The floppy cable may have four connectors, two card edge and two female pin connectors. The female pin connector nearest the end hooks up to the back of the 3 1/2 inch drive. (pin 1 to pin 1). If there is no female pin out, you need a converter to plug into the card edge connector and then to the drive.

Watch it! There are connector boards with both the card edge to pin out converter and a large power suply to small power supply converter - that's great, but SOME MANUFACTURERS PUT PIN 1 on the LEFT of the drive, and OTHERS PUT IT TO THE RIGHT! So this nifty little converter board may be BACKWARDS. Again, check pin 1 to pin 1 all around. If the floppy lights as soon as you turn the machine on, it is backwards. Hook the card edge connector directly to the 5 1/4 floppy, the "B" drive.

Notice if the Floppy Cable has a twist in the wires - it should. If it does not, either

1)Set the jumpers on the 3 1/2 to drive 0 - no easy feat
or
2)Buy another cable - $5

The purpose of the twist is to fool the machine into accepting both floppies as drive one, allowing you to reverse "A" and "B" without changing jumpers on the drive.

There is also usually a slot in the female portion of the card edge connectors to keep you from putting it on backwards. Plug one plug from the power supply into the "A" drive with a converter if one is not supplied from the power supply. If you have bought a second drive, the other card edge connector hooks to that drive to make it drive B.

Types of Floppy Drives
Besides the old standby 360K 5 1/4, there is a high density 5 1/4 that stores 1.2M of data. This drive is problematical. You will not be able to write to a low density diskette and use it on another computer with a low density drive without using the /4 switch when formatting. There are also 3 1/2 inch drives. The disks it uses are hard, less likely to go bad, and fit in your shirt pocket without a sleeve. Wonderful. Old low density 3 1/2's stored 720k and quickly went out of fashion. High Density 1.44's are the standard. Buy the high Density. Pay $15 (used) to $50. There are new combination 3 1/2 and 5 1/4 drives that only take one slot. If you definitely need 5 1/4, go this route and save the slot for a CD.

There are some new drives out there. There are 2.88 Meg 3 1/2 drives. Why??? How dumb do they think we are? Are we supposed to buy this overpriced drive, pay for overpriced disks, and drool for 5.6 meg disks next year? Anything less than a 10 Meg disk is silly when it takes 1 Meg to save a decent Drawing. AVOID this drive and wait for Floptical prices to come down. There are new ZIP drives (I hear FUJI invented them). They are, in effect, 130 Meg floppies, which allows you to use it as a hard drive and change operating systems as easily as changing your socks. You do change your socks, don't you? You could have a 130 Meg DOS 6.22 disk, a 130 Meg Windows 95 disk, an OS/2 boot, etc. Wow. I hope it catches on. I like it.

Don't listen to the guys who tell you that 720K disks formatted to 1.44 aren't reliable. Hogwash. Caution: Some computer manuals claim that you should never do this. They say that the low density disks are not made to be formatted high, and you will lose data. I have NEVER had this happen, so you make the call. If the only copy of your will is on a low density disk formatted to high, back it up somewhere. Personally, I could write my will on the LABEL of a 3 1/2. You used to be able to jumper HD drives to read low density disks high without drilling the little hole on the left side, but with the newer IDE controllers, the old jumper trick no longer works. Now I gotta drill little holes in the left hand side of low density disks. I still refuse to buy high density disks.

Some machines, notably IBM and Compac, have controllers that don't check for the little hole. They assume all 3 1/2 disks are high density unless told otherwise. That makes for great workday productivity, but the problem crops up constantly at work, where people who work on IBM-Compac all day take some disks home to work on their new clone, and report to me that the disks are "bad". Keep in mind that when you get calls for bad disks, there are usually two causes:

1) Low density disks have been formatted to high on an IBM-Compac, and they are taken home to a clone which checks for the high density hole, doesn't find it, calls it low density and can't read it. The user has to format his low density disks to 720K with the following command (DOS 5 and later)

C:\> FORMAT A: /F:720

(change drives as necessary) or drill a hole. This has to be done carefully so that little bits of plastic don't get into the actual disk area in the plastic envelope.

2) The machine (especially a laptop) is being operated in high humidity. I found that when I brought my laptop home and humidity was high from the Air Conditioner being off during the day (I'm a cheap bastard), I would get loads of disk errors until the place dried out. This explained many here to fore mysteries of reports of disks people took home being bad, only to check out fine in work the next day. Live n learn.

Hard Drives

Archaic note: You can sometimes put a 8 bit hard drive controller in a 16 bit board. You can put a 16 bit VGA card in an 8 bit slot. But, wonder of wonders, you can't seem to put a 16 bit VGA Card in a 16 Bit slot with an 8 bit hard drive controller! It seems that the second 8 bits of the VGA card conflicts with the addresses used by the 8 bit hard drive controller. And you wanted to be a computer repairman! Figured this out after hours of agonizing over a failing system where all cards checked out OK individually. It has to do with interrupts and memory addresses that differ between 86 class and X86 class machines.

Ok, ready for some jargon? There are MFM drives (usually old) RLL, SCSI (pronounced Scuzzy for some warped reason), IDE and ESDI drives. Buy whatever you get the best deal on, and fills your purposes (if you can afford ESCI, you probably aren't interested in building) but your controller MUST be compatible with that type. Buy a 16 Bit controller card. You can get 40, 80, 120, 1 Gigabyte and up Megabytes of hard disk space. Hard drive prices crashed in 1994-95, and the price differences between 500 and 850 meg drives is very low. 100 and 200 Meg Hard drives are selling for as low as $50 used as people pull them from machines to go bigger. Buy a compatible Hard/Floppy controller to match the drive and 8 bit for XT or 16 bit for AT to control all the drives. BUY NOW. The industry will reach a point where it will manufacture a 'hard drive crisis' like they did with memory and the price will rise and stabilize.

Older MFM/RLL Drives are also split into Stepper Motor and Voice Coil. Be aware the stepper motor are cheaper and will give you great service, but cannot be moved without "parking" the drive. A stepper motor hard drive is just like a turntable; if you shake the drive, the needle will go skittering across the surface of the drive platter, destroying data as it goes. Most MFM/RLL hard drive repairs are reformatting as a result of the user banging the machine around, or, (GASP!) turning the machine over and shaking it to get out a loose screw. Voice Coils can be safely moved, and are more expensive. Ask the seller which the drive is.

There are new hard drives which store information on glass prisms. Great. I can just see me dropping one. I hope they make them out of jelly jars. They never break. Especially the ones with Pebbles and Bam-Bam on the side.

High Tech Hard Drives
SCSI works by putting the controller on the Hard Drive, and the floppies work off of that controller. IDE is an animal unto itself. IDE also puts the controller on the drive, and then plugs into a card (not a controller) that also has the parallel, serial, game port and floppy controller on the same card. An OK hard drive is rated at 28Ms. The price is coming down on the IDE cards, too. Expect to pay $20 for a regular IDE with I/O, and $119 for a new, lower priced cache controller.

RLL is dead. RLL was really MFM type technology but used Run Length Limited encoding to format the drive at 26 sectors per track instead of 17. Increases the capacity of the hard drive by 50%. What doesn't work in most cases is formatting a MFM drive on an RLL controller. The drive works for two days then poops out. There seems to be no way to look at a used controller and tell if it is MFM or RLL. Make sure. Also be VERY wary of used controllers thrown in a box for $5 apiece. Most of these boards have been stripped of their chips, or have broken pins on the connectors.

Installation
MFM/RLL: There is one big cable that goes from both Hard Drives to the controller and a small one called a data cable that goes from each drive to the controller. Match pin one to pin one all the way around. IDE/SCSI: There is one connector that hooks from the drive to the interface board. The actual controller is built into the drive's logic board. Slide the Hard Drive into the case, connect these cables, and plug in the power supply lead. For two drives, get a book and follow the instructions. It's not that hard, but you have to deal with twisted cables and terminating resistors and such for MFM/RLL, and Master/Slave settings for IDE. The terminating resistor goes on the last physical device. There may be a jumper on the board to hook up the light on the case so that it merrily blinks when your hard drive is working.

Beware of old MFM systems that call themselves IDE. Citizen called their hard drive system IDE, but it used MFM drives and connectors. A call to their tech service confirmed this.

The MFM/RLL hard drive must be set up in your BIOS program, then low-level formatted and high level formatted. Pick up a book at the library, borrow one or ask a friend. The procedure is not difficult. The shareware programs IAU and HDDIAG makes the process easy and configures the drive to it's optimum performance. IDE drives NEVER get low level formatted without a specific IDE formatter. If you do, it goes stupid and becomes an MFM.

On clone 286, 386 and 486 machines, you must pick an entry from your Set-up program, which comes up when you start the computer. It is accessed by a particular keystroke, referenced on the screen before the machine actually boots DOS. The message will say something like "Press DELETE to enter Set-up". Set-up writes your component information into the CMOS. CMOS stands for something or other which I always forget. Oh, yeah, CompliMentary Oxide Semiconductor.

Shareware programs are available to help you pin down which "number" of a standard set of numbers your hard drive type is. An old IBM 10 meg drive is #1. An old Seagate 412 is #23. The BIOS will ask you for this number. If you bought from Crazy Johns Un-guaranteed Hard Disk Bargain Nearly New Shop, you may have to do some digging to find the number. Disk Manager, which comes with Seagate Hard Drives, will interrogate the drive for you, but is a real pain in the butt when the drive isn't Seagate. Here's a real kluge. My hard drive didn't fit my table, so I hooked the hard drive up to a machine with a settable drive table, formatted it, then saved the settings to the disk with Disk Manager. If the drive ever crashes, I'll probably have to repeat this process or update my BIOS. You need to know the number of cylinders and number of heads, at a minimum. The number of sectors for MFM is usually 17 sectors, RLL 26 or 27. Call the local computer club to track down a list of hard drive specs. You match the number of cylinders and number of heads in the drive table in your set-up program WITHOUT GOING OVER. Just like the Price is Right (hi Bert!). If your drive has 8 heads, you can pick 5,6,7 or 8, but not 9.

The IDE drive table entry is determined by MULTIPLYING the number of heads x the number of sectors x the number of cylinders, and matching that to the drive table entry that most closely equals the number of heads x cylinders x sectors. Sheesh.

The advantage is, you are not limited to the closest without going over rule. The one thing you MUST NOT DO is low level format an IDE drive!!! They are low level formatted at the factory. If you do a low level format, it becomes an MFM drive. This exciting information was passed on to be by the Seagate technical department AFTER I had low level formatted my first IDE three times trying to get the bear to work. There was NOTHING in my documentation telling me not to do a low-level. I had to get another drive and start over to get the full performance from the drive.

    SCSI
involves setting the hard drive table to "not installed". The information on the drive is send to the BIOS at boot up time.

    IDE
Imbedded Drive Electronics puts the controller on the drive, where it belongs. As long as your Motherboard's BIOS has User Settings entries, installing a drive 540 Meg or less should be easy. If the Motherboard is new enough to have AUTO DETECT IDE HARD DRIVES, the job is a breeze. What follows is a lot of pain boiled down a few pages which deals with what happens when the drive is over 540 Meg. Grab a fresh cuppa coffee and read on:

LARGE IDE HARD DRIVE FACTS & FAQS

THE WHAT OF IT
Hoo-boy. This can be tough, and it shouldn't be. I'm going to cut through all the horse hockey and give you the straight scoop on large hard drives, hopefully BEFORE you run up against it.

THE WHY OF IT
DOS is limited to 540 Megabytes in a hard drive partition. They never imagined you would need more. 1024 Cylinders is the most you can specify. With half the planet wanting to put in at least an 820 Meg Drive, the Industry had to come up with a workaround. So they did. They ALL came up with workarounds, and therby lies the rub. You buy a new Hard Drive, and maybe a new, "Super IDE" controller (I've yet to find one that works better than a normal IDE card for the hard drive part, and there are a lot of bad 16550 UARTs [COM port drivers] according to Industry sources), and you go to install - The Motherboard says, "Turn this stuff on in the BIOS", the Controller says "Throw these jumpers" and the Hard drive says "Use this Utility Disk." You soon find out that turning all three on leads to disaster. Just to make it more fun, different Hard Drive manufacturers and controller companies and BIOS makers have DIFFERENT schemes. So what do you do when a Western Digital Caviar is on C: and a Maxtor is on D:? And I guess you expect an answer...

THE HOW OF IT
As usual in this business, keep the solution simple and elegant. Don't make an OS/2 out of it. Look at the overall system you are going to end up with, and take the shortest distance between the two points. Play around with getting fancy later. Let's say you are going to end up with a 850 Caviar (TM) drive on C: and your old hard Drive on D:. Your old stuff will be transfered to C:.

First, prepare your old system. Do the following in order.

Upgrade to DOS 6.22.

Scan the existing drive, including all partitions and compressed mounted drives. Defrag all of them. Dump any temporary files and remove any cross allocation "phantom directories". That's those directories with names like TBLCH!@.&^%. You CAN get rid of these even though you get Access Denied or Directory not empty errors. How? Send me $10 in a self addressed... nah. Here goes. Your key is a cool little DOS utility called DELTREE. Go to the root of the drive and first attempt to RENAME the directory -

RENAME TBLCH!@.&^% DUMPIT

If you get Access Denied, run ATTRIB and remove any attributes.

ATTRIB TBLCH!@.&^% -r -a -s -h

If the directory contains any weird characters like smiley faces, go into super nerd high gear. You can RENAME these characters using the ALT key and the numeric keypad. Get a list of the ASCII codes from the back of a DOS book, or hunt and peck them yourself. Say the character is the paragraph symbol (a backward p). You would hold down the right ALT key and type 020 on the numeric keypad. Let go. Wow! There it is! You can use that symbol in a RENAME or DELTREE command. You may need to load ANSI.SYS depending on your machine. RENAME the file/directory name to something normal. Once you have the phantom directory renamed to something normal, DELTREE it. This does the amazing feat of removing all unaccessible sub-directories and files under it.Cool, huh?

DELTREE DUMPIT

DELTREE is a powerful command. Don't misuse it. If you do, special agents of Geek International will hunt you down and kill you. Scan and defrag again. Now that the drives, partitions and compressed volumes are cleaned up, move any information in partitions to the root partition, go into FDISK and remove any logical drives, leaving the empty partitions. Careful here! Read up on it if you need to. You want all your files in one big C: drive. Leave extra space unallocated. Next uncompress all compressed volumes, whether DBLSPACE or DRVSPACE or STACKER (TM) or whatever. ZIP directories to disk as necessary to make room. Remove DBLSPACE and DRVSPACE to get rid of .INI files (removing these in DOS parlance doesn't mean deleting the files, just removing the .INI files and such.) Disable CD ROM drives by REMming out entries in CONFIG.SYS and AUTOEXEC.BAT. Dump any references to STACKER or D*SPACE in CONFIG.SYS and AUTOEXEC.BAT with REM statements. Once you have one big, clean partition you are ready to move on. Do not continue until nothing is left but C: at reboot. Defrag once more.

Make a system disk. I repeat, make a system disk. (FORMAT A: /S). If you want to be really cool, next XCOPY the hard drive utility disk to this system disk (as your legal backup copy). What Utility Disk??!??. Uh-oh. Read on.

Back up if you need to - at least backup your DATA files to disk.

UPGRADING AN IDE TO AN IDE
Contrary to what you would think would be logical, first install the new Hard Drive as C:. You MUST do this, or it will be prepared as not bootable by the disk utility.Trust me. I learned the hard way.Go into the BIOS (AMI - Press <DEL>, Packard Bell and Acer may be <CTRL_ALT> <ESC>, etc) and WRITE DOWN THE PARAMETERS OF THE EXISTING HARD DRIVE. Remove the old hard drive by (turn it off first) disconnecting the flat gray controller cable. Note that the cable has a red stripe on one side. This indicates Pin 1. Remove the four prong power cable. Remove the drive and mark the parameters on the drive top with a Magic Marker (TM somebody or other, I'm sure) and place the drive somewhere safe, like in a small bag and put it in a drawer. Don't set it down next to the dog's water bowl. Touch something metal to discharge static and then remove the new hard drive from the bag. The instructions with the drive, if there are any, will tell you how to set it for "Master". Since the dealer didn't give you the manual or the disk, at this point

put everything away safely, get in your car, go back to the dealer and demand the disk and the manual. He will eventually succumb and give you a xerox copy and a disk copy of the utility disk. They usually only get one per box of drives. Drive back home and get back to where we were. Don't you wish you had read this first? One manufacturer's drive has jumpers MR for Master, SL for Slave, and CS for Connect here if you are Stupid. Choose Master for the first (C:) hard drive you are installing. Now the fun part. You must figure out how to set the old drive for Slave. Many drives do have a separate jumper setting for one-drive-only, just to confuse matters more. When you are confident that the new hard drive is Master (C: or Drive 0) and the old hard drive is Slave (D: or Drive 1), move on. If you are going to hunt and peck your way around, start by marking down the original positions of the jumpers. Duh. Connect the new hard drive with the end of the gray cable, Pin 1 to Pin 1. Look closely at the hard drive to find the "1". Hook up the power connector. There should be a second connector in the middle of the gray cable. Hook your old hard drive here and find a power connector for it. If you find that the IDE Cable only has one connector and/or there is no spare power connector, get back in you car, drive back to the dealer and buy a two connector IDE cable and/or a "Y" connector for the power connector. By the way, never connect a power connector with the power on. Don't fry your brand new hard drive.Turn on the machine. If the hard drive light comes on as soon as you turn on the machine and you get "Hard Drive Controller Failure" no matter what you do you most likely have the cable backwards. Your original installer may also have put the cable itself on backwards. Get Pin 1 to Pin 1 all around. When you start back up, the Motherboard may hang after the memory check. This is normal. Wait it out. The older the Motherboard, the longer the wait.You will get a friendly message like :Drive C: Failure, Drive D: failure.Get back into the BIOS. If you have a fairly recent Motherboard, your BIOS will have a wonderful option called AUTO DETECT IDE DRIVES. Let's assume it has this sweet utility and you can have two User specified settings. Run detect on Drive 0 and Drive 1. If it finds both, you are doing great. If it doesn't, you have some cable and jumper work to do. If it recognizes drive 0 and not drive 1, you may be running an old Disk Manager or some such which over-rides the BIOS and you are going to have to read the section below and do it the hard way, or you do not have the old drive set correctly for Slave, OR the second hard drive is so old it is hopelessly confused.

If AUTO DETECT IDE HARD DRIVES is not a BIOS option, you must specify at least the Cylinders, Heads and Sectors per track in the User Settings entry at the end of the hard drive table. If User Settings aren't allowed in your BIOS, get a life and go get a Motherboard dated 1990 or later. Sheesh. Most new drives have Cylinders, Heads and Sectors per Track listed on the top of the drive. If not, and you don't have a manual, you can use one of many shareware and freeware utilities available online to query the geometry from the drive, or get a book or look in a book in the library. You must have these numbers, unless you are using a hard disk installation utility which masks all this stuff. That's nice for today, but you really should understand the process on some level. Maybe you don't care..

With MFM/RLL drives, the actual geometry had to be specified - with IDE, it is only necessary to specify the Megebyte total, which is calculated as CYLINDERS x HEADS x SECTORS PER TRACK (x 512 bytes per sector). When the BIOS goes out to query the drive for readiness, the actual geometry is reported by the drive to the BIOS. As long as the BIOS can get to this information (and it is valid), the drive will initialize. Driver manufacturers use this query to end around DOS and bypass the limitations. The limitations are 1024 Cylinders, 16 Heads and 64 Sectors per Track (times 512 bytes per sector equals 536M).

WHAT ARE THOSE OTHER PARAMETERS?

Write Precompensation, Skew, Landing Zone, etc. are important to MFM/RLL drives, but usually not to IDE. Set Write Precompensation to 65535 and the Landing Zone to one cylinder higher than the number of Cylinders Specified. Leave other values at 0. Your Disk Utility may change these numbers. If they do, leave them alone.

Some machines only have one User definable setting. It may still be possible to have the Utility Disk set these up by overriding the BIOS. It may be messy. I can't cover all possible scenarios.

BAD SECTORS

IDE drives usually don't have bad sectors. If you get a drive that was used in an OS/2 system, you may need to low level format it; you must find an IDE low level formatter that recognizes your drive type. DO NOT USE an MFM/RLL low level formatter - it will destroy the factory parameters and turn it into a smaller, slower hard drive. You may need to run the low level formatter two or three times to completely get rid of OS/2 left behinds - they can show up as bad sectors to the formatter. Three times usually does it. If the low level formatting immediately starts counting off bad sectors, stop it and remove any other hard drive in the system. I don't know why, but sometimes you have to.

There are two kinds of bad sectors - hard and soft. Soft occurs when the formatter is unable to initialize a sector because of a random peice of dust in the drive or a hard to erase bit of data, like an OS/2 boot sector. You can usually format away soft errors with persistance. Bad Hard sectors are defects on the platters themselves, usually on the inner tracks, and

are there to stay. Mapping out bad sectors will make the drive work, but be aware that when you move the drive to another system, you may have a hell of a time because the geometry of the mapped out drive - say 1009 x 16 x 64 - is different than the geometry in the BIOS settings and the original geometry that may be used by the setup utility, which may take the Cylinders, Heads and SPT from a table based on the hard drives model. You may need to low level format, including generating a new map to get it to work in another system. This stuff is made to be set up once and used till it dies. Many of the early IDE hard drives develop bad tracks near the end of the drive. A trick I have used to get these drives working is to make a small parition at the end of the drive with FDISK - say the last two Meg - and leave them without a logical drive assignment. High level formatting then succeeds.

THE FIRST REBOOT - A PLANNED FAILURE

When you get to the point where both drives are recognized, save into the BIOS and reboot with the SYSTEM DISKETTE floppy. If you didn't make a system diskette, you are **cked. I warned you. (Reinstall the old hard drive and start over.) You may need to go into the BIOS and enable BOOT FROM FLOPPY. Probably not. On reboot with the SYSTEM DISKETTE, You will get another error message along the lines of Drive C: Failure, Drive D: Failure or CMOS options not set. This is normal. Place your Utility diskette in the drive and start your Disk program. With Disk Manager (Copyright and Trademark Ontrack), type DM/m. The /m parameter gives you more control over what happens. If you live right, both drives will be detected, and the only preparation necessary is to allocate one big partition on Drive 0 and high level format. DO NOT LOW LEVEL FORMAT. To be absolutely safe, disconnect the gray cable from the second hard drive just before you partition or format the new drive, in the unlikely event you are specifying the wrong drive. After the partition and high level format (this may be masked by user friendly (?) schemes by some disk utilities), reconnect the second hard drive. Do not do anything to Drive 1. Disk Manager (TM) or your disk utility will write special start up files to the new drive to do an end run around DOS. Imagine a big, stupid guard standing in a doorway. It is $50 to get in for adults, $15 for children under 12. When he asks you how old you are, say 11 even if you are 99. He'll let you pass for $15. That's how this works. "How big are you?" asks DOS. "540 Meg" answers the 1.2 Gig Hard Drive at every boot up. "Duh, OK" says DOS thoughtfully. DOS never thinks to ask the BIOS, which in most cases reports the true geometry, or, if it runs out of User Setting entries, a fake entry. Don't flip out if your new drive ends up set up as 30 Meg. If it works, it works. The BIOS is what checks the hard drive for geometry validity, and it is the hard drive utility's job to handle this.

WHO'S IN CHARGE HERE?

Okay, so who is going to control the Enhanced IDE settings of my hard drive? The hard drive itself!!! If you give control to the BIOS or the controller, you are giving control to a device that does not know what the hard drive will expect, but the hard drive always will. Set the BIOS to disable 32 bit access, large hard drive parition, LBA, etc, and only turn them on as last resort. Some machines, such as some Gateway 2000s (TM) need LBA turned ON. LBA is Logical Block Addressing. Don't use it if you don't need it to get the drive running. A few machines, including some 486 PS/2's, won't work at all with partitions bigger than 540 Meg. Other operating systems, such as OS/2 and some flavors of UNIX may need special setup or may not be able to run partitions larger than 540.

Leave the Controller set for normal hard drive and play with Super Speed access or whatever later. Ignore the Utility disk that comes with the controller unless you are installing a third and fourth hard drive. Although it is logical to tell the BIOS you have a large hard drive and the controller the same, the reality is that you ONLY NEED TO TURN IT ON ONCE. If you tell two or three devices to enable large drives, they will fight each other merrily, with you losing. Same with 32 bit access. The 32 bit access driver which comes with Windows does not work with large hard drives. The newer BIOS, newer Controller card and large hard drive all come with replacement drivers for Windows 32 bit access. Use the hard drive's utility again. Only it knows what works with the drive. Logical, right?

WHAT IF I CAN"T GET THE OLD HARD DRIVE TO ACT AS SLAVE?

I was afraid you would ask. Messy, but possible.Still begin by setting up the new hard drive as C:. You have to. You have no choice. If you don't it will never boot. Since the new hard drive is faster and will hopefully outlive the old hard drive, you want it as the boot device. Once you have the new hard drive working correctly as C:, remove it and re-install the old hard drive as C:,(change the BIOS) the new hard drive as D:. Follow the steps below to transfer the files, then remove the old hard drive, and replace it with the new hard drive. This works most of the time. Do not erase the old hard drive! Resetting the new hard drive as C: rarely but occasionally fails, necessitating a re-partioning, putting you back to square one. Sorry. Sometimes it is just impossible to set these drives up easily. You may end up doing a back up and restore no matter what you try.

WHAT IF NOTHING WORKS BUT ONE DRIVE AT A TIME?

You probably have a very old IDE drive as the original. You have three choices:

1) Back up to disk or Zip to disk
2) Back up to tape or
3) Take the machine over to a friend's house, and stop at the dealer (oh, no, again?) and buy a null modem cable (Laplink (TM) cable). Make sure you also buy any 25pin to 9pin converters you need, which means you must determine whether the open COM port you are going to use on both machines are 25 or 9 pins. Convince the friend that you are competent enough to install one of your hard drives in his machine, and that you can put it back together so that he can still play tetris tonight. Install one hard drive in his machine (assuming he/she has an existing IDE controller), have the other working in yours, type HELP INTERSVR at the DOS prompt and use DOS 6.22's built in machine to machine transfer utility. Get your friends machine back to normal, and get the hell out of there before he starts Tetris.

MOVING FROM MFM/RLL DRIVES TO IDE.
If you have two flat cables (a fat and a skinny) plus a power connector running from your old hard drive, you have an MFM or RLL drive installed. My sympathies. Back up to disk or tape, remove the old hard drive AND controller, put in an IDE controller (actually, it's not a controller, just the card to handle the controller on the IDE drive itself. That's why it's called IMBEDDED DRIVE ELECTRONICS.) and install the new drive. Consider COM port and LPT port changes this causes. If your Modem is on COM 2, you have to change COM 2 on the IDE card to COM 4. But thats another book.

DELETING OLD PROGRAMS
Yep, I agree. Get rid of some of that old stuff before you go through this process. But watch out if you are a heavy Windows user. Windows programs install DLL files and VBX files and fonts and all kinds of stuff to your Windows and WINDOWS\SYSTEM subdirectories. Blow the 30 bucks and buy an uninstaller. Always remove Windows programs with an uninstaller. There is no other way to tell what DLLs are used by what Windows program, unless you are a total dweeb and actually LIKE doing hex dumps till 3 am. Windows 95 has a hidden utility called RunDLL that allows you to run a DLL like an EXE to see what it does.

Hard Drive FAQs by Farnum Andrew Quillimork
WHAT IS DRIVE ROCKET (TM) and why should I care?
DRIVE SPEEDER UPPERS
Most "high speed" IDE controllers and new hard drives come with speed 'em up schemes to make your hard drive go faster. I'm not going to tell you not to play with them, but DON'T use them until your hard drive has been working for a good week. Especially if you leave an old hard drive in the machine, and run the speeder upper against that. I'm sure most of them work fine most of the time. but I've had to low level format a couple of drives after three days of high speed operation, and I've lost a work hard drive's data to cross allocations (before I knew the DELTREE trick). SCANDISK is a good way to find out if the speeder upper is going to trash your drive (if, indeed, it trashes your drive, you now know. This is tough love stuff). Whatever drive speeder you choose to mess with, use the Advanced Options to thoroughly test the best settings for it. One particular make has a quick check option. If you run the quick install it may actually slow your drive down. There are three 'most popular' speed up schemes:

1) 32 bit access under Windows (TM), Windows for Workgroups 3.11 (TM) and Windows '95 (TM). With the aforementioned codicil of replacing the driver with 540+ drives, this is a very stable utility which works with all but some some real old programs.

2) A new technology in most new IDE hard drives is called MBS (Multiple Block Size) or read-and-write-multiple mode.

3) An older hard drive may be able to use a scheme where a utility will install a device driver to execute I/O (In/Out) requests in RAM rather than the norm, which is BIOS calls (much slower). Your BIOS may offer Shadow RAM, which is an older technology alternative. To use device driver RAM I/O, you have to disable Shadow RAM. Test both for speed

SO HOW DO I KNOW IF MY HARD DRIVE IS QUICKER?
We sometimes (or at least I) wonder when all is said and done if the system really ended up any quicker. You can download Benchmarks till you are blue in the modem, but many benchmarks, especially those touting a particular product, make end runs around the BIOS and sometimes even hard code information the system will look for (especially in Video Benchmarking) in the Hardware Device! I say the proof is on my wrist. When all is said and done, when the high speed drive is installed, the speeder upper is running, the controller is set to use higher data rates, the BIOS is at 0 wait state, and the VESA Local bus Video Card with Windows Accelerator is installed, all I care about is the WIN test. It's a moronic little test that anyone can do. Before you make any changes to your system, take off your watch, go to a DOS prompt and type WIN. Mark the number of seconds till the Hour Glass is replaced by the pointer. Make your

changes. Repeat. Tweak your changes. Repeat. Try different combinations. Repeat. Doesn't it all come down to how long it takes to load Windows and Windows programs? Who cares if the data rate is 10 times faster if the CPU is slugging along and backed up to next tuesday, or all your wait states are 2 and your external cache is turned off in the BIOS? Be results oriented, and don't worry about Benchmarks. If you play DOOM all day or run CAD all day, time them instead.

SO WHY DOES MY HARD DRIVE END UP WITH LESS MEGABYTES THAN THE DRIVE IS SUPPOSED TO HAVE?
The Driver manufacturer is using Binary Millions (1,024,000) and the operating system and software are using Decimal Millions (1,000,000). See this effect most clearly by running MEM/C|MORE from the DOS prompt. Notice the numbers on the lines versus the numbers in parenthesis.

(DOS 6.22 is a registered product of Microsoft Corporation)

Modules using memory below 1 MB:

Name	Total	=	Conventional	+	Upper Memory
MSDOS	65,901 (64K)		65,901 (64K)		0 (0K)
HIMEM	3,744 (4K)		3,744 (4K)		0 (0K)
EMM386	3,120 (3K)		3,120 (3K)		0 (0K)
COMMAND	4,992 (5K)		4,992 (5K)		0 (0K)
win386	12,304 (12K)		12,304 (12K)		0 (0K)
SMARTDRV	25,632 (25K)		25,632 (25K)		0 (0K)
POWER	13,840 (14K)		13,840 (14K)		0 (0K)
DOSKEY	4,144 (4K)		4,144 (4K)		0 (0K)
WIN	1,520 (1K)		1,520 (1K)		0 (0K)
COMMAND	3,088 (3K)		3,088 (3K)		0 (0K)
Free	516,944 (505K)		516,944 (505K)		0 (0K)

WHEN MY DRIVE STARTS TO FILL UP, SPACE DISAPPEARS! Howcum?
The larger the hard drive, the more "slack space" is generated. Each bit of data takes a bigger minimum chunk of bytes, which becomes significant as the drive size grows. This is a hard drive fact of life. Sorry. It's my fault. I admit it.

The second reason is that if you are DBLSPACEd, DRIVSPACEd or STACKed (TM Stac Electronics), the amount of free space is ESTIMATED based on the compression ratio it expects to acheive. If you are filling the drive with text files, you will get more than you expect. If, however, you clutter your drive with graphics (GIFs, BMPs, etc) and ZIP files, these files are unable to compress via the compression program or, in the case of ZIPS, already compressed. One of the dumbest things you can do is to spend an evening zipping stuff on your compressed drive to make room. I know. I've done it. (Everybody together: Duh.)Windows 95's Microsoft Plus! comes with a drive fourpeler. So far, it works on one drive I use it on and causes SCANDISK errors on the other. It did add about 80 more meg to an already DRVSPACEd 200 Meg drive.

SHOULD I DRIVSPACE (TM) MY DRIVE?
Mine is. I love it. The guys who tell you not to do it are the same guys who told you that Windows sucked.

Don't do it till you need it, and DON'T drive space an RLL drive that will run Windows. Otherwise, the performance hit is well worth the 80% space gain.

Here's a warning you should never, ever, ever forget. Send me $5 just for telling you. Never, ever, ever let a compressed drive fall below 10 Meg free. Hideous data and partition destroying things can happen, especially if your TEMP directory is set to a compressed volume or your Windows Swap File is temporary and set to a compressed drive. Set your TEMP directory to the uncompressed volume and allow 10 Meg free space at all times on that volume. Never, ever use shareware disk speed em ups on a Drivespaced drive. The first time you defrag or scandisk, well, it's just too hideous to describe. Back to leaving space on a drivespaced drive:

SET TEMP=D:\TEMP

Create this directory on D: (or whatever the uncompressed host is) and put the line in AUTOEXEC.BAT.

Use a Permanant Swap file on the uncompressed drive. This goes for Windows '95, too! All programs don't use the SET TEMP variable, and may choose their own place for temporary files, usually it's own sub-directory. Don't let it run out of space while creating temporary files. It's brutal. It's worse than a traffic accident.

Why am I getting LOCK UPS AND 32 BIT FAILURES?
If you get everything tweaked and the system starts locking up on you, you've done a little TOO good of a job. Something in the system is running faster than the CPU can keep up with (or vice versa), and Interupts are getting clobbered. Back off a little, including using these handy little tips:

1) Try removing HIGHSCAN if present in your EMM386 line

2) If you are on a Network, wake up the Supervisor and ask him what X= statements are needed in the EMM386 line for your network hardware card.

3) Back off the wait states in the BIOS from 0 to 1, or 1 to 2, especially if you have slower speed SIMMS

4) If you have non-parity SIMMS, see if your BIOS lets you specify NON-PARITY.

5) You still haven't dumped that EGA Monitor?

6) 32 Bit access may fail under quite a few conditions
         -Another Virtual Device Driver *.vxd in SYSTEM.INI. REM them one by one.
         -QEMM stealth is using an "M" switch instead of an "m" switch.

(There are three cults in this industry: QEMM(TM) users, Lotus 123(TM) users and WordPerfect 5.1(TM) users. You oughta see these guys at COMDEX. Don't ever argue with them. Many are unstable. Just kidding, guys... guys??? Put that power cord down... F7! F7!)

7) I am singularly unimpressed with Vesa Local Bus. If you have Vesa Local Bus cards and you get weird lockups, your Motherboard manual may tell you about a jumper than will change the Vesa Wait State from 0 to 1.

There are other considerations, especially in getting Windows for Workgroups 3.11 to work with both 32 bit file access and 32 bit disk access.

8) If you get lockups when starting Windows along with occasional EMM386 #6 errors, you have both the BIOS or a Network card and DOS=UMB competing for an area between 640K and 1 Meg RAM. Exclude the UMB in your EMM386 line, and if that solves your problem, start backing the exclude down. For example:

device=C:\DOS\EMM386.EXE NOEMS X=A000-FFFF

If that works (ignore 'overlapping address' errors), narrow it

device=C:\DOS\EMM386.EXE NOEMS X=A000-EFFF (then A000-DFFF, etc)

Memory is counted in hexidecimal - the ranges are

A000-AFFF (Usually VIDEO)
B000-BFFF (Usually VIDEO)
C000-DFFF (Usually free, but many times Network cards camp here)
E000-FFFF (Some portion of this will be used by BIOS ROM routines and shadowing)

C800-DFFF is the safest range, but is not much fun. Like driving in third cross country.

Reboot your system and press F5 when you see Starting MS-DOS... (If you don't see starting MS-DOS, get upgraded, you old fart.) This forces a clean boot. Go to the WINDOWS subdirectory and run MSD.EXE. The three Memory Utilities will map out what areas of Upper Memory are being used by the BIOS and the VIDEO. These are the areas you want excluded.

Continue to narrow the range until the smallest exclusion possible has been isolated, e.g

device=C:\DOS\EMM386.EXE noems X=E800-F800

Western Digital (TM) also says that UNDELETE causes problems by using Int 26h.

ENABLING SECONDARY IDE FOR THE THIRD AND FOURTH DRIVE
Here's where the game has different rules. Since the IDE controller is what is providng the Secondary IDE, you want to give control of it to the controller. Get the first two drives working flawlessly before attempting the third drive. A utility should have come with the IDE controller which loads a device in CONFIG.SYS to enable the third and fourth drives. Use it. You will probably be instructed NOT to set them up in the BIOS.

Here is a section from a readme by our friends from foreign lands. Since they don't list an address or phone number anywhere on the box or inside, they won't mind me quoting their README:

"MORE THAN TWO DISK DRIVES
   1. WBIDE.EXE supports up to four IDE disks access capability.
      Two are 1FXH port and another two are 17XH port.
[NOTE]: The 1FXH port connector must be attached at least one disk,
        before you attached any disks into 17XH port connector.

      If any IDE disk is attached into 17XH port connector, we strongerly
      suggest you to execute WBIDE.EXE with first way, a device driver on DOS.
      There is the only way to access the logical drives on 17XH port IDE disks
      under DOS, such as C:, D:, E: and so on.
[NOTE]: The IDE disks, where are attached into 17XH port connector,
        do not specify cyl/hd/sect parameters in ROM BIOS SETUP."

Doesn't that give you a headache?

FINALLY, THE KUDOS
Many reading sources were used while learning how to deal with larger hard drives, and while no material was drawn directly from the sources in an attempt to use copyrighted work (with the exception of the IDE Controller readme), I gratefully acknowledge the expert help files, readme files and manuals of the good folks at Seagate, Conner and especially Western Digital, all Trademark their respective companies.

One final tidbit. Make sure you are running SMARTDRV (with 256 if you only have 4 Meg RAM) and load the CDROM device driver BEFORE SMARTDRV.

FORMATTING
Formatting the MFM/RLL hard disk is involved but not difficult. HDDIAG and AMIDIAG (AMI, the BIOS people) are both free or shareware programs available at Computer Shows and through magazines for a couple of bucks each (Registration will cost more. These folks deserve their money.)

They will walk you through the low level formatting, which prepares the disk for your system. Seagate and some other manufacturers come bundled with Disk Manager, which is a great utility, but only works well with that brand hard drive. Next you run your DOS program FDISK, in which you set up the DOS partition. If you are running DOS 3.3 or less you are limited to 32 Megabytes per partition. Thus, a 40 Meg hard drive must be split up into more than one partition (C and D [and maybe E]). A drive runs faster if you minimize the C partition and maximize the others. The D and above partitions run much faster. No big deal to run FDISK. Finally, you high level format the disk, i.e. format C:/s which makes the hard disk ready for use and bootable and format d: which prepares the D drive. Take this whole process slow and easy. Block out quiet time to do it.

The IDE drive usually takes only FDISK'ing and high level formatting. I have found many of the old IDE drives don't like to be moved from machine to machine. They get to the end of a re-format and fail. If this happens to you, here is a "if all else fails" trick. Go into the BIOS and spec the hard drive as having 15 cylinders LESS than the documentation

calls for. Continue with the format process, letting the drive time out in the BIOS routine, low level formatting with an IDE low level formatter, FDISK and high format.

MODULE 5 Video

The Monitor
VGA is the only way to go. It has become the standard. The choices are:

Mono:
Monographic Monitor. Green, white or amber on a black background. Don't try to use a TV, even if it calls itself a "Monitor". Monitor in TV language means that there is a video out RCA type plug in the back for hooking up to a VCR and such. A TV only does 40 columns across (characters) and you need 80. A Mono Monitor is OK to get you up and running. Otherwise, you will be tempted to buy something less than a very good monitor. Don't. PLEASE don't buy a cheap VGA monitor.

CGA
Color Graphics. Also called RGB for Red, Green and Blue. Shows 4 colors (figure THAT math out!). Tandy CGA shows 16. Dead. It is slightly possible to run Windows in CGA, but it is ugly as hell.

EGA
Enhanced Graphics. 16 colors at one time. Was the high end standard a few years ago. Gone and hardly supported. Uses weird Memory addresses. Go higher or Mono. This is dead technology.

VGA
Video Graphics Array. This is where you want to be. "Real" VGA is .31 dot pitch or LESS. VGA comes in two flavors: analog and digital. In most electronic and audio applications, digital is better than analog. In VGA, it's the reverse. Analog is better. You need VGA to run most programs.

Super VGA
Super VGA is enhanced VGA. Has to do with the number of lines of resolution on the screen. A monitor whose resolution is 800x600 is considered Super VGA.

Old IBM's used 12 inch screens; most Monitors today are 14", with 15 and 17" available. Go 14 at least. Once you are up and running with Windows, there will be a lot of information to squint at.

VGA Calculations
Oh no, more Math! Someday you may be interested in calculating how much Video memory you will need to run higher resolution Video. When you do, dig this article back up and read this section.

Pixels n' Color
As opposed to TV, which is measured in Lines of Resolution (don't get me started), Computer Graphics are measured in Pixels. The screen is made up of little tiny dots of light, a number of them concentrated with different colors at each Pixel Point. Absence of color is black, saturation of color is white. The more Pixels on the screen, the better the resolution (less jaggies, less blurring) and the more possible colors per pixel, the more realistic the image. If your graphic sends a signal to your Video Card that Stanley's hat is a distinctive bluish green just a hair lighter than the green on the back of a dollar bill with a cast of blue akin to a drowning victim, your 16 color card would yell at the color guns "Yo! Gimme green!" A 32K color card and monitor would faithfully duplicate the Dollar Bill-Drowning Victim-Blue-Green. OK?

   VGA Resolutions
Standard VGA is 640 X 480 - that is, 640 Pixels (dots) wide by 480 Pixels high. 640 x 480 = 307,200 Pixels. The third number in VGA specs is the number of colors. We add 16 colors, making the Standard 640 X 480 X 16. It takes 4 bits of storage for each pixel to make 16 colors. 4 Bits is half of a Byte (8 bits) so 640 X 480 X 1/2 Byte = 153,600 Bytes, or 154K of Video Memory. The low end VGA card is 256K, so you are in good shape. To move up to 256 colors, each color takes one byte, so 640 X 480 X 1 Byte makes 307,200 Bytes or 307K or a 512K Video Card to run that resolution. Here's a chart to help you decide how much Video Memory you want to start with.

Horizontal	Vertical	Colors	Bytes per pixel	Memory needed	Board Size
640	480	16	0.5	153600	256K
640	480	256	1	307200	512K
640	480	32768	1.87	574464	1 Meg
640	480	65536	2	614400	1 Meg
800	600	16	0.5	240000	256K
800	600	256	1	480000	512K
800	600	32768	1.87	897600	1 Meg
800	600	65536	2	960000	1 Meg
1024	768	16	0.5	393216	512K
1024	768	256	1	786432	1 Meg
1024	768	32768	1.87	1470627.84	2 Meg
1024	768	65536	2	1572864	2 Meg
1280	960	16	0.5	614400	1 Meg
1280	960	256	1	1228800	2 Meg
1280	960	32768	1.87	2297856	over 2 Meg
1280	960	65536	2	2457600	over 2 Meg

Installation:

Plug the Monitor AC cord into an outlet, or some older monitors plug directly into the Power Supply of the Computer from the back of the Machine. You can buy an adapter to do this for newer monitors. Plug the Monitor Cable into the Video Board (next).

Mini Glossary #2
VIDEO

VIDEO MEMORY

RAM on the Video Card itself to increase how many colors, pixels and size graphic your monitor can display. Watch it! There is regular old DRAM, on most cards, and VRAM, special video memory. If you are paying for VRAM, make sure you get it. Got it?

Interlaced Vs Non-Interlaced.

A non-interlaced monitor is better. Interlaced Monitors refresh the odd lines on the screen, then the even ones, so that it looks like the screen is keeping up with video changes. This is called "lacing", hence interlaced. It allows a slower speed monitor to look faster. When you notice it, it is called screen flicker.

Dot Pitch

The lower the number, the clearer the picture. A .38 Pitch monitor looks like there is a milky film over the picture. Save your pennies till you can afford .28 Dot Pitch, Super VGA. You need 256 colors to show full color pictures. If you are going to go VGA, it's silly not to be able to see photos in full color. PLEASE look at a Monitor's picture closely before buying. There are a LOT of crap Monitors on the market right now. Buy Sony or NEC if you can afford it. A good buy is a refurbished NEC Multisync 3D. Say what you will about Super-VGA, Interlacing, etc., etc., my 2A has a clearer picture than some $1000 Monitors I've installed.

Refresh Rate

Higher is better. A high refresh rare reduces flicker.

Windows Accelerators

The thing with a Graphical User Interface (that;s a GUI, folks, pronounced Gooey. . .GUI and SCSI, Gooey and Scuzzy, any shrinks out there?) is that it takes a LONG time for graphics screens to change with regular equipment. So some guys have come up with schemes to make graphics happen faster. A video board with an S3 chip set (or ATI's Mach 8 or Mach 32 chip), which should add about $25-50 to the cost of the board, will, they claim, make Windows run 3 or more times faster. VESA Local Bus boards add speed to graphics, too; you should only have to have one or the other.

VESA

Another standards committee. When you have an open architecture system like the clone world has, all bets are off that Vendors are going to provide you with what you expect, unless somebody is setting the standards. For Modems, it's CCITT, for Memory it used to be LIM. For video, it's VESA, the Video Electronics Standard Association, which defines, among other things, Monitor timing for several resolutions at certain refresh rates. The better Companies have provided VESA TSR's (Terminate and Stay Resident programs) that allow you to make your old board VESA compliant. A lot of newer graphics programs only run if VESA is present. VESA Local Bus is the 32 bit Slot standard by the same outfit. There used to be free VESA extensions that worked universally on all major video cards. The newer versions are annoyware - it interrupts your boot up with a whine to register, and craps out after 21 days (UNIVESA5). You need to identify the chipset on your video card and call the BBS for the card manufacturer to get the latest VESA extensions. There are shareware/freeware utilities out there to identify your chipset. Gee, maybe I oughta make this document crap out after 21 days... maybe replace all the occasions of the word CPU to "Crotch rot" or something. "If you have an old Crotch Rot..."

Some games and CD Roms come with VESA TSR's hidden in subdirectories on the disk/CD. SIM Tower comes with a great one.

PIXELS

The more dots you have on the screen, the more colors and more realistic the picture. Watch the first and last numbers of three number specs. 640 X xxx X 16 is pretty normal VGA. The 16 is the number of colors. 16 is OK, you can't view color photos with less. Many programs, notably Windows, won't show photos with less than 256 color capability. 800 X xxx X yyy is considered Super VGA. 800 X 600 X 256 is what I run with a Tseng 1 Meg Video Board and a NEC Multisync 2A Monitor I picked up refurbished.

The Monitor (video) Board

For whatever monitor you buy, you have to plug a board into the computer to run it. A used Mono board can be had for $10 everywhere. All those boards that came out of old PC's and XT's and all the Manufacturer over-runs are sitting around waiting for you. So you can have up and running video for $79 or so. Each standard (Mono, CGA, EGA, VGA) has it's own card. Some VGA cards run anything, but, in general, you need a CGA card to run a CGA Monitor.

Frequencies

Different Monitor resolutions operate at different frequencies. Older VGA cards will have a dipswitch bank on the edge of the card, accessible from the outside, or will auto-select. If you get scribbly lines on your Monitor when you boot up, you have the wrong frequency selected.

Installation:

Plug the board into an expansion slot, usually the farthest left. Plug the Monitor cable into the small receptacle on the back of the card. Use care here. Trying to plug in a VGA Analog connector into the board blind is the leading cause of Monitor trouble: it fits just enough to push a pin or two back up into the plug. If you are having trouble with your monitor, inspect the connector VERY carefully. Gently pull any pushed in pins back out (With the Monitor OFF), taking care not to deform the pin.

MODULE 6 The M Word

Other I/O... the M word.

CD's

Yes, this is the same type of CD that you put on to listen to yer basic Achy Breaky Heart or Beethoven's Fugue for Fuguettes or whatever it is you ken to, and Laser Disks for Video are the same breed of animal. This Christmas, Phillips VIA Magnavox VIA whatever they call themselves this year are touting interactive CD video, which in strict Computerese might be designated Organized Thrashing.

In any event, you can put a whole mess of information in a very small space on a CD. The music on the disk is actually only taking up a very small portion of available space, and, whether out of guilt or whatever, the manufacturer puts the information on a couple of times for good measure. Hence over sampling, hence 32X over sampling. You can't hear any difference over 4X over sampling. Hence Mr. Sony lives very, very well, Domo Arigato, on the extra money you paid for those other 28 samples. Anyways (are you still awake?) there is usually some Video information on the Disk as well that you just can't get to because the video output stuff was bypassed in the manufacture to pay to put in those extra 28 over samplings. Now we're getting somewhere....

You see, if they let you have everything you could use the CD for the first time you bought a CD device, you wouldn't buy any more CD equipment. I have a perfectly good portable CD player right next to my computer. Why can't I use it as a CD-Rom for my machine? It frosts my butt that I can't.

Ok, if you want it, you will pay $75 and up (new) for a double speed CD-Rom. You also need an interface card. If you want the system to work at it's maximum potential, you will have a SCSI interface that also ties in your sound board, your Hard Drive, Floppies and I/O ports. Don't get me started.

The problem with the $75 wonder is that it is ssssllllllloooowwwww. You will pay $139 to $200 for a decent quad speed (4X) CD-Rom. The difference probably costs the Manufacturer at least $5. The CD ROM will provide you with a READ ONLY device that allows you to look up your drunk uncle in Seattle for the mere cost of the $49 CD Telephone Directory for the West Coast. Let's just hope you call him before he moves... and changes his phone number (he owes mucho alimony). If he does, you need a new Directory. What are we going to do with all these outdated CD's 5 years from now?

CD Rom Speed

CD Rom devices have to move at a certain speed, or the sound won't be able to be in real time with the pictures. Anything animated would look like a bad Japanese movie. So the industry came up with "MPC Compliance". All newer CD Rom drives are MPC2 Compliant, even the Mitsumi (no technical support because they don't put their addresses on anything) Company.

The standard now has to be double speed and up, because a single speed drive can not do Video and Audio at the same time, just like Pia Z*dora can't talk and think at the same time. Make sure your CD drive is MPC2 compliant, not just MPC. The good news is, Double speed now is the price of single speed a year ago. Pay $100 for a Sony double speed drive at a show. The Phillips can be had for a good price, but it's interface isn't supported on any sound cards I've seen, wasting a slot in the machine for two interfaces.

4X CD Roms are becoming the new standard. What's the difference? A single speed CD Rom does just that... searches and plays information at the same speed. The output speed of the CD has to be well regulated. If you are watching Lorraine Bobbit's testimony on CD Video ("I remember evvverryting..."), you don't want her speeded up, you want it at "real time" speed, hence the CD must turn at 8 frames per second or whatever. When you want to search for the next section, say Mr. Bobbit's X rated show, you don't want to SEARCH at the same speed, so the double speed CD Rom speeds up to do the search. The 4X fourples the search speed.

6X CD Roms are now in wide distribution.

CD Rom Installation

You should absolutely, positively without fail operate your new computer system for two weeks BEFORE installing a CD ROM, Sound Board, Scanner or anything else. Make damn sure your Modem, Windows Video Drivers, mouse, etc. are working under all conditions before attempting to install one of the above devices. There is an absolute ART to getting all devices to work on their own IRQ's, Memory addresses and DMA channels. If you don't know whether your modem operated correctly before you installed the CD Rom, you can't narrow down the cause of your woes.

An internal CD Rom has three main connections: a power socket that you hook a lead from the power supply to, a small two pin cable and an IDE type connector that both hook up either to a CD ROM card or, if you live right and buy the right equipment (I never do either, it seems) both hook up to your sound card. Once those connections are made you will need to add device drivers to CONFIG.SYS and AUTOEXEC.BAT in your startup files. Only certain CD Roms hook up to certain Sound Cards. Don't blame me. Ask the seller if the drive will hook directly to the connector on your sound sound, and have the model number ready. Also make sure the dealer gives you the two cables a disk and a manual. Like hard drives, you get nothing unless you ask for it.

I would suggest that if you are hooking up both a CD Rom and sound card, you install the CD Rom first without the sound card in the machine. There is no way to properly debug a memory problem until you know that all but one device is operating.

A disk will come with the CD Rom to install the startup device drivers. You need to know what IRQ's are available so that you can tell the startup program which IRQ to use.

Your best bets are IRQ 10, 11 and 12. If Windows is on your machine, type MSD from the Windows sub-directory and choose IRQ usage for a current state of what is ACTIVELY using IRQ's. It's not foolproof, but it helps. You will probably need to choose a memory address. This is a trial and error process. This is what I would suggest:

Accept all the defaults the start-up program suggests. Load device drivers in CONFIG.SYS and AUTOEXEC.BAT low. Choose NO DMA, and make sure you have BUFFERS=20 or higher and FILES=40 or higher. I don't care what Microsoft says, just do it. Set buffers for the CD Rom ridiculously high, say 50. You can lower it later. Test the CD under DOS. Start Windows, install the driver for MultiMedia and test the CD Rom under Windows. If all goes well, go back and try DMA channels 1,2, etc. until you get one that works. Then start lowering the CD Rom buffers by 5 and re-booting until the drive refuses to load. On mine, it's about 35 (which is 35,000 bytes of precious memory, folks!). Then, and only then, load MSCDEX high in AUTOEXEC.BAT. Test. If successful, load the CONFIG.SYS driver high and re-test. Get away with as much as you can and then WRITE DOWN the settings someplace. Now, and only now are you ready to put in a sound card.

Here is the scenario for a working combination of MITSUMI CD Rom and Soundblaster PRO Sound card, a very common combination.

The CD Rom will not work directly with the sound card. Do not plug the cable into the Soundblaster card, but into the CD Rom card. Plug the two wire audio lead onto the Soundblaster card. You may have to reverse the wires for an old Mitusmi. Load the CONFIG.SYS driver high with 35 buffers. Load MSCDEX high in AUTOEXEC.BAT. You are going to have to choose a high memory range for the CD Rom, because the default WILL NOT WORK with the Soundblaster default. You should change the default CD Rom address and NOT the default Soundblaster address, because many programs ASSUME the Soundblaster is set to 220h. The reason you must choose a high memory address for the CD Rom is that Soundblaster uses some higher memory addresses in addition to 220h, and you MUST get above address 300h for the CD Rom not to interfere with the Soundblaster. Once again, the fruits of my hours of agony are passed on to you. You don't care.

Many new sound cards have the proper CD interfaces built in. You will most likely have a SONY interface and one or two others on the soundcard. There is also a two wire connector from the CD ROM to the CD Rom interface card. You may have to purchase a special two wire connector to plug in from the CD ROM to the sound card to make CD sounds come through the sound card. Once you have the right interface connector and sound connector, you can eliminate the CD interface card.

In order to hook more than one CD to a sound card, you have to buy a special sound card, such as SoundBlaster Multi-CD.

There are new CD's called IDE CD which eliminate a lot of setup hassles by connecting the CD ROM like you would a second hard drive. What happens when you have a second hard drive? Got me. Okay, I got one, and now I can answer the question. The CD ROM device driver loads in CONFIG.SYS by checking for devices on the IDE channels in order: Primary Master, Primary Slave, Secondary Master and Secondary Slave, and assigns the CD ROM dynamically to the first available port.

If you buy a SCSI CD Rom, good luck. Let me know how you do.

A word about WORMS.
Write-Once-Read-Many. A decent idea. You never change the program contents of a Commercial Software package between Upgrades anyway (quick time out for a definition: SOFTWARE UPGRADE: Whenever enough people yell about a number of major bugs in a piece of $600 Software, the Company has some programmers fix the bugs, then they charge YOU $49 to $129 to get the bug fixes. This is America.), so this device would make sense. About the only time you will see one of these is if you go to certain software shops and appliance dealers (no kidding!) that sell you an empty box which you take to a machine on which is made a copy of the program before your very eyes, using the aforesaid WORM drive. I think the WORM comes in because they get UPGRADES (see above) over the Modem. I did this once. In Delaware. The guy who made the copy was pissed off because he had a Chinese couple over by the Washers and Dryers and they were ready-to-buy, as they say. So this guy is watching Mr. and Mrs. Chen with one eye and trying to operate a WORM drive with the other. He was sweating all over the disks. After 3 attempts, he handed me a disk which, of course, when I got it home, did not work. I hope he got his 5% from our friends from foreign lands. A WORM drive would allow your Company to distribute Annual reports n such on a media that isn't alterable.

Sound Boards
Now, you too can hear annoying {BEEP}s in 16 track Stereo Splendor! Only $189. This is an idea who time has come and the technology hasn't. These things have been on the Market for years, but are still plagued with problems. My dear Brother is sweating over his second board as we speak, trying to get the IRQ to agree with the WIN.INI settings to agree with the DMA channel to work under Windows. A board should plug in and work. What if you bought a car and the salesman said "This is a great little spitster, but, uh, by the way, don't change the radio station when you are making a right turn. If you do .....KABOOM!...."

Well, I gotta admit that I broke down and bought one of these things. Bought it over the Internet used. A Soundblaster PRO. It is a pain in the ass, but fun I guess, once I got everything working together. They told me it was $20 for the special audio hook up wire. Turns out you reverse the wires and it works. How do you casual users out there do it? I do this stuff full time and it drives me crazy.

Live Video
Yes, dear friends, you too can capture the rapture of a Veg O-Matic Commercial and drag the Video into your Computer Monitor. But Wait! That's not all! You can even record it and play it back if you have 80 Megabytes of free Hard Disk Space lying around (who doesn't?) This is one of those areas where I get the tingly feeling that with a VCR tuner and a RGB converter, I can build one of these puppies myself. Stay tuned. Just like Ronnie Reagan and Star Wars, if I figure it out, I'll pass on the technology.

Put it all together and whattaya got? MULTIMEDIA!!! (Fireworks, patriotic songs, please...) They will put it all together for ya for $200 and up. As for yer humble servant DJ, I gotta do it piece by piece. CD Rom prices have crashed to $100, and some wonder boy is going to put a high speed Video Card on the Market for $99, and SOMEBODY in this blessed land of ours should come out with a sound card that works. For $59. You gotta have patience in this business, but know when to hold your nose and JUMP. Like the day a few years ago 1X9's went down to $23. I sold my son at auction and bought 4 Meg (he was happy for me. "great deal, Dad!") Three days later Bush slapped a tariff on the Koreans which drove the price up to $38. Then the plant burned down in Singapore. It affected 5% of DRAM production, but everybody raised their prices to $46 on that excuse. So you gotta be ready to jump.

PLUG N PLAY for 95
This is THE most overdue technological advance in the Industry. This shoulda happened in 1989. At the latest. According to all the magazines, Microsoft n' all those guys have agreed to a common Plug N Play standard for new hardware. Here's how it works. You get a new modem, you plug it in. It works. WOW!!!!!!

No longer will the machine ask ME which IRQ, DMA, COM Port, Parallel Port or Memory Address is available. How the hell should I know??? I gotta do two hours worth of digging in a diagnostic program or three to find out to a reasonable doubt what the machine knew all along! Finally, the machine is going to keep track of what it is using, and will dynamically allocate IRQ's and such as it should.

Watch for Plug N Play in late '95 as part of Windows '95. I predict it will be bigger than VESA Local Bus and will be accepted immediately (definition of IMMEDIATELY: sooner than total market penetration of OS/2). I'll be buying a

Plug N Play Motherboard as soon as one comes out at a reasonable price and will include a section in Build Yer Own Version 4.5.

Well, after three months with Windows 95 Beta and Production, Plug N Play works... sometimes.

MODULE 7 - Building SUMMARY
You have installed the Motherboard and Power Supply, hooked up the speaker and LED's, inserted the Memory chips, set the Motherboard dipswtich(es), put in the Monitor Card and plugged in the Monitor, plugged in the keyboard, inserted the Hard/Floppy Controller, slid in and connected the drive(s), and plugged the whole shebang into the wall. You have left any optional devices such as mice and printers out of the picture until the basic machine is working well.

Now turn it on.

DON'T PANIC Tip of the Decade - If everything is hooked up right, you turn on the machine when you finish building and NOTHING happens, there are four usual causes:
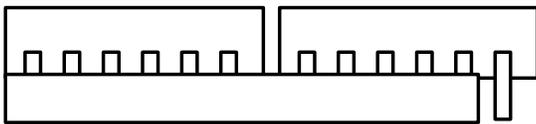
Bad Power Supply Connection

1) On an older VGA card, the wrong frequency is selected on the video card. Turn the machine off, make note of the current switch positions, and flip a switch or two. If you get scribbly lines when you turn on, you have found the problem. Find the right switch combination, and you are in business.

2)The Power Supply is not hooked correctly to the Motherboard. This is a really stupidly designed connection that bust fingers and tempers. Check it.

3)Memory - This used to be 70% of no starts. If you are using DRAM chips, one leg has squirted out of the socket. Trust me. I've done it ten times. Get a flashlight and magnifying glass and happy hunting. With SIMMS, a SIMM didn't seat quite right. Unsnap it and snap it back in. It may take three unsnaps and snaps to get it right, but it is VERY VERY common for this to happen. Remember this: EVERY chip must be PERFECTLY in place for ANY to work.

4) Not enuf Memory - Some Motherboards require a minimum number of banks to be filled before it will start. Make sure you have a supported memory combination (usually 4 Meg).

If everything is hooked correctly, the Memory will count off as it is checked, and you will be sent (hopefully) to a set up program in BIOS to describe and save the configuration of your system. You now need to add MS-DOS from a disk to "Boot" the computer, and you are up. You need an operating system to run the computer. DOS 5.0 is the minimum you should consider. Go DOS 6.22. Avoid MS-DOS 4.x. Obtain the software disks for your operating system before you finish the machine. Have a bootable floppy nearby at ALL times. Mine is velcro'd to my Monitor. The moment you see your first A> prompt you are in business. Open a bottle of champagne, pour one for me, and accept my hearty congratulations.

MODULE 8 - Windows 95, DOS Operating Systems and Startup Files
First of all, if you haven't already done so, upgrade to MS-DOS (not IBMDOS or PC DOS) version 6.22. Anything less is just plain silly.

Windows 95
Okay, so this is what you have been waiting for. I've been running Windows 95 since May, and here's the scoop:

Over the course of three days of almost straight 8 hour days, I managed to install the Final Beta Version of 95, which the install routine estimated would take me 40 to 60 minutes. Not surprised? The reasons it took so long:

My hard drive was almost full
The drive was Drivespaced
I'm on a Network which resembles Auschwitz
I have a Compac (TM) (the video drivers are special)

I won't bore you with the whole story, but in the course of the install, it failed for the following reasons:

Nobody told you that you should strip down your CONFIG and AUTOEXEC files. All these DOS drivers trying to load under Windows 95 drove it crazy.

Windows fragged the drive so bad trying to fit everything on the drive that it trashed the FAT.

My Network demands both VIRUS scanning of all available drives each day and runs an Inventory so the Network Gods can search your hard drive for deadly shareware (the Windows Network drivers caused both the Virus checker and the Inventorier to Virus check and Inventory the ENTIRE NETWORK! (two gig)).

The Mail function in the Beta just plain didn't work without File Scan rights. It worked in the final version.

Windows 95 installation Q&A's
http://www.bcpl.lib.md.us/~djelliot/win95faq.html

So you've looked at the box... and seen the 4 color Window... which is hurling straight at the ground at Mach 1 (who chose this logo?) and you say to yourself... "Do I want this on my machine?" You calm your fears and carry the freindly blue box to the register... why you are even getting into the spirit of it all! You hum that catchy tune till it's your turn "Well, you can START ME UP!" Just as the Clerk whisks away your credit card, you reach the chorus... then pale and quiver as you remember the line... "You make a grown man cry-y-y-"

Should I buy it?

Definitely, unequivocably yes. The product is here to stay, and waiting just puts you behind. Learn the system now. By the time you get good at it, Win95.1 will be out and you'll be ready, while you're co-workers are still vacillating. Don't wait for a 100% bug free product. I've been running Windows 95 since May 25, and the short and skinny it is that it is definitely worth having and using if your machine is at least a 486DX2 with 8 Meg of Memory.

What's the Installation routine?

This question is first and must be first because it is the single most important thing you need to know about the product, which is a GREAT product. It is of paramount importance to Microsoft to make you feel that it is as easy as falling off a log to install it. It is not. It can be a gut wrenching, fearsome disaster. You will never read that on the box. If you could read that on the box, you wouldn't buy it, the product wouldn't penetrate the Market, the product would collapse and MS would have an OS/2 disaster. Bill has no intentions of letting that happen. There are things you should do before you put Disk 1 or the CD in your drive. If you don't, you may end up with a machine that runs NOTHING until a super geek straightens it out. The end of my first installation ended after seven hours of install time with a flashing screen that was useless (the hard drive thrashed to a FAT destroying grinding halt and the Video driver was bad). Only my start up disk saved me. Although vast improvements have been made since this Beta copy, there are things you must do before starting installation, and recommendations I urge you to follow.

Back up your drive. Now that I've said that, and since I know you won't do it, I'll move on to what you WILL do.

Run a thorough SCANDISK. How can I put this? Bluntly, I guess. If you don't run SCANDISK you are stupid. There. Plain enough?

Run DEFRAG. See number 2.

Assure you have 50 Meg of available Hard drive space after SCANNING and DEFRAGING. If you are DBLSPACED, get DRVSPACED. If you are DRVSPACED, do not attempt the installation until SCANDISK and DEFRAG run with no errors. In a nutshell, my first installation failed because there was just barely enough DRVSPACE for the installation, and the copying and replacing of all those Win 3.1 to Win95 files caused a fragmentation of my disk so bad that my Win

stopped the installation cold with a failure. Had I not known what to do (see other sections of BuildIt), I would have done some really dumb stuff that would have caused me to lose everything on the drive. Do not attempt this installation with 'just enough' space. The installation process needs lots of room for temporary files. Move some programs to disk or to your Network until after the installation, then restore them. 50 Meg. You have been warned.

Run a professional Un-installer and remove any Orphans. Remember when you first got Win 3.1 and you bought or downloaded lots of bad software, and then you 'uninstalled' them by deleting their sub-directory? You know now that you have 10-50 meg of DLLs, VBXs and other files which the bad program's SETUP.EXE copied to your WINDOWS/SYSTEM directory. Now is the time to get rid of that junk. It will be a year before I understand the file system of Win95, and for the first six months I will make no attempt to remove anything from \WINDOWS\SYSTEM. Whatever junk is left over from old programs will be there for a LONG time if you don't remove it now. If you are willing to really do it right, and you have the original disks for all your software, then the ultimate way to install Win 95 is to:

back up data to disk (DOC files, spreadsheets, etc.)
Run uninstall to remove Windows programs and orphans
Rename your \WINDOWS directory to \WINOLD
Reinstall WIN 3.1 to \WINDOWS
Get it working how you want it
Back up the non-matching DLLs in \WINOLD\SYSTEM
Reboot the new WIN and make sure critical Icons work
Delete \WINOLD
Install Windows 95 over a clean WIN 3.1 system
Strip your CONFIG.SYS and AUTOEXEC.BAT to a minimum
Dump as many TSR's, old DEVICE drivers as possible
Log on the Network and make sure all is normal
Dump any old mappings, , etc
Dump any weenie menu or other startup shell

Diskcopy disk 1 if you are installing from floppies. Copy AUTOEXEC.BAT and CONFIG.SYS to a system disk no matter what version you are installing.
Begin your WIN95 installation, choosing DEFAULT for as many options as possible. Once you have a 640x480x256 VGA driver working, you can always go back and raise the resolution/colors/Options. If you attempt to install GENDAC0.9.0 VLB 1076x1024x6 gazillion colors and it doesn't work, you are screwed. You cannot run SETUP from a DOS prompt to install a standard VGA driver. THERE IS NO DOS PROMPT. You can bounce out to one AFTER Win95 loads, but if it doesn't load, you are in for some fun. So choose a vanilla VGA for the initial installation. Let Windows find and configure your hardware. Don't attempt to set up fancy stuff on the fly like Exchange. Save it for later. Your goal here is to get Win95 up and running first, and tweak it later.
The single most important option is to say YES to making a Boot Disk. If you don't.... three guesses.

Be prepared for a long haul. I have every wish that you will be able to install in the half hour predicted on the package. Reality check: If you have $100 theatre tickets for 8pm and you need an Oil change, are you going to pull into Jiffy Lube(tm) at 7:15? It only takes 15 minutes, right? Yes, the actual Oil change takes 15 minutes, but waiting behind the idiot who wants his old oil back and a criminal investigation of the mechanic takes another 45, the Check Verifier being off-line takes another 15, and replacing the cash register tape takes another 10. We know this, we prepare for it, we leave an hour to an hour and a half for this 15 minute job. Hence we need to apply the same logic to this installation. Expect at least three hours uninterrupted. Don't start this at 11 when your Boss wants your weekly report at 12. Start it at 4 and prepare to stay until it's done.
It is largely a myth that Win95 won't need to be reinstalled. The package says that it only reinstalls what is corrupted or needs to be changed. That just isn't so. Unless you are replacing a working device with another working device or installing a previously uninstalled option, it basically rebuilds the system and doesn't just replace GENDAC.VGA with VGA.VGA on a failed installation.

Is it 16 or 32 bit?

Win 95 is a 32 bit wannabe that has been watered down for the masses. Just like Italian restaurants who add sugar to pasta sauces to satisfy American palates, just like TV shows adding sex and violence and touchy-feely dialogue to increase ratings (see Homicide 95), Windows 95 stepped back and became Windows 3.2 plus some neat 32 bit stuff.

It is an awesome product, but a line had to be drawn in the sand. Microsoft did not want to make the same mistake made by Apple and IBM and Digital and countless others who replaced a current product with a new one, making the investments of their loyal buyers obsolete. Win95 HAS to run Lotus for DOS, has to run ProComm 2.4.2, has to run all those proprietary database programs built at little cost and enormous profit by Consultants. If you are in this business, you have been in many offices where the machines are configured to run a program developed by some guy in Topeka, who stops by every six months to install an 'upgrade' to handle something like Leap Year or Daylight Savings Time, and the machine has to stay configured HIS way, or the customer can't do payroll or track inventory. The Company has been paying this clown $1200 a year for these changes, and has too much invested to have someone new redevelop it under Windows 3.1, much less in 32 bit code. So this Clipper database has to run under Windows 95, even though it was written in 1988.

IBM has tried many times to replace the standards in the Market wholesale - Microchannel Architecture (throw away all your current hardware) and OS/2 (run your current software at your own risk) and the Market just did not buy it. Bill Gates is, lets face it, smarter than the average bear. He knows that what the Market really wants is gee-whiz power software with lots of pretty colors and new buttons to push, but that still runs Tetris 1.0. Standards are abandoned slowly and carefully. Win95 is based on the ability to run 386 machines. Perhaps Windows 96 will support only 486DX and up, which it should, but the Market howled when this was tried for Windows 95. There is just too much legacy hardware and proprietary software still out in the Market.

What's the big difference from 3.1?

For the uninitiated, Win 95 is a clean desktop with Program Groups popping up from the bottom of the screen instead of cluttering the desktop. Shortcuts to favorite/much used programs sit right on the Desktop, replacing the clutter of Program Groups. That is as far as many users will go. That is as far as many users CARE to go. "Where is my Payroll?" "It's right there, see that Icon with the Dollar Sign?" "Oh, this one?" "Yeah." "Double Click it?" "yeah.". "Oh, ok, there's payroll. Now, where's solitaire?" "I'll make you a shortcut". The above paragraph is the sum and substance of the average corporate users reaction to of Win 95. Give a guy 50 cable channels and the first thing he wants to know is how to tune in Vanna.

What goes on in the background is quite another story. Disk access is MUCH faster. Display changes can be dynamically made from Control Panel. Dial up Networking, TCP/IP, on the fly hardware changes, drag and drop object handling and many, many other vast improvements are there. To the accountant, to the clerk, to the salesman, it will all seem to be just a new desktop look and feel. Since you, the reader, has wound his way through this book all the way to this point, you are different. You care what the system is doing, how it is doing it, and how it can do it better. You will realize that there are vast improvements to the technology of the desktop.

What's the catch?

The price for all this improvement is a familiar lament. It takes time and power to load all this neat stuff in the background. It takes time to load all the stuff you just might need. The net effect is that your 486DX280 with 540 Meg high speed Hard Drive and 8 Meg of 80 Nanosecond Memory, which gets to the C:\> prompt in under 6 seconds.... takes just as long as your 386DX took to load Windows 3.1 last year. :::Sigh::: There you have it. Time stands in place as the technology improves on an almost 1:1 ratio with the increase in speed of the hardware. That is, as the speed of hardware increases, software technology does more and more in the same time frame. Without a fundamental change in the technology basics, in the year 2010, our p-9 CPU wrist computer will still take 50 seconds to load Win2010. But it'll do incredible stuff. And Fred will still want to know how to load Tetris 1.0.

What other claims need to be de-bunked?

The most obvious is that when a program crashes, you will be able to recover without re-booting your machine - that each program runs in a fully protected environment. Bull. A stuck interrupt is a stuck interrupt. There is no way to clear a stuck interrupt without rebooting. UAEs are here to stay. It has been replaced by a reworded but identical message: reboot. "This program has executed an illegal instruction and will be terminated. Close all programs and restart your machine." You can, in all fairness, recover from a lot more errors than under 3.1 - just don't expect a stuck FIFO buffer to magically regenerate.

Will it run my existing software?

Yes, and that's why it's still largely a 16 bit product. If you and 25 million other people will agree to throw away all your existing software, MS can provide you with a true 32 bit product.

Is the 640K barrier gone?

No. Sorry. Lurking at the bottom of this operating system is the same old 640K stack. Don't believe me? Pop out to DOS prompt and poke around.

How do networks run?

With the June release, networking and Mail have become very pleasant to deal with - drive mapping and mail notification are very smooth. IS guys are going to HATE it! Clicking "My Computer" shows the ENTIRE network - not just your Server. (Hey Net Guy - did you remember to cancel that backdoor account?

Netware scripts are run quite successfully (that I've tried) with the exception NAVINV, which should be illegal for IS to install in the first place (makes an inventory of your hard drive at every boot up, so they can track what you are doing).

Tell me something neat to do right away!

OK. Get on-line. Wind your way down to graphics. Find a BMP that warms your cockles. Display it. Right click it. Make it your desktop background with one last click. Awesome.

Operating Systems other than Win 95
You have learned about the Hardware. When your machine is finished building and you throw the power switch, the CPU looks to the BIOS for instructions. The BIOS tells the CPU about all the installed peripherals, like hard and floppy drives, monitor, modem, printer, etc., then the BIOS goes looking for an Operating System. The Operating System on 90% of Intel Desktop Computers is MS-DOS or IBMDOS. Yes, you can boot up to other Operating Systems - CP/M, OS/2, UNIX, XENIX, etc. The vast, vast majority of software, though is MS-DOS/IBMDOS, and in my humble opinion, don't even worry about other Operating Systems.

The BIOS looks to the boot record of the first active device it finds on Drive A or Drive C. The boot record is a special area at the start of a disk which, if not written over, contains the information the BIOS needs to boot up. In MS, the files are MSDOS.SYS and IO.SYS. If the DOS version is 5.0 or up, it also looks for DBLSPACE.BIN (or DRVSPACE.BIN). DBLSPACE.BIN, if enabled and valid, tells the BIOS to split the Hard Drive into compressed and uncompressed partitions. Otherwise, IO.SYS and MSDOS.SYS tell the BIOS to look for CONFIG.SYS and AUTOEXEC.BAT in the root drive of the bootable device. These two files are files that you create or are created for you by others which tell the machine how and what to operate over and above the defaults. The defaults are pretty skimpy, and to operate in a decent computing environment, you will need to maintain decent CONFIG and AUTOEXEC files.

The 640K memory limitation is still with us, and if you have a 386 or 486 (or Pentium), you need to write good CONFIG.SYS and AUTOEXEC.BAT files to throw as much as possible above 640K. This is an art.

To cut to the skinny, here is a set of recommended startup files as a starter for MSDOS 5.0 and up.
CONFIG.SYS
DEVICE=C:\DOS\SETVER.EXE
FILES=40
BUFFERS=20
DEVICE=C:\DOS\HIMEM.SYS
DEVICE=C:\DOS\EMM386 NOEMS   <------only on 386/486 machines
DOS=HIGH,UMB   <-------only on 386/486 machines
DEVICEHIGH=C:\DOS\ANSI.SYS

FILES are set to 8 by default. This is not enough. Your program may not be smart enough to check for available file handles and may crash. Higher buffers make for faster operations during such activities as formatting disks and backing up.

Years ago at Microsoft, some nerd discovered that the area at the top of the first Meg had been forgotten by DOS. HIMEM opens this area up, via the A20 Line. It must be present to use higher memory functions.

EMM386 controls both upper memory (640-1024K) and high memory (1024-??????K). The NOEMS switch tells DOS to emulate extended memory, and RAM would tell DOS to emulate expanded memory (old and passe. You may need this to run older programs like old versions of Lotus and DataEase before 4.5). EMM386 and HIMEM must be loaded before you can use DOS=HIGH,UMB.

Effect of DOS=HIGH,UMB   DOS=HIGH,UMB
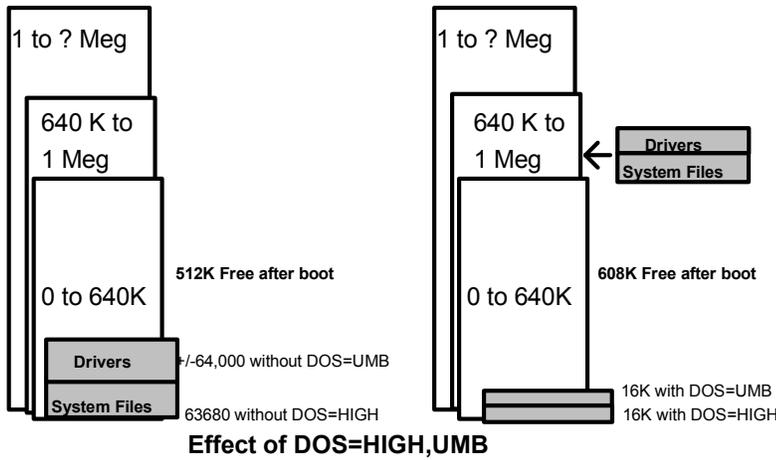
It does not matter where in CONFIG.SYS this line appears. DOS scans the whole file looking for this line before executing. DOS=HIGH tells DOS to load as much of itself as possible in upper memory, i.e. above 640K and out of your way. DOS=UMB tells DOS to scan the area between 640K and 1024K, and set up empty areas as Upper Memory Blocks where it can put device drivers, mice drivers and other TSR's.

DEVICEHIGH=ANSI.SYS tells DOS to load the extended character set (you will get to know ANSI graphics on bulletin boards) and the HIGH portion tells DOS to attempt to put the program in Upper Memory, above 640K. To intentionally NOT load the driver high, you would instead use DEVICE=C:\DOS\ANSI.SYS.

There are lots of other goodies to load through CONFIG.SYS like CDRom drivers and such. Remember that this is a one shot deal. You cannot load or unload (ok, I'm over-simplifying again.) device drivers once the machine boots up.

More Fun with EMM386

There are other switches that you use with EMM386 as you begin to tweak your machine. Most notably, when you begin to learn how to "read" upper memory, you may find that the BIOS has reserved an area of Memory that it really isn't using. You would tell DOS to attempt to load stuff in this are with an INCLUDE statement. You may also find that DOS is using an area of upper memory that the BIOS as failed to mark reserved but is using anyway. You would exclude this area with an EXCLUDE statement. Let's say that you know that b000-bfff is empty but reserved by BIOS for video, and that your network card is using d800-dfff but not informing DOS. Your EMM statement would change to the following:

DEVICE=C:\DOS\EMM386.EXE NOEMS i=b000-bfff x=d800-dfff.

Notice that I am making implicit calls to the devices in the file? ALWAYS do this. Get in the habit. Always make calls to C:\DOS\ or whatever the path is. That way, if you make boot floppies or change your hard drive setup or whatever, you are never assuming DOS knows where to go.

Periodically search your hard drive for duplicates of DOS files and destroy old copies. Nothing can give you as much trouble as "Incorrect DOS Version" or using an outdated file like EMM386. Get a source for the new EMM386 and HIMEM files, etc as they come out. You can get them yourself by calling Microsoft Downloading Service at 1 206-936-6735 or visiting their Web site at www.miscrosoft.com.

AUTOEXEC.BAT
PROMPT PG
LOADHIGH C:\DOS\SMARTDRV.EXE 512 256
PATH C:;C:\DOS;C:\WINDOWS

TEMP=C:\WINDOWS\TEMP

PROMPT pg sets your on screen prompt to show more information than the default. Without this line, as you change directories on your hard drive, you would not see the directory you changed to, it would just always say C: Pretty dangerous during file deletes.

LOADHIGH tells DOS to try to load the following command into upper memory. Eliminate LOADHIGH from the line to load it low or if you have a 286. SMARTDRV.EXE holds the last few commands and results into memory so that if you make the same call over and over, the RAM will not have to fetch the same stuff over and over from the hard drive. With SMARTDRV loaded, type dir by itself from the root of C:. Type it again. You should see a decent speed difference. 512 is the amount of Memory in K to allocate from extended memory to SMARTDRV. 256 is the amount in K to use when under Windows.

PATH is a totally cool line which gives DOS a number of places to look before it comes back with "BAD COMMAND OR FILENAME". If you use one program a lot, like I use XTGOLD, add it to your path.

PATH C:;C:\DOS;C:\WINDOWS;C:\XTGOLD

Now you can type XTGOLD from ANY subdirectory on ANY drive, including networks and floppies, and it will find XTGOLD.COM and execute it.

It is a very good idea to set a TEMP variable in AUTOEXEC.BAT. Many programs create temporary files as they work, and if the TEMP variable is not set, they may attempt to store the temporary files in weird places, like on your CDRom, fer instance. Make sure your TEMP call is to a VALID path, i.e., make sure there IS a C:\WINDOWS\TEMP directory or weird crashes will occur (guaranteed).

Although I could go on for a few hundred more pages about DOS and MEMORY, this thing has to end somewhere. Here's a few more DOS tips before I go.

Ascertaining the DOS Version
It is important to be certain which DOS Version you are operating; making Memory available with UMB's is futile if the user is running DOS 3.3. The Version of Microsoft Disk Operating System or IBM Disk Operating System running can by found at any DOS prompt by typing VER at the prompt.

C:\>VER

IBMDOS VERSION 5.0

Preparing to make adjustments to software:

Backing up startup files
Before attempting to make changes to startup files, it is always a good idea to start by assuring that you can return the system to "where it was" before any changes are made. Make the appropriate backups and rename batch files before editing.

C:\>copy autoexec.bat autoexec.old
C:\>copy config.sys config.old

If you later need to restore the original file, from the C:> prompt,

C:\>rename autoexec.old autoexec.bat
C:\>rename config.old config.bat

Making a Bootable Floppy
The second step before making changes to critical files is to make sure the system can be accessed in the event that changes cause a "boot crash". An example would be where a user automatically runs Windows 3.1 from the autoexec.bat file, and MSCDEX.EXE is causing a crash in the boot sequence. The easiest recovery is to have on hand a "clean boot" floppy.

Smart Computing Tip: It is advisable for every DOS user to always have a bootable floppy close at hand. Being able to instantly perform a clean boot can prevent many panic situations.

With the bootable floppy still in the drive, copy the critical files to the floppy for possible later use, but renamed to "stay out of the way" until needed.

If you find that you need to boot the system from the floppy, the autoexec.bat files and the config.sys files will be available to you from the floppy by renaming them from autoexec.old and config.old back to their original file names. Be aware that if you are attempting to execute these files, only files referencing proper paths will be successfully executed. For example, if the original AUTOEXEC.BAT file read as follows:

PROMPT PG
\DOS\SMARTDRV.EXE 256

only the PROMPT PG line would execute from an A: Drive boot. Since the other two lines are EXTERNAL commands, the program calls must have a valid PATH. The AUTOEXEC.BAT file would look for would look for \DOS\ SMARTDRV.EXE in the \DOS sub-directory of A: (it is located in C:\DOS). The PROMPT PG command is INTERNAL, i.e. is loaded with DOS at the beginning of the boot and can be considered a "system TSR". The AUTOEXEC.BAT (AUTOEXEC.old)and the CONFIG.SYS (CONFIG.old) file need to be examined before use to correct any invalid paths and edited if necessary. The above AUTOEXEC.BAT would need to be re-written as follows:

PROMPT PG
C:\DOS\SMARTDRV.EXE 256

Be aware that if a STACKER drive is present on the machine, you will not be able to access any files on the STACKED drive without executing the line in CONFIG.SYS which enables the stacked volume. If, for example, your DOS subdirectory is under STACKED volume D: (a bad idea!), you would not be able to run EXTERNAL DOS commands from the floppy without first mounting the STACKED volume. For example, in the users Drive A: AUTOEXEC.BAT file,

D:\DOS\EMM386.EXE noems

would not load if the drive is a STACKED drive OR the line

DEVICE=C:\STACKER\STACKER STACKVOL.000
had not been executed from CONFIG.SYS.

REM'ing a file
Any changes to a batch file should be done by "rem'img out the line". This process disables the program or Device Driver line when next invoked. It is still available when it is appropriate to enable it again. Deleting the line takes the chance that the proper path or parameter could be forgotten when the program or Device driver is again needed.

Placing a REM at the beginning of a line in a batch file prevents it from executing. In early versions of DOS, the user will receive a "Bad Command or File Name" message at boot time, but the warning is benign and the effect is the same. The offending (or suspected offending) line is not loaded. From within DOS 5.0's EDIT, or from within DEBUG or whatever the chosen Editor in use is, simply type REM at the beginning of the line to be temporarily removed and the operating system ignores the line at the next boot up. REM changes, or any changes to batch files, do not take effect until the file is run again. The actual purpose of the line is to leave REMarks in the batch file as a reminder of the purpose of the following line or lines, or as explanation to a future user. Do not hesitate to use this feature to explain changes you have made to the batch file.

Using DOS's Edit Command
DOS 5.0 provides a very good editor (much simpler than Edlin) that should be present for use by any user who has DOS 5.0 installed on their system. Users understand Edit in that it looks like a Word Perfect or other word processing program, with a menu at the top. The requirements for using the Editor are:

DOS 5.0 or higher, the file QBASIC.EXE, usually under the \DOS sub directory and the file EDIT.COM in the SAME sub directory as QBASIC.EXE   A PATH Command to the sub directory containing EDIT.COM and QBASIC.EXE. The latest version of IBMDOS has replaced EDIT with a program called E. Everybody hates it.

Symptom: System locks up

There are two methods to find an offending line in an AUTOEXEC.BAT or CONFIG.SYS file:

Removing all lines and replacing them one by one or disabling lines one at a time until the offending line is found. The second method is quicker, the first method more thorough and more exact from a diagnostic viewpoint. If you are using the second method. remember to "un-REM" any line you have disabled before moving on to the next.

Continue to enable or disable device driver and TSR's from the files one at a time, re-enabling or dis-abling the last line with each edit. Try to determine the purpose of each line. It may be necessary for the proper function of the system.

Device Drivers may perform the following functions (this is not a complete list)
Enable an External Floppy
Provide Memory Management (Himem, SmartDrv, QEMM, EMM386, etc)
Enable Virus Protection
Set DOS system preferences (ansi.sys, ega.sys)
Enable another Device (Scanner, CD Rom)
Mount a Virtual Drive
Mount Network Drives
because you have found the "offending" line does not mean that you have solved the problem; in most cases you must find a way to make the two co-exist.

Autoexec.Bat loaded programs may do the following (not a complete list)
Provide running parameters for Device Drivers in Config.sys
Start Virus Protection
Load "Sidekick" type programs
Load Memory Management
Set System Parameters
Start Networks
Start Windows
Again, finding the offending line is not a solution, but a major clue.

Symptom: Low Memory
Eliminating DOS=HIGH from the Config.Sys file causes DOS system files to load low; subtracting 50,000 bytes of available low memory. Under DOS 5.0, add DOS=UMB under DOS=HIMEM.SYS and DOS=EMM386. and try to load all Device Drivers high

Check memory available at any point (under DOS 5.0) by going to the DOS prompt, changing to the \DOS subdirectory and typing C:\DOS>mem /classify |moreThis display will tell you, a page at a time, which programs are loaded low, which are loaded high, and the remaining UMB's and free Memory.

DATA COMPRESSION
Lots of would be geeks will tell you that they don't trust DBLSPACE, DOS 6.0 to 6.2's data compression scheme. The compression package included with DOS 6.22 (DRVSPACE) I have found to be very reliable and indispensable. It does slow down your system, but you are not likely to notice until you run Windows, especially if you load a network.

To start at the beginning, data compression is a method of reducing the space used by files on your hard disk by not storing repetitive information. The line

THE QUICK BROWN FOX JUMPED OVER THE BROWN FENCE QUICKLY

might be compressed to

^~FOXJUMPEDOVER~FENCE^LY

with codes to mark the replacements. Different types of files compress at different rates. PKZIP and ARC use similar schemes, and, by the way, it doesn't make sense to store ZIPped files on compressed drives. Store them on the uncompressed drive, so the machine doesn't waste time trying to compress them further. If you store a lot of text files, compression will be about 4 to 1, while graphics, which are too complicated for DRVSPACE to handle, will store at 1 to 1. You can get special utilities to compress graphics. Your overall compression rate should be about 2 to 1, making a 200 meg hard drive have an effective capacity of 380 Meg, allowing 20 meg of uncompressed space.

The major players in hard drive compression are STACKER and MICROSOFT. Here's a short little story of how Goliath (MICROSOFT) gobbled up David (STACKER).

Stacker had been the leader in hard drive compression for a number of years. The biggest complaint about the product was that it had to be loaded at boot up time, so if something went wrong in the boot process, the stacked drive would not load, and users would many times destroy the drive trying to recover.

Microsoft saw the market potential of building in data compression to foster sales of it's upgrade to DOS 6, and, along the way, "borrowed" a few lines of Stacker code to get the product to market, which they called DBLSPACE. They made a few improvements and a few mistakes. One major mistake was not protecting DBLSPACE from SMARTDRV, a utility that takes information the user wants to save to disk and 'holding' it for a few seconds until the CPU isn't busy, thereby freeing the user to continue working, rather than waiting for disk reads and writes. If the user turned off the machine before SMARTDRV wrote to disk, nasty things happened. If the compressed drive became full, nasty disk allocation errors occurred (and still can. Never let disk space fall below 5 Meg.) Other weird hardware/software combinations also caused weird problems. Another mistake was that in order to get the product to market, there was no utility to UN DBLSPACE a drive. The big improvement was that system files were modified so that the compressed drive was mounted by a BIN file DBLSPACE.BIN before the machine got to CONFIG.SYS, lessening the chance the drive wouldn't load.

Stacker saw that big, bad Microsoft was about to make their product obsolete, and would be vulnerable to being gobbled up by Gates and Co for a song. They said "Well, shit, we need to come out with a Stacker product that pre-loads pronto!" So they thought, if Microsoft can do it to us... and lifted a few lines of code from the boot loader for DOS so that they could pre-load too. It sorta kinda works. I don't like it. It is much too kludgy, and I ended up taking it off my machine.

Stacker sued Microsoft for taking code. Microsoft sued Stacker for taking code. VP's of both companies posted letters on the Internet blasting the other. The judge ruled that Microsoft had to stop shipping DOS 6.2 and pay some bucks, and ruled Stacker had to pay some bucks to Microsoft. Microsoft didn't care about the bucks, but cared about millions of copies of DOS sitting in warehouses, sold and ready for shipment. So, in classic American business practice, they muscled Stacker into an agreement by buying 20% of the company. DOS released DOS 6.22, changing the name of DBLSPACE to DRVSPACE and added a default switch to SMARTDRV (/X), which disables write caching. They also added a utility to reverse the drive to uncompressed. This was easier than telling users what I am about to tell you, and tell you to tell ALL the users you work with. Never, ever, turn your machine OFF before exiting to a DOS prompt. You have been warned. Using the three finger salute (Ctrl-Alt-Del) is ok, in that the system will delay re-booting until everything is written to disk, but turning a machine off with Windows running is suicidal. Don't believe me? Start Windows, load Word and a document, make a change and turn the machine off. Do this five times. Then run CHKDSK. EEEEK!!!! I warned you.

MODULE -9 Firmware and Data Communications

<u>**PORTS**</u>
You may not be ready for this yet, but here goes. There are Ports for adding peripherals to your machine, just like you add a CD or turntable to your stereo. A mouse usually needs a serial port or works off of it's own card, and a printer a Centronics Parallel port. The following will NOT a full diatribe on ports, but a starting point.

<u>**PARALLEL**</u>
This one is easy. Plug the 25 pin end into an I/O card you have bought for the computer. Plug the weird looking end into the printer. This port is usually called LPT1. Your network printer, if any, is usually piped over the Network via LPT2 and a capture statement.

SERIAL

Also known as RS-232. Usually a 25 pin connection. A little more complicated, but faster and more versatile than parallel. Don't get scared by all the technical jargon that comes with serial port devices.

I've rewired one ONCE for a special application, and I used to install about 400 of them a MONTH. Serial ports most often are for Mice, scanners, plotters and external modems and such. The serial port is the place most computer hacker wanna-bes have trouble. They represent 80% of my trouble calls. The first and best advice is, KEEP IT SIMPLE. DON'T mess with an IRQ that works, and NEVER, NEVER change the memory address of a COM port. Okay, okay, I'll back up. There are COM ports for serial devices. COM 1,2,3 and 4. You use them in order as you need them. Usually the Modem (MOdular/DEModulator), which allows you to call CompuServe and give them all your money is COM 1 and the mouse is COM 2. COM 1 is, by default IRQ4 (Interrupt ReQuest 4) and COM 2 IRQ3. Each has a memory address. Here's the dangerous part: you are advised, in the worst pidgin English in the manual to mess with flipping IRQ and memory addresses and COM port assignments around. Please don't!!!!! Leave it alone. Keep it simple. Messing with them is akin to switching spark plug wires in your car. Two devices can use an interrupt, but not at the same time. If your mouse and modem use the same IRQ, you will get garbage on the screen during communications every time you move your mouse. All you need to know unless you futz with them is:

*IRQ1 - Keyboard
*IRQ2 - Reserved for Cascade
IRQ3 - COM2 Address 2f8 and COM4 Address 2e8
IRQ4 - COM1 Address 3f8 and COM3 Address 3e8
IRQ5 - LPT2 - Second printer, Sound Card, Network card
*IRQ6 - Floppy Drives
IRQ7 - LPT1 - Your first printer goes here
*IRQ8 - Clock
*IRQ9 - Reserved for Cascade
IRQ10 - AVAILABLE (scanner, CD Rom, etc.)
IRQ11 - AVAILABLE (scanner, CD Rom, etc.)
IRQ12 - AVAILABLE unless used by a proprietary mouse(COMPAC)
IRQ13 - AVAILABLE
*IRQ14 - High level communications

* Leave them alone. You have been warned.

The best scenario is Modem COM1, Mouse COM2, anything else COM3 and nothing COM4, because the mouse on COM2 will corrupt anything you use on COM4, and if you put the mouse on COM1, nothing on COM3, and something on COM4, the BIOS may ignore COM3 and put your COM4 device ON COM3. Then nothing will work.

IBM PS/2's use their own IRQ schemes, and XT's are slightly different. Your compatible, however, should be like the table above.

MODEM MOUSE WARS

Here is the MOST common modem - mouse problem and it's solution. Harry the Hack buys an internal modem for $99 from Joe's Modem Wonderland. He knows his mouse is on COM1, so he sets the Modem for COM2, IRQ3, address 3f8 and plugs that baby in. The modem is recognized by Prodigy but won't dial out, so he makes a terrible mistake - he starts flipping IRQ's and addresses and COM ports and gets hopelessly lost. He either gives up or takes the machine to Joe, who charges him $125 and refuses to tell him what he's done.

What's happened is that the mouse is indeed on COM1, but there is also an active COM2 on his I/O card, and, even though nothing is hooked up to it, the BIOS thinks that two devices are hooked to COM2. What is necessary is to either jumper out COM2 entirely on the I/O board or set it to COM4, address 2e8 instead. COM2 is now free for the Modem. A better solution is to move the mouse to COM2, change COM1 on the I/O card to COM3 and put the modem on COM1. That way you avoid the problem of a blank COM3 being taken over by COM4. End result: Modem COM1, Mouse COM2, Nothing (but recognized) COM3. End of problem.

Don't call me if you mess with IRQs and Memory addresses. It gives me a headache. If you futz with the memory address, I won't even talk to you at the Christmas Party.

To summarize, put in the I/O board, hook up your printer, call it LPT1, hook up your preferably internal modem as COM1, IRQ4 and your mouse as COM2, IRQ3 then leave it alone. You have been warned.

You've mercifully reached the end of Version 3.2 of Build-it. I hope you use and re-use this document for a long time to come, and that you pass it on to friends. Good Carma, Domo Arigato and konbanwa.   --DJ Elliott, October, 1995

BOOK 2 - Modems and Communications
BOOK 3 - Another Internet Primer
are available by special request or at http://www.bcpl.lib.md.us/~djelliot