sible for the 6502-based hand held computer being sold by Panasonic and Quasar. The JR-100 will be sold to the home market – primarily the hobbyist and home study market at first. A full line of peripherals is planned – modems, floppy disks, etc.

Astrovision demonstrated the Bally Arcade with a plug-in expansion unit housing a full-stroke keyboard and running the language ZGRASS. This graphics language was developed (if memory serves) by Tom Defanti at the University of Illinois in Chicago. The goal is to allow artists and other non-technical types to create breathtaking real-time animations without having to learn machine language programming. The result is beautiful. Since the Z80-based Astrovision game machine has the same multi-chip display controller used in Bally's coin operated arcade games, high quality graphics is possible. What makes it practical is the ease with which figures drawn on a tablet can be saved as procedures, located anywhere on the screen, and can be magnified and rotated at will.

Astrovision seems intent on aggressively pursuing this project, but it isn't clear how effectively they will be able to compete. As with the other machines mentioned so far, don't expect to see the ZGRASS machine next week.

For those who take their graphics seriously, Toshiba was pleased to announce the T100 computer. When used with a high resolution color monitor, the user has access to 8 colors on a 640 by 200 dot array. A multi-line liquid crystal display was shown as an alternative. The packaging of this CP/M machine reminded me of the NEC PC-8000 – very stylish and business-like. Equipped with a Z80, 32K of ROM and 64K of RAM, this computer should appeal to those who are interested in doing some serious work.

Sharp had a surprise of its own. The original PC-1200 hand-held computer (available from Radio Shack for some time) has been joined by an 8-bit brother: the PC-1500. While this new machine is much faster than its predecessor, the most amazing feature was the availability of a color graphic printer. For a total price of $550, Sharp users will have access to a computer with a pocket-sized drum plotter that lets you draw pictures with any of four automatically selected pens (red, green, blue, black). This is one product that has to be seen to be believed – and even then you won't believe it.

The PC-1500 is available now. (Of course I ordered one!)

At long last, the Casio FX-9000 desktop computer is on the market. This computer has a built-in 5" monochrome display with the ability to show graphics images with a 256x128 resolution. The sleek styling is reminiscent of the Hewlett Packard HP-85, but the price (under $1800, fully loaded) is more in keeping with Casio's products. The FX-9000 uses a Z80 compatible processor and gives the user access to two types of RAM. Front panel accessibility to RAM cartridges lets the user choose between 16K dynamic RAM cartridges, and 4K CMOS cartridges. The 4K byte RAM module contains its own battery, so that programs which are saved on this module can be removed and saved for instant reloading later.

Texas Instruments developed and showed a similar 4K RAM cartridge for the 99/4. Since TI also showed a new Assembler/Editor system, the ability to let users make their own cartridges is quite appealing. My, what a difference a year makes.

TI also showed a nicely designed expansion box which does much to reduce the clutter associated with fully loaded systems.

Atari's booth was almost impossible to enter. It was as if everyone who attended the show decided to check them out at the same time. The official authorized Atari Pac Man program was introduced. The action is a little different from the previous version done for the Atari computer (Jawbreaker) by OnLine Systems. Compared to the Pac Man games also shown by Magnavox, Astrovision, Texas Instruments, and others, Atari did a very nice job at software development. Coleco's hand-held version of the game was not as exciting, but then it doesn't use a color display screen either.

While my emphasis has been on hardware, it should be noted that software was on display as well. Automated Simulations displayed some of their newer programs for the Apple and Atari computers. While they are known primarily for their adventure games, Automated Simulations has developed a line of educational games (such as Jabbertalky) which are terrific.

The fact that a few dedicated people are willing to make the effort to generate educational games which teach as well as entertain should not go unrewarded. These people are doing an excellent job and are to be congratulated.

Both Activision and IMAGIC showed cartridges for the Atari video game which demonstrated exceptionally high quality graphics. Not surprisingly, these booths were well attended as well.

So much to see, and too little time! I was so busy getting all this information for you dear readers that I barely got to examine the solar-rechargeable flashlights, underwear with built-in loudspeakers, and ball point pens with built-in clocks and music synthesizers.

But that is why there are two shows a year. So until the next CES this June in Chicago, I'll just have to be content with what I saw. ©