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A COMPARISON OF TWO COMPUTER GRAPHICS SYSTEMS

by

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A COMPARISON OF TWO COMPUTER GRAPHICS SYSTEMS

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I would like to thank my parents, Alan L. and Silvia F. Mayer, my brother, Lincoln Mayer, my grandmother, Selma L. Mayer, the thesis advisers: James Ver Hague, Robert Keough and Jack Slutzky, the staff of the Visual Communications program at the National Technical Institute for the Deaf at Rochester Institute of Technology, Donald H. Beil and many other people. My successful completion of the Computer Graphics Design graduate program at Rochester Institute of Technology was made possible with their generous support.

Graphic designers are hesistant to use computers because:

_they don't know much about them.

_they feel intimidated by technology in general; computers seem to be complicated and unattainable.

Because of their fears and lack of knowledge, designers don't often get the opportunity to use computers to enhance their work. As a graphic designer of nine years, I empathize with these designers.

During those nine years, I noted the emergence of computer graphics in:

Television
Animation
Slide presentations
Architecture and engineering
Medicine and the sciences
Research and development
Cartography

I foresaw the use of computers in the design studio and how a computer graphics system could help a designer. I thought the advantages of having a system could be:

_graphics could be produced without the clutter of a drawing board.

_graphics could be stored on a disc and be displayed on the system for client presentations.

_graphics could be reworked instantly, eliminating new comps and additional presentations.

_savings in time and money for client and designer.

_lower overhead expenses and more time for other profitable work.

Now I can safely say computer graphics is an exciting dimension of visual aesthetics that is distinctive from the fine and applied arts, video, photography, film and animation. This distinction would enhance the client's image and broaden the designer's capabilities in design services.

One word of caution: Computer graphics are only as good as the designer's level of design excellence and computer skills.

I chose to pursue a Master of Fine Arts in Computer Graphics Design at Rochester Institute of Technology in Rochester, NY because I felt:

_my future would be limited without further training as demand for computer skills grew.

_my fears were set aside by my enthusiastic desire to learn and grow with technological advances in computer graphics.

_I would be one of the 1% of all designers in the nation to have a graduat degree in computer graphics design.

_I would have expertise in advanced computer graphics.

_I would have a second lease on my professional aspirations, especially in design management where computers could enhance design work.

_I wanted to have a successful and fulfilling career.

I enrolled in the Computer Graphics Design graduate program when it opened in the fall of 1984. Two weeks later, I was:

_overwhelmed by the computer vocabulary.

_struggling with the bewildering procedures used to operate just one computer graphics system, let alone other systems that were yet to be learned.

_wailing to the teachers about my frustrations and fright of failure.

Fortunately, my teachers, Bob Keough and Jim Ver Hague, had anticipated that I and my classmates would be like forlorn puppies wandering around in a strange land. These capable and compassionate teachers:

_explained the basics of the current computer graphics system in use.

_demonstrated the procedures step by step.

_provided training excercises.

_handed out appropriate assignments keyed to the class's level of computer skills.

_gave individual tutoring and personal support.

In time, through hands-on experience and with the teachers' support, I gained expertise and self-confidence in using the computer as a tool when an assignment called for computer graphics.

Out of the studies came an idea to compare two computer graphics systems to see how each system works with print design. My personal experiences is the basis of this thesis. My major goal is to show that computers are not to be feared and can easily become an indispensable tool for the designer.

I INTRODUCTION 1

Objective

The objective of this comparison of two computer graphics systems is to find out how each system works with print design jobs.

Print design is the design and production of material that is to be printed.

Objective Rationale

I wanted to find out how a computer graphics system can be used to produce computer graphics for incorporation with on-board work. On-board work is a design or production activity on the drawing board. I wanted to see if the incorporation worked well enough to be used on a professional basis such as presentation comps, mechanicals and final artwork. The information from these studies would be useful to my future professional work, especially when working with computer graphics systems.

System Selection Rationale

The nature of the print design work required the use of the raster system which treats the display screen as a canvas and allows the designer to electronically paint images on the screen, giving a richer texture and a variety of graphic effects than the vector system which tends to be flatter and devoid of texture. A raster system also allows a video camera to scan an image or object and electronically rework the scanned image on the screen. The image, both painted or scanned, are represented on the screen as thousands of picture elements, or pixels. The pixels can be manipulated individually, partly or as a whole until the designer is satisfied with the final artwork.

Among the several computer graphics systems at Rochester Institute of Technology, the Artronics 2000 PC system with the Artron 2000 Paint program and the Macintosh with the MacPaint program were raster-based and able to provide the precise pixel manipulation required in producing professional computer graphics that met the designer's quality standards. Therefore, both were selected as the targeted computer graphics systems for the comparison studies.

After the selection of the Artronics and Macintosh, the next step was to study the technical aspects of both systems so I would understand better how to use them to their fullest potential. I divided the technical aspects into three parts: Technical Data Comparison, Input Applications/ Output Options and Paint Program Comparison. A list of the function definitions of each paint program is located in the Appendix for easy reference.

Notes

After perusing the data, I found some things worth noting:

The Artronics works in color and sells for $40,000*. It has five components and features a 256-color palette. Sixteen million colors can be obtained through the Hue, Luminosity and Saturation controls.

The Macintosh works in black-and-white and sells for $1150*. The optional MacPaint program sells for $60. It features a 38-pattern palette. There are three components and the main unit houses the CPU and display monitor which saves space.

Both systems offer a scanning option which a video camera is connected to the computer and a scan program is used for the scanning process. Any illustration, photograph, video image or object is scanned by the camera and converted into thousands of pixels which are presented on the display monitor screen in either a black-white halftone or gray halftone. During the scanning process, the brightness and contrast levels are adjusted. The scanned image can be brought into the paint program for reworking until the desired result is achieved.

The Artronics' Image Grabber option provides a choice of soft-edge for halftone scans or hard-edge for high-contrast scans. It provides for user specification of gray scales up to a possible 256 values. It also has a color scan but was not used in the computer graphics production for the thesis.

* See page 6.

The Macintosh's MacVision option has only hard-edge scans that causes grainy texture in the picture since it does not have a gray tone scale. However, by adjusting the brightness/contrast controls, the texture can be smoothed out. Other image grabbing capabilities for the Macintosh are also available through other vendors.

The Artronics has a 8-bit CPU (Central Processing Unit) which is slow but can be upgraded to 24-bit. The Macintosh has a 32-bit CPU which is faster.

The Artronics lists the menus on the left side of the display monitor. The color palette is below the display screen and can be called up with the graphics tablet and stylus. The Macintosh combines pull-down menus and icons which represent computer functions. A choice of functions is made with a mouse*. The pattern palette is always visible when the MacPaint program is used.

The Artronics has a longer training period due to the numerous menus and complex function procedures. The Macintosh has a shorter training period due to the combination of menus and icons and simple procedures.

The Artronics can produce gradations from light to dark for one particular color or from color to color. The Macintosh has only black/white patterns and does not have graduations. Included in the pattern menu are halftone screens of varying percentages.

The Artronics has anti-aliasing which helps to minimize the jaggies around the type. The Macintosh has no anti-aliasing, however it indicates which size a selected font will look best, a feature not available on the Artronics. The Apple LaserWriter, a laser printer*, eliminates these jaggies when printing Macintosh work.

*See Glossary.

The Artronics has a terminal monitor with a keyboard for input/output processing with the Central Processing Unit. The Macintosh has a keyboard but no terminal monitor. Instead, there is a Dialog Box that appears on the display screen whenever the computer requests more information from the user before proceeding or cancelling whatever the user was about to do. The Dialog Box provides procedure instructions on certain activities such as disk switching, file naming and printer setup. Also, the Dialog Box will warn the user that it can't do a certain activity that it was asked to do or that some work is about to be destroyed.

The Artronics has a limited number of software but they are impressive input applications. Besides the paint, Image Grabber and graphic programs, the Artronics can take Lotus 1-2-3 or other spreadsheet programs when equipped with the Presentation Graphic Producer (PGP), an upgraded Artronics program. Also with PGP, files can be sent to a typesetter for typesetting and to a laserprinter, notably the Apple LaserWriter.

The Macintosh may have less output options but can take more input applications since it is an easy system to write software packages for. It also takes Lotus 1-2-3 and other spreadsheet programs as well as other business programs. The Macintosh can also be connected to the Apple LaserWriter.

TECHNICAL DATA COMPARISON CHART

Basic System used in test. Quoted prices as of October 1986.

	Artronics PC 2000 System	Macintosh System
Price	$40,000 (w/o options)	$1150 (w/o MacPaint and options)
Hardware	Five components: CPU with 2 disc drives Color display monitor Keyboard Graphics Tablet with stylus Terminal Monitor	Three components: CPU with one disc drive and houses B/W display monitor Keyboard Mouse
Paint Software	Artron 2000 Paint program	MacPaint program
Color	256 color palette	Black/White
Type	Included in Artron 2000 Paint Program	Included in MacPaint
CPU	8-bit computer	32-bit computer
Memory	640K bytes RAM, 64K bytes ROM plus a 2 Megabyte RAM Circuit Board*	128K bytes RAM, 64K bytes ROM
Disk Capacity	360K bytes, 5 1/2" soft disk	400K bytes, 3 1/2" diskette
Screen	12" diagonal	9" diagonal
Resolution†	Height: 480 pixels Width: 512 pixels	Height: 342 pixels Width: 512 pixels
Image Area	Height: 480 pixels Width: 483 pixels Total: 230,400 pixels	Height: 230 pixels Width: 396 pixels Total: 91,080 pixels††

* Added for greater RAM memory.

† Both systems have medium resolution bit-mapped display. The medium resolution standard is 512 pixels wide by 300 pixels high.

†† For printing on 8 1/2 by 11" paper, total working area is 8 by 9 15/16" or 576 pixels wide by 716 pixels high for a total of 412,416 pixels.

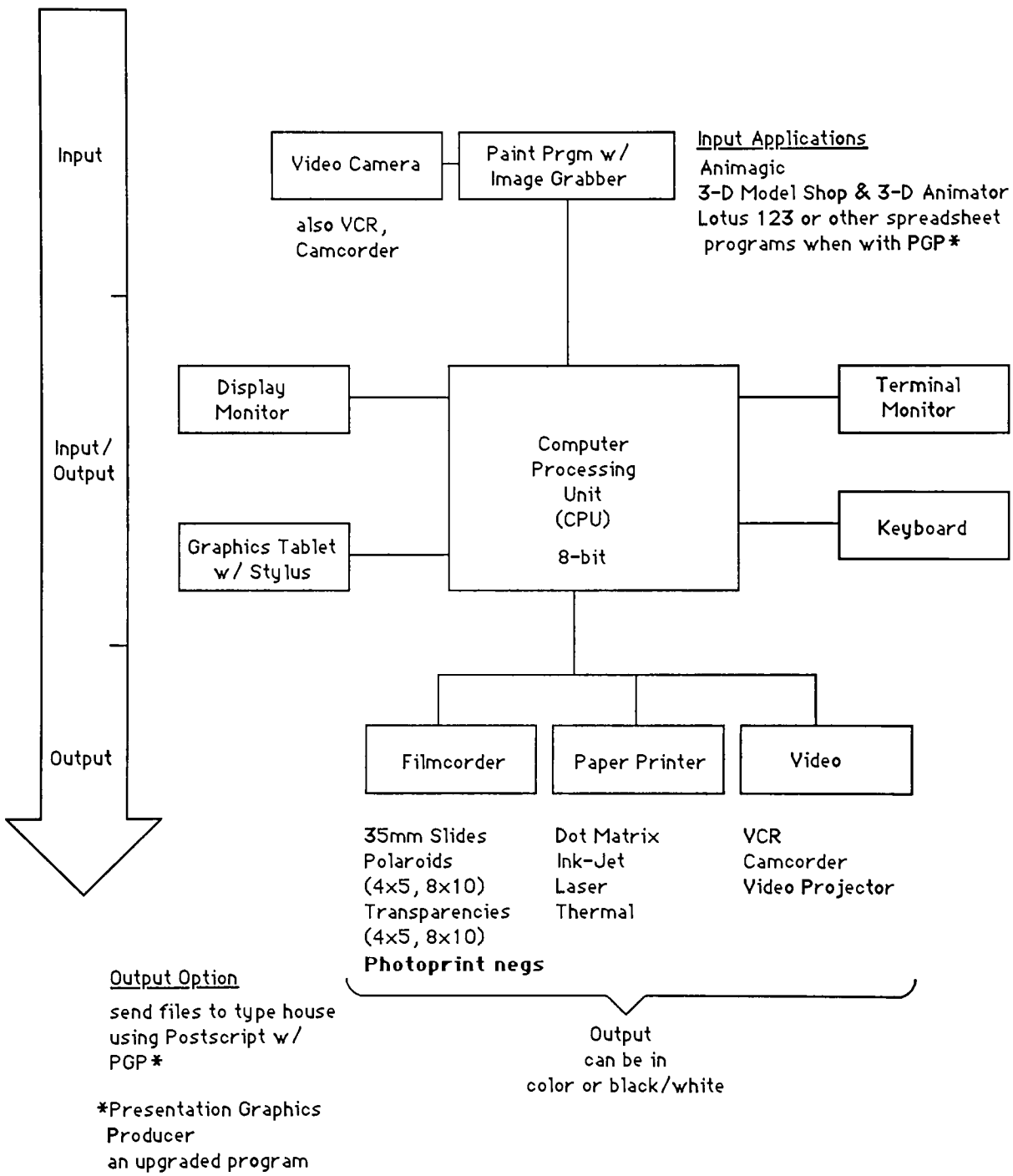
Optional accessories on next page.

Optional Accessories used in test

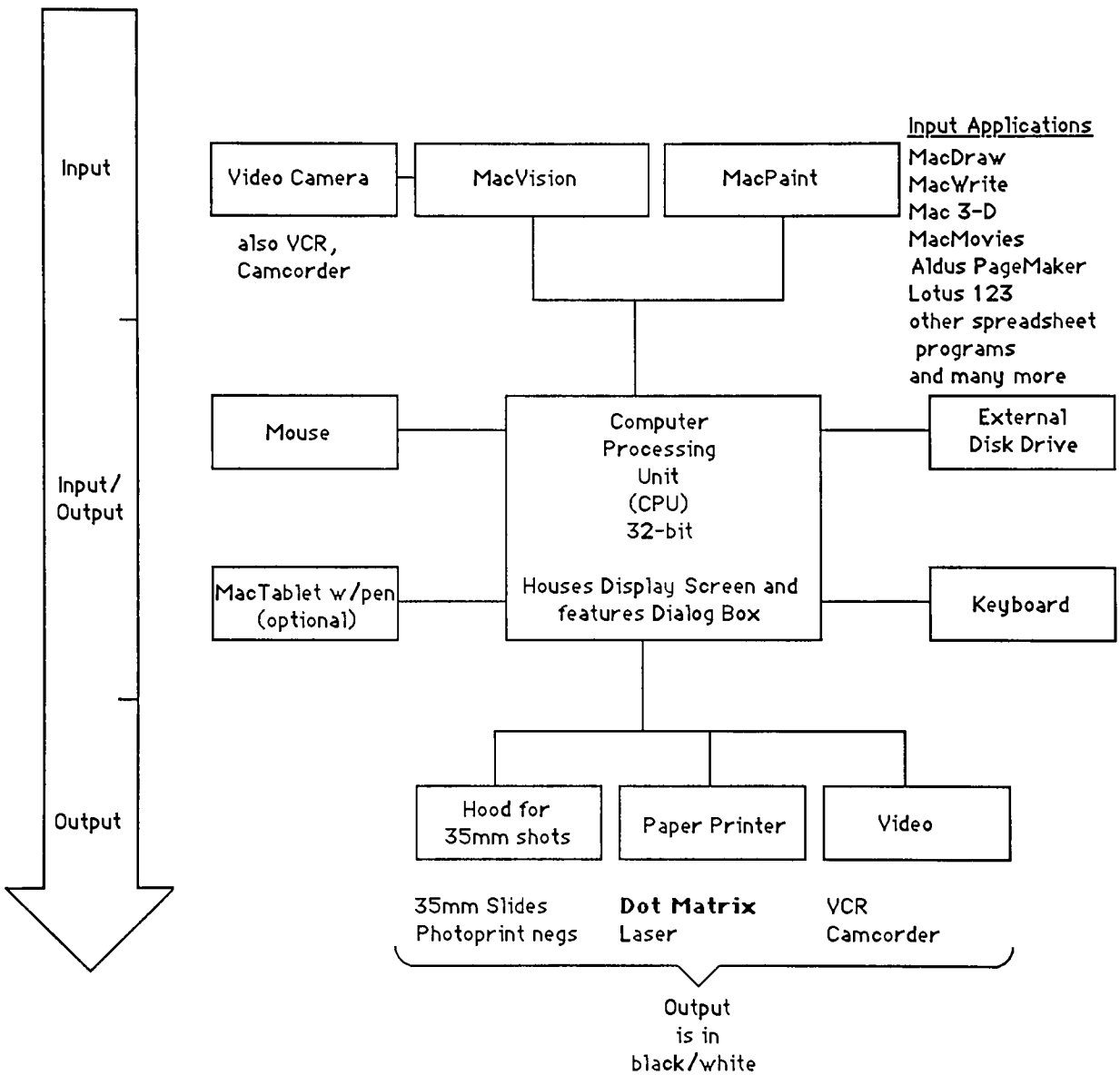
	Artronics PC 2000 System	Macintosh System
External Disk Drive	Not available	Macintosh
Scan System	Image Grabber	MacVision
Video Camera	RCA TC1005 video camera	RCA TC1005 video camera
Hardcopy Output Device	Polaroid Video Printer, Model 4	Imagewriter, dot matrix
Hardcopy	Color photoprint negatives	Paper

*At production time, only these hardcopy devices were available.

Input Applications/Output Options of the Artronics PC 2000 System



Input Applications/Output Options of the Macintosh System



Similarities

Both paint programs were compared to find similar functions.

Draw freehand lines.
Draw straight lines at any angle.
Draw lines at 90° and 45°.
Draw connecting lines.
Paint in solid color or pattern.
Spray paint in solid color or pattern.
Create patterns.
Use pattern for lines and borders.
Put down a grid.
Remove a grid.
Make a grid of any size.
Align lines, rectangles, squares and four-sided figures on a grid.
Draw outline rectangles.
Draw filled rectangles.
Draw outline circles.
Draw hollow polygons.
Select line thickness.
Select brush shape.
Erase entire or part of display screen.
Clear display screen.
Magnify part of image for detailed work.
Move an image on the screen.
Copy and paste an image.
Rotate an image 90° counterclockwise.
Make repeating image copies.
Enlarge or reduce an image either horizontally, vertically or proportionally.
Fill in a hollow shape with color.
Fill in area surrounding specified image with color.

Select font from font list.
Select font size and style.
Place text anywhere on display screen.
Revert to last image for starting over.
Merge images.
Set up for video scanning.
List images.
List fonts.
List font sizes.
List font styles.
Display and store brushes.
Display and store patterns.
Display and store images.
Print image.
Copy a file.
Display a file size.
Delete a file.
Rename a file.
Switch to a blank disk.

*Definition of paint functions is in the Appendix.

Differences

Both paint programs were compared to find differences.

The Artron 2000 Paint cannot do these MacPaint functions.

Apple menu
Undo
Cut
Trace Edges.
Type Alignment: Flush Left, Flush Middle, Flush Right.
Brush Mirror
Move whole image off screen.
Scroll
Specify nonrectangular image without background (Lasso).
Draw lines that invert when crossing other colors.
Line Width Chart
Draw round-cornered rectangles.
Draw filled shapes.
Use keys for extra functions.
Print Draft.
Print Catalog.

The MacPaint cannot do these Artron 2000 Paint functions.

Draw in color.
Enlarge or reduce images using percentage size.
Create a specified curve.
Manipulate points of a figure.
Paint in Picture Paint, Solid Average, Picture Average, Solid Push, Texture Push, Solid Push Average, Texture Push Average and Cycle Paint.
Edit Color Hue, Color Luminosity and Color Saturation.
Spread
Copy Color.
Merge Colors.
Shade
Shift
Imprint
Sort
Cycle Colors.
Create or store new brush.
List palettes.
Create new fonts.
Rotate image to any specified degree.
Copy a rectangular shape into a non-rectangular area.

*Definition of paint functions is in the Appendix.

The technical data studies completed, I started preparations for the computer graphics production.

First, I specified two categories of computer graphics as a guide.

Scanned Image	An illustration, photograph, video image or object that is scanned by a video camera and represented as thousands of pixels on the display monitor screen in either a black-white halftone or gray halftone. During the scanning process, the brightness and contrast levels are adjusted. The scanned image is reworked until the desired result is achieved.
Scanned Image with Illustration	The finished scanned image is merged with a finished illustration which was produced on the computer. The illustration can be either a free-hand drawing, a technical drawing-drawn to precise measurements and of a technical nature, or business graphics in 2-D or 3-D form.

Second, I developed a print advertising campaign for a trucking company that makes use of computers in their operations. The use of computer graphics in the ads would reflect the company's use of high technology in providing premium professional services to its clients. The ads would be printed in the appropriate magazines to reach the target audiences. For client presentation, ad comps would be finished artwork, including the computer graphics. These comps would be the focal point of the computer graphics production. I made seven layouts, using paper and color markers, to serve as a guide in producing the computer graphics. At this point, I decided not to use the type provided on the computer because it would not be as sharp as phototype that would be used in the comps.

I selected appropriate photos of trucks, that in final scanned form, would be used in the comps.

Third, each of the layouts was assigned to its respective category and system with production notes.

Ad with Scanned Image	System	Notes
"Lease a Truck Fleet"	Artronics	Color, pixel texture
"Mountain Road Experts"	Artronics	Gray tones, pixel texture
"We're There First by Sunrise"	Macintosh	B/W, high contrast

Ad with Scanned Image and Illustration	System	Notes
"Go Places with the Shipping Professionals"	Artronics	Color, solid paint
"Colorado-Denver Delivery, Inc."	Artronics	Color, gradation
"New Computerized Truck/ Tracking System"	Artronics	Color, solid paint and gradation
"Have a Chunk of the West"	Macintosh	B/W, pattern

All preparations done, I was ready for the production phase.

The production took three weeks due to shared computer time with computer classes, students and constant reworking on the images with the art direction provided by Jack Slutzky, Thesis Committee member. During impromptu meetings with Slutzky, I would present each image on the display monitor for critique. I was able to rework the image on the spot instead of producing new comps and scheduling another meeting. Also, in reworking the image, if I made a mistake, I could start over by clearing the screen and then display the previous image. I could save the reworked image at any point in the reworking process before going further. This flexibility of the systems saves time, materials and money routinely spent on on-board work and adds invaluable flexibilty to the designer/illustrator.

Description of Computer Graphics Production

A description of the production of computer graphics for each ad is provided.

Lease a Truck Fleet (Slide 1) Artronics

To create an image of a fleet of trucks in motion on the highway, a photo of a truck was scanned, using a high contrast effect, an eight-tone gray palette and a hard-edge halftone. Using the Copy and Percentage Size functions, two copies of the scanned truck were made, each copy smaller than the previous. During the copy process, each copy was positioned, creating a fleet of trucks.

The image was still rough as it was in gray tones and the pixel texture was uneven. The Copy Color function was used to deposit selected colors into the gray palette. As I was coloring the image, I kept in mind the color theory: warm colors advance and cool colors recede. The plan was to paint the trucks in warm colors and the surrounding area in cool colors to create a feeling of depth and motion. After several attempts, I succeeded in a harmonious color palette and started work on smoothing out the pixel

texture. There were several pixel clumps caused by the Copy function and pixel sprays of unwanted color. I used the Airbrush with a large brush to break up the pixel clumps and smooth out the pixel texture. Switching to a brush with the smallest brush shape which was the size of a pixel, I then proceeded with the careful but tedious color corrections of stray pixels. More touch-up work was performed on the trucks until the image was finished to my satisfaction. I had achieved the goal which was to have uniform pixel texture with several colors while preserving the recognizability of the trucks.

Mountain Road Experts (Slide 2) Artronics

The advertisement would have a truck in a mountain snowstorm. Drawing on my experiences with the Lease a Truck Fleet image, (Slide 1), I started with a medium-contrast, 16-tone gray palette and hard-edge scan of a truck coming up a steep grade with a mountain towering in the background. Using the Copy Color and Spread functions, I deposited a black-to-white graduation range in the palette. Then I carefully changed the first four dark blocks and last two light blocks into gray blocks, using the Luminosity and Saturation functions. The result was a gray monochrome. I touched up the truck, foreground and mountain. The Airbrush was used to create snow in the sky. The pixel texture was smoothed out. The finished image provides an interesting comparison of a gray monochrome and pixel texture with the colors and pixel texture of the Lease a Truck Fleet image.

An unexpected surprise was that the color print came out too light so the custom photo lab redid it at no cost. It came out grayer with minimal contrast. I was disappointed at the results although it was no fault on the lab's part. After analysis of the print and review of the picture shooting procedures of the image, I concluded that the lightness of the image was not adequately adjusted by the brightness control of the Polaroid Video printer that caused excessive bleaching of the color negative. The lab compensated with a longer exposure on the print that produced the grays

and minimal contrast.

The solution was to shoot several exposures, using different variations of brightness (from light to dark), which would produce a print that with the correct contrast and color balance. Unfortunately, I didn't have the time to reshoot due to the Graduate Thesis show coming up soon. Next time, I'll be prepared.

We're There First by Sunrise (Slide 3) Macintosh

A dramatic image of a truck on the highway at sunrise was needed for effective visual impact on the reader. Since the high-contrast scans of the MacVision tended to be grainy, the brightness/contrast levels were carefully adjust to minimize the graininess. Such precise control was necessary in order to obtain a dynamic pixel texture, causing a dramatic play of light and shadow on the mountains and truck, simulating a sunrise. In the MacPaint program, the truck and surrounding areas were touched up. The sky was filled in with black for the white headline overlay. This job was very easy.

Go Places with the Shipping Professionals (Slide 4) Artronics

I wanted to combine a halftone scan of a truck with a color illustration of a mountain background. I discovered that the work was more complex than expected, taking more time than any of the six other images. During the scanning process, a medium-contrast, 16-tone gray palette and soft-edge halftone were selected. The truck was enlarged, resulting in a muddy image. I worked on all parts of the truck until the details were clear. I also touched up the highway. I was very careful to maintain a halftone effect instead of a painterly look. The 512-line resolution of the halftone is not clear and sharp as the 1024-line resolution option.

After finishing the halftone, I drew the illustration and smoothed out the jaggies on the mountain peaks. I was careful to locate the illustration's color blocks on an area of the palette to avoid color conflicts in the merger

of the two separate images and palettes. If the halftone palette and illustration palette were to overlap each other, differences of color on both images would appear. This planning and the correct use of the Merge color function procedures resulted in a perfect match. Subsequent touch-up in a few areas were done and the image was ready.

Colorado-Denver Delivery, Inc. (Slide 5) Artronics

For the front of a promotional folder, the image should be attractive and exciting. I used the image from the Go Places with the Shipping Professionals, (Slide 4). I kept the halftone of the truck intact and worked on the illustration. With the exception of the sun and ravines, the sky, mountains and plains were converted from solid color into color graduations. I was careful to locate the color graduations on the illustration palette to avoid conflict with the halftone palette in the merge process. This job took the shortest time of all seven images.

New Computerized Truck/Tracking System (Slide 6) Artronics

This image used a halftone and an illustration with both solid color and color graduation. There were two problems that came up. The first problem was that after repeated scan attempts, the scanned truck still looked muddy. Finally, a soft-edge, 16-tone gray palette scan was made. Considerable time was spent in intensive touch-up work, even rebuilding the mirrors, front wheels and components on top of the cab roof. After two days, the truck was finished. Then I drew the mountains and put in the color graduation. In the merging process, the second problem occurred when both palettes overlapped, causing unwanted colors in the merged images. After adjustments with the illustration palette, I got the unwanted colors again. Fortunately, the affected areas were minimal so I easily corrected the colors with the Solid Paint function and then applied touch-ups where needed. The image was then ready.

Have a Chunk of the West (Slide 7) Macintosh

This job combined a free-hand illustration and a technical illustration. While drawing the states, I had to measure the proportions with a ruler on the screen since the grid was invisible. Even if I made a visible grid using Filled Shapes, I would have to erase the grid with the Eraser. However, it was a minor inconvenience. I stored the states in the Scrapbook and drew the mountains. A medium halftone pattern was used to shade the mountains. Then I pasted the states on the mountains and touched up where needed. It was an easy job.

Notes on Hardcopy Output

After all images were finished and approved by Slutzky, I started the hard copy output process. For the Artronics, the Polaroid Video Printer with a 35mm camera was hooked up. I used Kodacolor with a 100 ASA rating. I took three to four shots of each image, using the bracketing method with the brightness control of the printer. I used a custom photo lab instead of a commercial photo lab in order to obtain quality color prints. On the Macintosh, the printing head was cleaned and a new black ribbon cartridge was put in. I made two to three printouts of each image and selected the best one of each set.

Final Ad Comps Production

The comps were 8 x 11 1/2". I wrote and typese the copy. I produced 3M Color Key overlays bearing headlines and text. Then the computer graphics, overlays, acetate and mat boards were assembled. The finished comps were ready for exhibition in the Graduate Thesis Show as well as for study.

Both systems performed well and produced high quality graphics fit for professional work such as client presentations, mechanicals and final artwork. Again, computer graphics are only as good as the designer's level of design excellence and computer skills. In this case, thorough study of the computers, solid computer skills and careful design planning has resulted in some dazzling work. The comps are an excellent representation of the practical use of computer graphics in print design.

How Computer Graphics Helped each Ad

Lease a Truck Fleet (Slide 1)

The concept of motion was interpreted as a fleet of trucks moving on the highway. The color theory, warm colors advance and cool colors recede, was used in developing a harmonious color combination which the trucks were painted in warm colors and the surrounding areas in cool colors. The pixel texture is uniform yet lively. The eye-catching image is full of motion and shows that the company is on the go with hassle-free professional shipping. The balance of the pixel texture uniformity and recognizability of the trucks called for careful fine-tuning. Too much texture or too much detail of the trucks would have adversely affected the image.

Mountain Road Experts (Slide 2)

To have a strong visual impact, the truck is placed in a mountain snowstorm. This adds credence to the professionalism of the company drivers delivering the shipment through the mountains under adverse conditions. The gray monochrome and pixel texture gives the effect of a late afternoon storm. The image is subtle yet carries weight. The gray monochrome and medium-contrast calls for several exposures using different variations of brightness in order to obtain a picture of correct contrast and gray color balance. If this procedure is not followed, poor picture quality will result.

We're There First by Sunrise (Slide 3)

The idea was to show a truck in the mountains at sunrise. The white headline rising behind the mountains simulates a sunrise. Even though the scan produces a grainy texture, careful adjustment was made on the scan system's brightness/contrast controls. The result was a dynamic pixel texture which caused a dramatic play of light and shadow on the mountains and truck. The finished image is a visual delight in black/white and emphasizes the punctuality of the company's next-morning delivery service.

Go Places with The Shipping Professionals (Slide 4)

An image with both a halftone and an illustration can be an interesting design effort. The gray halftone of the truck contrasts with the color illustration yet works together well. I started out doing a full illustration which didn't look right. Inserting a scan of the truck added a realistic look to the image and gave credibility to the ad's message.

Colorado-Denver Delivery, Inc. (Slide 5)

For the front of a promotional folder, the image should be attractive and exciting. The Go Places with The Shipping Professionals was used. The use of color graduations in the illustration gave the image a dazzling effect and lent an aura of sophistication to the folder. Careful planning must be made to facilitate the correct use of several color graduations which can result in a highly effective attention-getter.

New Computerized Truck/Tracking System (Slide 6)

The idea was to use a halftone and an illustration with solid color and color graduation to heighten the excitement of high technology used in the company's truck tracking system. The truck bearing down the highway in a dramatic setting makes for a dynamic image that would not have been explosive had a full illustration or photograph been used. Lengthy touch-up of the halftone and careful planning for the palette merges are the rule rather than the exception. The greater the complexity of a process, the more thorough the planning and execution must be in order to achieve successful results.

Have a Chunk of The West (Slide 7)

Since most truck network ads are usually dull, the challenge was to create a pleasing ad. The combination of mountains is an effective representation of the company and its terminal points in the mountains. An insightful touch was the diagonal cut at the base of the mountains, running from upper left to lower right, giving the impression of a mountain highway. A graduation pattern for the mountains would have been nice but was not available. Also, a laser printer would provide continuous tone instead of lines left by the dot matrix printer. Anyway, the result is still a first-rate advertisement which could easily have been a lackluster effort.

Summary

Having considered all technical data comparisons of both systems pertaining to price, hardware, input applications, output options, processing performance, paint programs, similarities/differences and features unique to each system and the results of the computer graphics production, I have, with due respect to print design, have presented my conclusions as herewith:

Artronics

This system's strongest feature is color with a wide variety of stunning graphic effects. The only drawback is the slow processing speed due to the 8-bit CPU but can be upgraded to 24-bit for faster processing plus a wider range of 200,000 colors and a 1024-line resolution which is clearer and sharper than the 512 line resolution. The step-by-step procedures of a function is tedious but makes for tight control in producing exact graphics. For color separations in four-color printing, slides or negatives can be readily shot or the color image can be stored on the disk and sent to the printing house. At $40,000, the Artronics is an excellent investment compared with its higher-priced color counterparts, ranging from $100,000 to a half million dollars.

Macintosh

This system's strongest feature is ease of use, especially as a desktop publishing facility. Coupled with the Aldus Pagemaker program, (A publications design program that produces page compositions including illustrations, halftones, business graphics and typset copy.), and the Apple LaserWriter printer, the Macintosh produces 8 1/2 x 11" B/W publications of superior quality. The only drawback is the 9" monitor which shows only part of the sheet, having to move the window to another area. The 32-bit processor is faster and an external disk drive can boost the memory to 800K or more, depending on selection of hardware. At $5745, including the

MacPaint, LaserWriter and Aldus Pagemaker, the Macintosh is the best system available at that price. It has many capabilities for facilitating print design work, especially with mechanicals. The Macintosh can also take business programs that would aid in the management of studio operations. Also, a color system can be integrated for $12,000.

The thesis completed, I now breath a sigh of satisfaction on a job well done. Looking back on the thesis work and the two years of study in the Computer Graphics Design graduate program, I wonder in amazement, "Wow! What an accomplishment! I actually completed all the work and now know a lot about computers and computer graphics!" That is a valid statement because two years ago, I didn't know a damn thing about computers let alone how to use one. However, I had the foresight to recognize the potential of computer graphics skills in today's competitive job market and such skills would advance my design career. Sure, the graduate studies were demanding, but it wasn't that hard. The tough part was using my design skills that would make full use of the computer's capabilities. That is, I knew how to operate a system but I had to learn how to use the computer as a design tool. Nevertheless, I wanted to do my best even though I acknowledged the fact that there are always some people who are better than me in some areas like illustration or animation but I was better than them in my own area--print design. I did know one thing . . . nearly all of the classmates were interested in animation and jobs were very competitive in that area.

The print design field was wide open for designers with skills in computer graphics and this opportunity was right down my alley. My goal was to combine my nine years' experience in print design with computer graphics and be able to offer solid skills in the relationship of computer graphics and print design. I was confident that there would be a need for these skills, especially in design management where decisions were made on the kind of artwork to be produced for print design jobs. My experiences, viability of computer graphics in print design and job opportunities were major factors in the logical development of a thesis study of computer graphics systems pertaining to print design.

Having completed computer graphics applications in animation, slides, video, 2-D and 3-D computer graphics programming, and independent study in photography and print design, I was now ready to pursue my thesis work

in comparing two computer graphics systems to find out how each system works with print design. I started with creating several pieces such as a 16-page annual report, invitation card, brochure, advertisement, a network map and several slide graphics. These pieces were to be used in a promotional program for a truck company. I wasn't too happy with the results for the work did not properly reflect my design abilities and computer skills as per se the rule: Computer graphics are only as good as the designer's level of design excellence and computer skills. In other words, the work was lousy: I had tried to be something which I was not- an illustrator, not a designer. Slutzky gave me another one of his legendary tirades which had reduced people to a quivering jelly of senseless babbling. I just sat and participated in a classic argument between professor and protege. I paid close attention and picked out the valid points among the salty language and drawn-out admonishments. I wasn't crushed as lesser people would have been. I was just frustrated because I didn't seem to make things work right and I wanted him to help me in his own direct yet colorful way. He railed at me for not defining the target audience which had specific needs that I would be able to address in visual terms. I also had to know what the company had to offer to the target audience. Slutzky scolded me on my sketchy preparations which produced such poor results-a hodgepodge of corporate design and illustrations that did not reflect my design capabilities and use of the computer's potential.
At the end, he said that he was coming down hard on me because I could take it and needed blunt feedback. Also, he encouraged me to try again because I can do better than what was done.

Satisfied with the discussion as well as enjoying a pyrotechnic show of Slutzky's salty language and airy exhortations, I studied the points raised during the critique. I threw out three months worth of work and started on a new tack. I studied the company and made a list of services. I defined the target audience and focused on magazines as the means to bring the message to them. Now I was focusing on the use of print design as a

marketing tool. Then I developed an advertising campaign that featured the services of the company. The ads would have a computer-generated image of a truck accompanied by headlines and copy which I wrote. I presented the layout comps to Slutzky, Keough and VerHague. They agreed on the new direction I was taking.

The computer graphics production and final comps production was exciting and constructive. I could feel that I was finally doing something worthwhile-combining design skills and computer graphics to create exciting images to be used in ads. Instead of illustrations which I don't do, I worked with photographs and manipulated the scanned images into dazzling results. I was now more motivated because everything was falling in place and I liked what I was doing. During the production, I was learning more things about the capabilities of the two systems and applying solutions to problems that cropped up. Studying the finished comps, I would note how the computer graphics enhanced the message of the ad, presenting the company in a favorable and dynamic light. At the Graduate Thesis Show, many people liked the comps very much. I did too, for I thought they were an excellent representation of the practical use of computer graphics as a marketing tool which could be used if appropriate in a marketing program. Also I preferred doing ads than corporate design work because ads are people-oriented and I like working with people.

Writing the thesis was very frustrating because I had never written a technical paper or even a large research paper. I usually wrote short stories, essays or copy for ads or promotional work. I started off with a small draft which was promptly rejected by Slutzky. He growled at me, "Andy, write an outline FIRST!" I did so and then wrote a 65-page draft which tried to provide to designers a process for selection of a computer graphics system. Slutzky criticized me for using academic language and not being clear about what I was trying to say. Summing up his opinion, he declared that I was just bullshitting around. He again emphasized that I should write an outline, organizing the work in a logical order. He said

that Keough and Ver Hague should read the draft and meet together since the two might have other ideas to help me out. I agreed. When we all met, the agreement was that I should start with an outline and proceed from there since the draft was unsatisfactory. I produced an outline with concise descriptions of each area to be written. Keough advised me to write the thesis as if I was writing a letter to a friend, describing my personal experiences with the thesis work. No academic language, just keep it clear, simple and to the point.

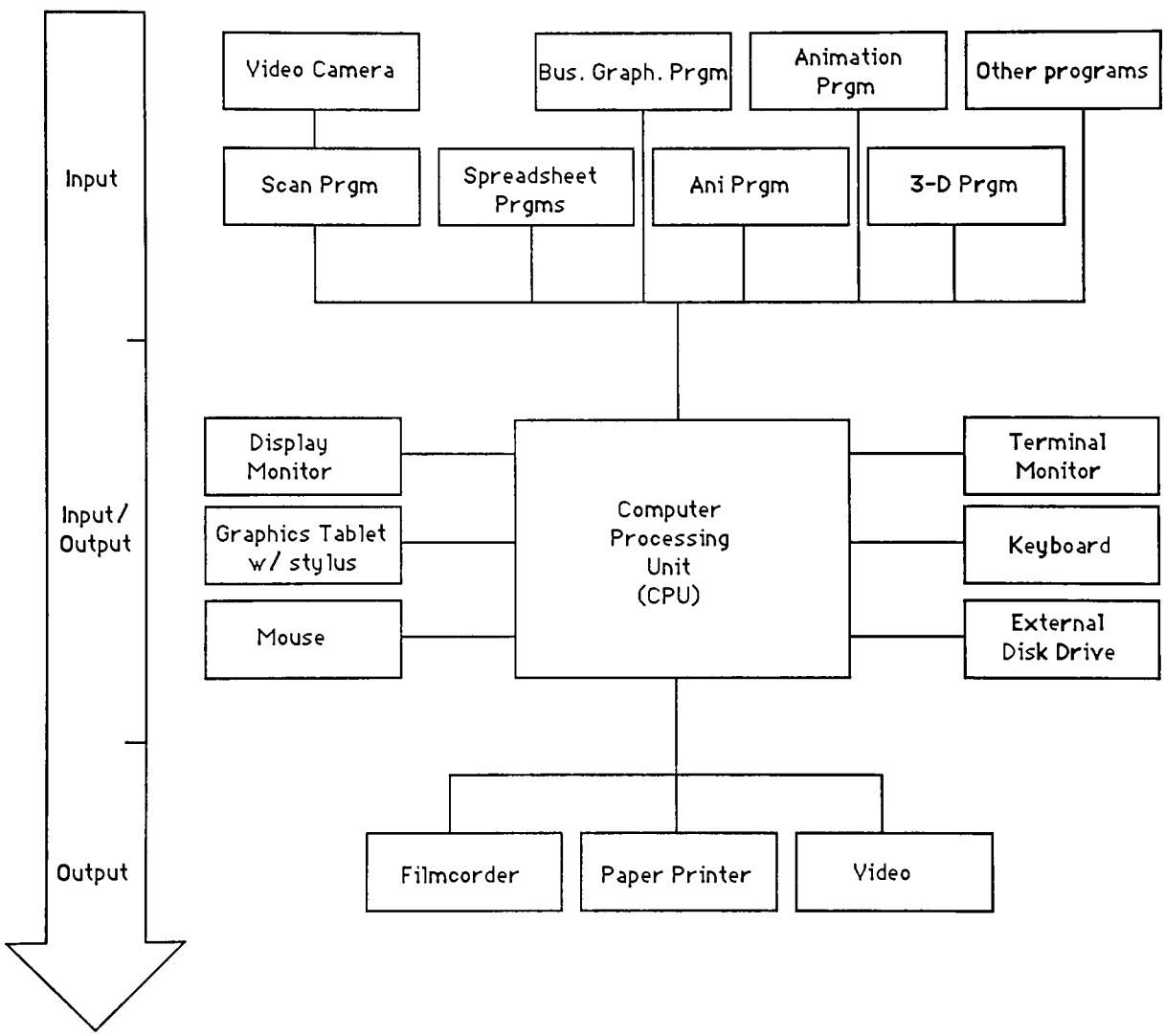
I did that and I felt much better writing something that I actually could understand! The thesis committee was pleased with the results and gave me the go-ahead to produce the final draft with a few revisions including a personal summary of the thesis experience which I am now writing here. I learned two things: Start with an outline and write clearly.

During the thesis process, I was able to learn more about the specifics of a computer graphics system: The whats, whys and hows of computers and computer graphics. Now I can explain in simple terms about a raster system compared with vector graphics; the importance of the number of bits in the CPU as related to the speed and memory of the computer; icons and commands, input applications, output options; resolution definition and how a high resolution differs from a low resolution; and so on. I can explain and demonstrate the application of computer graphics in various areas such as print design, animation, slides, video, computer programming and other areas that use such applications.

I appreciated the thoroughness of the Computer Graphics Design graduate program especially when I was invited with Slutzky and Nancy Oyos, a classmate, to make a presentation titled "Computer Graphics: The Artist's Ally or Threat?" at a workshop for designers who were interested in computer graphics. This was in Atlanta and the workshop was sponsored by the Atlanta Chapter of the Graphic Artists Guild. I went down there in September of the second year of the program. My presentation went very well. I asked people to describe their background and why they came.

Then I gave a basic overview of computer graphics and how a computer graphics system works. Then I got each person to have a hands-on session with an IBM PC XT computer equipped with a Chartpak software package. At the end of the workshop, the participants said that they enjoyed the presentation very much and learned a lot. I felt good because I was able to help them to understand a bit more about computers, reducing their fears. I also had pride in myself because in the space of a year, I had learned a lot within the program, enough to be able to give a presentation. Later, Keough asked me to give a presentation to a group of high school teachers on telecommunications and electronic publishing which went over well. I am careful not to cause "MEGO"-meaning My Eyes Glaze Over when explaining the basics of computers to people who are learning about them.

In the span of two years, I progressed from zero to a knowledgeable and well-educated person in the area of computer graphics. I can walk into an art studio and give an authorative explanation on the pros and cons of a certain system or how computer graphics can enhance their work. I have a portfolio full of computer graphics and print design work which could even sell me on its own merits. I am looking for a position in design management with a company that deals with print design and also with slides if possible. I had achieved my goal in acquiring computer skills and combining these skills with my print design experience. I can now discipline myself and tackle any job, applying myself with the confidence that good results will happen. I am confident that I will have a good career and know that this program will make the difference in being successful in my future endeavors. Thank you Bob, Jack and Jim for your guidance and support.


Input
Input/
Output
Output
Video Camera
Bus. Graph. Prgm
Animation
Prgm
Other programs
Scan Prgm
Spreadsheet
Prgms
Ani Prgm
3-D Prgm
Display
Monitor
Graphics Tablet
w/ stylus
Mouse
Computer
Processing
Unit
(CPU)
Terminal
Monitor
Keyboard
External
Disk Drive
Filmcorder
Paper Printer
Video

The Artron 2000 Paint Program has seven menus and seven permanent functions listed vertically on the left side of the display screen. They are listed here as shown on the screen and described in the following pages.

HELP
BRUSH
OK
ESCAPE
CLEAR

MENU PAINT
MENU EDITING
MENU GEOMETRIC ALTERING
MENU DRAWING
MENU FILES
MENU LIST
MENU EXTRAS

COLOR/OVERLAY

Permanent Functions Description

HELP-gives detailed information and instructions on the current function.
BRUSH-display and select one of 28 standard brushes.
OK-used to verify certain actions or functions.
ESCAPE-used to end or cancel most functions.
CLEAR-erases display screen.
COLOR-shows current color of the selected color from the color palette.
OVERLAY-a color function that allows things to be painted without destroying other colored painted pieces on the screen. It is the equivalent of placing a piece of clear acetate over the work and painting on the acetate. It is within the Color function and is activated by pressing the Color function twice.

Notes

Color palette-Four rows of 64 small color blocks for a total of 256 colors are below the image area on the display screen and are brought up to the screen with the graphics tablet and stylus. Each block can be colored in any of sixteen million possible colors.

Zoom-magnifies sixteen times a section of the paint area for detailed work. There is a small button on the stylus. When pressed, the zoom function is activitated.

Lines, rectangles, circles, curves and type can be painted in texture, picture paint, average paint, push paint, sychronized paint and airbrush.

Menu Drawing

The drawing menu functions deal with drawing and composing pictures on the display screen.

LINE-draws straight lines at any degree in any color, brush style or width.

LINE TRACE-same as Line except it begins the next line at the last point of the previous line.

RECTANGLE-draw and fill rectangle or square. Drawn in current color or texture. Not affected by brush style.

BOX-draw an outlined box without fill. Affected by brush's width and style.

CIRCLE-draw an outlined circle in any color, brush style, width or texture.

CURVE-draw any size or shape of curve in any color, brush style, width or texture.

TRIM-define and fill area surrounding image.

FILL-fill in enclosed area with current color.

TEXT-display line of text in current color or pattern.

FONT-select current font from font disc for use in TEXT mode.
The fonts are American Black, Cooper Black, Helvetica Bold, Helvetica Demi, Helvetica Medium and Time Roman.
The sizes are 60, 30, 24, 18 and 12. NOTE: Each font are available either in all sizes or some sizes only.

ALIGN-aligns Lines, Line Traces, Rectangles, Boxes, Text or four-sided figures to Grid.

GRID-display grid in overlay color on display screen.

GRID SIZE-display grid in specified size as set by user.

ERASE GRID-erase grid. NOTE: Since grid is displayed in overlay colors, any work painted in overlay colors will also be erased.

If GRID or TEXT is selected, the sub functions will be:

MOVE FIGURE-moves figure to desired place on display screen.

SCALE-alters image size with use of stylus.

%SIZE-alters image size in exact percentage size as specified by user.

If CURVE is selected, the sub functions will be:

BOX-designate an area with a box with 90° angles.

FREE POINTS-designate an area with four free points.

DUPE-duplicates exactly the last four-sided figure last made.

And when one of these sub functions is selected, the sub-sub functions displayed will be:

ROTATE-rotates a figure at any degree clockwise or counterclockwise.

MOVE POINTS-moves corner points of figure to alter image.

MOVE FIGURE-moves image to another area on display screen.

SCALE-alters image size with stylus.

%SIZE-alters image size in exact percentage size as specified by user.

Menu Paint

The paint menu functions deal with the applications of color and texture Whenever a function of any menu is in use, one of these paint functions is always active. The use of many functions of other menus will be affected by the current paint function. The terminal monitor shows the current paint function for convenient reference.
Aside from the Airbrush function which is turned on and off, only one of the paint functions can be used at any time and will stay in effect until another paint function has been selected. Airbrush has no effect on the Picture Paint, Picture Average and Texture Paint functions.

SOLID-paints in current color and brush style.

TEXTURE-paints in current texture and brush style.

PICTURE PAINT-uses a picture as a brush.

SOLID AVERAGE-facilitates blending solid colors into the color background.

PICTURE AVERAGE-facilitates blending each color pixel of a picture paint pattern into the color background.

SOLID PUSH-pushes color from one area into adjacent areas.

TEXTURE PUSH-pushes more than one color simultaneously into adjacent areas.

SOLID PUSH AVERAGE-combines the actions of the Solid Push and Solid Push Average functions.

TEXTURE PUSH AVERAGE-facilitates blending each colored pixel of a Texture Push pattern into the color background.

CYCLE PAINT-shifts color of image along a preselected range on palette.

AIRBRUSH-sprays in selected paint function.

Menu Editing

The editing menu functions deal with editing colors, brushes and textures.

HUE-change colors.

LUMINOSITY-change brightness of color.

SATURATION-change shading from pure to greyed color.

SPREAD-create graduated shading between two colors.

COPY COLORS-move a selected color to any block on the color palette.

MERGE COLORS-merge specified colors of two color palettes.

PATTERN-use new texture pattern on display screen to make current pattern.

EDIT BRUSH-create or modify any brush style.

Menu Geometric Altering

The geometric altering functions are used to alter all or parts of the picture on the display screen. Images can be stretched, reduced, enlarged, rotated, mirrored, distorted, imprinted, shaded and changed in various other ways.

COPY-copy a four-sided area.

BUFFER COPY-copy with disk buffering which enables copying an image onto itself without a mirror effect.

SHADING-shade a four-sided area with a shading gradation between the four corners to be determined by the colors selected for each of these corners.

SHIFT-shifts some or all of the colors of a portion or all of an image within a rectangular area.

IMPRINT-changes color of anything painted in overlay color to any other color, texture or texture picture, or change anything in any color to the overlay color.

SORT-rearranges color on palette in ascending numerical order in terms of either Hue, Luminosity or Saturation.

When one of these above functions is chosen, the sub functions will be:

BOX

FREE POINTS

DUPE

When one of these sub functions is chosen, the sub-sub functions displayed will be:

ROTATE

MOVE POINTS

MOVE FIGURE

SCALE FIGURE

%SIZE

Menu Files

The file functions deal with storing or displaying files of images, textures, font sets, palettes and brush sets on the current disk.

STORE BRUSHES-stores brushes on disk.

RECALL BRUSHES-displays selected brush on display screen.

STORE PATTERN-stores texture patterns on disk.

RECALL PATTERN-displays selected texture pattern on display screen.

STORE COLORS-stores palette colors on disk.

RECALL COLOR-displays selected colors on color palette.

STORE IMAGE-stores image on disk.

STORE SCREEN-stores screen image on disk.

RECALL IMAGE-displays selected image on display screen.

If RECALL IMAGE is selected, the sub function will be:

MOVE FIGURE

If STORE IMAGE is selected, the sub functions will be:

MOVE FIGURE

SCALE

%SIZE

Menu List

The list functions deals with file lists and file maintainence.

LIST BRUSHES-list brushes.

LIST PATTERNS-list texture patterns.

LIST PALETTES-list color palettes with stored colors.

LIST IMAGES-list images.

LIST FONTS-list font sets.

RENAME-rename a file.

COPY-copy a file.

DELETE-delete a file.

STATUS-display remaining space on disk.

FILE SIZE-display file size.

Menu Extras

The Extras menu has miscellaneous functions and Artron option packages.

GRAB*-activates Image Grabber for scanning process.

DISK-select a new disk.

PRINT*-print screen or activate Compuprint.

EXTERNAL SYNC-connects Artron Color Display to an external video sync source for video production.

CYCLE-animate areas of color on the painting screen.

FONT ORIGINATOR*-activates the Font Originator that creates font sets in any style and size.

QUIT-quit the painting session.

*Optional packages.

The MacPaint program has seven pull-down menus at the top from left to right. These menus are:

APPLE
FILE
EDIT
GOODIES
FONT
FONT SIZE
STYLE

On the left side of the screen, there is an arrangement of icons which represent drawing functions and a line width chart. On the bottom, there is a palette of two rows of 38 different patterns with a large box on the left side, showing the current pattern.

The MacPaint program is stored in a disk that has been prepared (initialized) with a MAC-DOS which is a disk operating system that organizes information in the Macintosh computer. The initialized disk carries five system menus which are:

APPLE
FILE
EDIT
VIEW
SPECIAL

The system File and Edit menus have similar functions to the MacPaint's but have additional functions. A description of these system menus will follow after the description of the MacPaint menus.

Apple Menu

The Apple functions are to assist the user in the operation of the Macintosh computer.

SCRAPBOOK-used to store material for later work.

ALARM CLOCK-set the alarm to make a beep at the desired time.

NOTEPAD-write notes to yourself while you work. When the computer is turned off, the notes are automatically erased.

KEYCAPS-shows what figures and letters appear on the screen according to use of Shift or Option keys.

CONTROL PANEL-adjustable controls for operation of the computer.

- Speaker volume (beep sound)
- Date and time
- Keyboard repeating speed
- Keyboard touch
- Blinking rate of insertion point
- Mouse tracking
- Desktop pattern
- Mouse double click speed

PUZZLE-a little game that the user can play.

File Menu

The File functions deals with the use and printing of graphic files.

NEW-starts a new graphic file following the storing and closing of a previous graphic file.

OPEN-opens another stored graphic file.

CLOSE-removes the image from the display screen. If the changes have not been saved, the computer will ask through the dialog box if you want to save it.

SAVE-stores the image in a file on the disk. If it already has a name, the old version is replaced with the new version.

SAVE AS-gives two choices:

1. The image can be saved using a new name so that the old image won't be replaced.

2. Asks through the Dialog Box if you want to eject the disk. You can put another disk to store the image on.

REVERT-goes back to the last version saved. All the changes or mistakes made will be removed, making for a fresh start.

PRINT DRAFT-prints the selected image on paper in dark gray.

PRINT FINAL-prints the selected image on paper in black.

PRINT CATALOG-prints small pictures (1 x 1 1/4" each) of all the graphic work that has been saved on that disk.

QUIT-exits the MacPaint program. If your work has not yet been saved, the computer will ask through the dialog box if you want to save it before exiting the program.

Edit Menu

The edit functions deal with the mechanics of composing an image.

UNDO-reverses (undo) the last graphic thing you did.

CUT-erases specified area and copies to memory inside the computer.

COPY-copies specified area into memory, but also leaves it on the screen. Enlarges or reduces specified area with original proportions, also in horizontal or vertical format using Shift and X keys while moving Mouse. Also makes multiple copies with Command and Option keys while moving Mouse.

PASTE-puts down on the display screen the copied picture from memory.

CLEAR-erases the specified area or what has been copied or cut before.

INVERT-will change black to white and white to black in the specified area.

TRACE EDGES-puts another line (outline) around all lines in the specified area.

FLIP HORIZONTALLY-will flip the specified arrea from left to right.

FLIP VERTICALLY-will flip the specified area top to bottom.

ROTATE-will turn specified area 90° counterclockwise each time.

Goodies Menu

The Goodies functions facilitate the Icon functions in drawing and composing the image on the display screen.

GRID-puts an invisible grid on the screen and automatically aligns lines and four-sided figures. A visible grid can be made using a Filled Shape. See Drawing Shapes in Icon Menu.

FAT BITS-enlarges part of the image for detailed work.

EDIT PATTERN-patterns in the Pattern Menu can be edited into different patterns.

BRUSH SHAPE-displays 32 brush shapes for selection.

BRUSH MIRRORS-a brush with four mirror sides that automatically reflects the drawing activity in symmetrical shapes. The mirrors can be either used singly or on combination and works with any of the 32 brush shapes.

INTRODUCTION-shows and names each part of the MacPaint workscreen.

SHORT CUTS-shows some fast ways to do things that can be done with the menu functions.

Font Menu

The Font Menu lists four font sets for font selection.

CHICAGO-medium weight sans serif

GENEVA-lightweight sans serif

NEW YORK-lightweight serif

MONACO-lightweight sans serif

The fonts are available in seven sizes.

9 10 12 24 36 48 72

Style Menu

The fonts are available in the following styles. Any combination of styles can be made.

PLAIN
BOLD
ITALIC
UNDERLINE
OUTLINE
SHADOW

The text can be set in these three alignments:

ALIGN LEFT
ALIGN MIDDLE
ALIGN RIGHT

Icons Menu

The Icon functions deal with drawing and composing images on the display screen.

LASSO-specifies nonrectangular area without background for further work.

MARQUEE-specifies rectangular area with background for further work.

HAND (scroll)-moves picture around or off display screen.

A (text)-types in letters.

AREA FILL-fills in an area with selected pattern or solid black or white.

SPRAY PAINT-used as airbrush, spraying selected pattern, solid black or white, on screen. When Shift key is used, Spray Paint is moved horizontally or vertically.

BRUSH-paints with selected pattern or in black or white and in selected brush shape. When Shift key is used, brush is moved horizontally or vertically.

PENCIL-draws lines in any manner. When Shift key is used, the Pencil draws only horizontal or vertical lines. Will draw negative line on positive area and positive line on negative area.

LINE-draws straight lines. When Shift key is used, it draws only horizontal, vertical and 45° lines. With Option key, lines are drawn in selected pattern. Line reverses when drawn over other lines or areas. Line width is selected from line width chart.

ERASER-used to clear part or all of screen. When Shift key is used, Eraser is moved horizontally or vertically. When Eraser icon is double-clicked, the whole screen is erased.

LINE CHART-displays five lines. The first line is a dotted line that denotes no border on Filled Shapes. The next four lines are in different widths and space (for repeating copies).

DRAWING SHAPES-there are five different drawing shapes that come in both outlined and filled shapes. The filled shapes are filled with the current pattern.

The shapes are:

Rectangle
Round-Cornered Rectangle
Freeform-shape is drawn freeform. Line is connected to last point of previous line.
Polygon-shape is drawn with straight lines. Line is connected to last point of previous line.

Border lines are selected from the line width chart.

There are key functions for more different shapes.

	SHIFT	OPTION
Rectangle	square	patterned border
Round-Cornered Rectangle	round-cornered square	patterned border
Oval	circle	patterned border
Freeform	------	patterned border
Polygon	horizontal, vertical or 45° lines	patterned border

Pattern Menu

Patterns can be used to fill areas and draw some lines. A pattern can be edited or a new pattern made. Patterns are displayed in two rows of 19 each for a total of 38 patterns. The large box at the left of the rows indicates the pattern currently in use.

System Menu

The system functions organizes the information used in the operation of the Macintosh computer.

APPLE-same as for MacPaint.

FILE-deals with files in current disk.

OPEN-opens selected file.
DUPLICATE-copies selected file and labels it "Copy of . . ."
GET INFO-displays information about disk:
space available on disk.
space used.
located in internal or external drive.
date created.
date modified.
file lock indicator.

PUT BACK-puts the selected files back into the disk.
CLOSE-closes an opened file.
CLOSE ALL-closes all opened files.
PRINT-prints selected file.
EJECT-ejects the current disk.

EDIT-same as for MacPaint with two extra functions which are:

SELECT ALL-selects all active files on display screen.
SHOW CLIPBOARD-displays current contents of whatever was cut or copied. This is for temporary storage. For permanent storage, use the Scrapbook in the Apple menu.

VIEW-views file lists in several arrangements which are:

BY ICON-shows the contents of a file as icons. In this function, icons can be moved and their names edited.

BY NAME-lists the contents of a file alphabetically by name.

BY DATE-lists the contents of a file chronologically by modification date. File changed most recently is listed first.

BY SIZE-lists the contents of a file by size, largest first. Useful for seeing which of the files are taking the most room on the disk.

BY KIND-lists the contents of a file by kind-it tells which application created it such as MacPaint or MacWrite.

SPECIAL-disk maintainence functions.

CLEAN UP-arranges all icon files in neat rows and columns.

EMPTY TRASH-files are thrown in the trashcan displayed in the lower bottom right corner. When this function is activitated, the contents of the trashcan are emptied.

ALIASING — The visual effects that occur when the detail of an image or object exceeds the precision of the display area. Example: A diagonal line is represented as a stair-step line on a CRT. (See Anti-aliasing).

ALPHA-NUMERIC — A character that is a letter or numeral. (See Special Character).

ANTI-ALIASING — A process which removes the effects of aliasing on a CRT or other raster display so that stair-step lines appear continuous.

ARCHITECTURE — The physical structure of a computer's internal operations, including its registers, memory, instruction set, input/output structure and so on.

ASCII — American Standard Code for Information Interchange. Computers use a numerical coding system to represent letters, numerals and special characters. This standard specifies which number will stand for each character. This standard is the most popular convention for the representation of alphanumeric data on storage devices such as disk and tape, in a computer's memory, and for transmission of data between computers or computers and peripheral devices. (See EBCDIC).

BACKUP — The creation of copies of data files or disks for the purpose of being able to recreate the data in the event of machine failure or human operating errors that destroy the original data.

BINARY Base-two number system where each digit stands for a power of two. It is the simplest number system because it uses only zeros and ones to represent each number. Easily adapted to electronic circuits, it has become the basis for all digital computers. All computers use binary internally in the storage and representation of information, as well as instructions.

BIT A binary digit, the smallest unit of digital information. Each bit can can have a value of zero or one. All other alphanumeric data are made of combinations of bits. (See 8-bit/32-bit Computer).

BIT MAPPED DISPLAY An area in the computer's storage reserved for graphics. Each pixel in the image has a specific location on the display screen.

BRUSH Any simple shape which can be copied rapidly as it is moved across any path on the screen with the effect of pulling a brush filled with paint across the canvas.

BYTE A byte is 8 bits. The basic unit of data processed by the computer's CPU, a byte is usually used to represent an alphanumeric character or a number in the range 0 to 255. Certain combinations are used by the computer to represent alphanumeric information of programming instructions. (See ASCII).

CHARACTER Any letter, numeral or other linguistic, logical or mathematical symbol.

CHIP Slang for integrated circuit. (See Integrated Circuit).

CODE Something written in a computer language.

COMMAND A word or phrase, usually in a menu, describing an action for the computer to perform. Also, a combination of the Command key and a character key that accomplishes the same thing.

COMMAND KEY A key that, when held down while another key is pressed, causes a command to take effect.

COMPUTER Any device that can receive and then follow instructions to manipulate information. In any computer, both the set of instructions and the information on which the instructions operate may be varied from one moment to the next. A device whose instructions may not be changed is not a computer.

COMPUTER GRAPHICS Any computer-generated picture produced on a CRT screen or hardcopy output device. (See Output).

COORDINATE The location of a point in terms of units from a specified origin.

CPU Central Processing Unit. The "brain" of any computer, it is usually the largest chip in a computer and is used in every computer operation that processes data and executes instructions. It moves data from one memory location to another, adds and subtracts, tests values, and branches to code locations.

CRT Cathode Ray Tube. In practice, the name "CRT" is often used for any television-screen type of display. (See Monitor).

DATA — Information of any kind. Often the idea of numerical information is implied.

DECIMAL — Base-ten number system, the most commonly used number base. All numbers are expressed in combinations of the symbols 0-9. Though it is used for communication between users and computers, it is not directly processed by the CPU nor are values stored in memory in this format, but must be converted to base-two values before it can be handled by the processor.

DIGITAL — A type of electronic circuitry in which all information is processed as binary states.

DISK — A circular piece of material which has a magnetic coating similar to that found on ordinary recording tape. Digital information can be stored magnetically on a disk, much as musical information is stored on a magnetic tape. Disks may be either "hard" or "floppy". (See Floppy Disk and Hard Disk).

DISK DRIVE — The mechanism or peripheral that holds the disk, retrieves information from it, and saves information on it.

DISKETTE — A small floppy in a square plastic envelope. (See Floppy Disk).

DISPLAY MONITOR — See Monitor, Display.

DISPLAY SCREEN — The screen of the display monitor. (See Monitor, Display).

DOS	Disk Operating System. The way a particular computer organizes information. A disk initialized on a Macintosh (MAC-DOS) cannot be read by an Artronics PC which uses an IBM disk operating system (MS-DOS).
DOT MATRIX PRINTER	See Printer, Dot Matrix
EBCDIC	Extended Binary Coded Decimal Interchange Code. Used by IBM and IBM-compatible hardware for the representation of data. (See ASCII).
EDIT	To make corrections or changes in a program or data.
EXECUTE	To run a program or portion of a program.
FILE	A collection of information stored on a disk.
FILMCORDER	An outpout device that records display images on photographic film or paper.
FLOPPY DISK	A small inexpensive disk, called "floppy" since it is made from flexible materials.
FONT	A collection of letters, numbers, punctuation marks, and other typographical symbols with a consistent appearance.
GRAPHICS TABLET	An input device that uses a flat tablet and stylus for converting graphic and pictorial data into binary inputs for use in a computer.

GRID	Uniformly spaced points in 2 or 3 dimensions within which an object may be defined.
HARDCOPY	Images produced on paper printouts from printers or on film or transparencies from filmcorders. (See Softcopy).
HARD DISK	An expensive disk made from rigid materials.
HARDWARE	The physical parts of a computer. (See Software).
ICON	A graphic representation of an object, a concept or a message.
INITIALIZE	To prepare a disk so that the computer can store information on it.
I/O	Abbreviation for Input and/or Output. The process of transferring data to and from the computer. Keyboards, disk drives and printers are examples of I/O devices.
INK JET PRINTER	See Printer, Ink Jet
INPUT	Information arriving at a device. The same data moving around in a computer system can be output one instant from one part of the computer and input the next instant to some other part of the computer. The word "input" is also sometimes used as a verb. (See Output).
INSTRUCTION	One action taken by a computer, such as adding two numbers, comparing one number with another, or transferring control to a different part of a program.

INTEGRATED CIRCUIT	An electronic device in which a number of circuit elements, ranging from a few dozen to tens of thousands, have been miniaturized to fit on a chip of silicon only a quarter-inch square.
JAGGIES	A commonly used term for aliasing. (See Aliasing).
K	Abbreviation for the metric prefix 'kilo' which means 1000. When referring to memory size, each K actually equals 1024. A computer with 64K bytes of memory means that the computer has 64 times 1024, or 65536, bytes of memory.
KEYBOARD	The typewriter-like device that allows entry of information into a computer.
LASER PRINTER	A plotter which produces display images on photographic film in a raster format using a laser.
LOCK	To prevent files or entire disks from being altered.
MEGABYTE	A megabyte is 1024 kilobytes or 1,048,576 bytes. Roughly, one million bytes of storage.
MEMORY	The portion of a computer which stores information. (See RAM and ROM).
MENU	A list of computer program options appearing on the display screen from which a person can choose one or more through the use of a input device such as a keyboard, mouse, or pen.

MICRO-COMPUTER	A small, low-cost computer that performs input, processing, storage and output operations following a set of instructions.
MONITOR	A television set, often one that is specially manufactured to be connected to a computer. (See Display Monitor and Terminal Monitor).
MONITOR, DISPLAY	A CRT that displays the image generated by the computer.
MONITOR, TERMINAL	See Terminal.
MOUSE	A small device that is rolled around on a flat surface next to the computer. When the mouse is moved, the pointer on the screen moves correspondingly.
OFF-LINE	Not connected directly to the computer system.
ON-LINE	Connected directly to the computer system and available for access by same.
OPTION KEY	A key used like the Shift key to give an alternate interpretation to another key. Used to type foreign characters or special symbols.
OUTPUT	Information leaving a device or process. The output can be displayed on the screen or printer. The word "output" is also sometimes used as a verb. (See Output Device).
OUTPUT DEVICE	A device used to display or record an image. (See Hardcopy and Softcopy).

PAINTING	Free-hand sketching with a pen, joystick, mouse, paddles or keystrokes on raster displays where the line width, brush shape and color can be changed.
PAINT PROGRAM	A software package which enables the user to "paint" in real time and see the results on a raster display. Paint programs usually do not require programming skills.
PERIPHERAL	Input/output devices that can send information to and/or receive information from a computer. Some typical peripherals are CRTs, disk drives, keyboards and printers.
PIXEL	Short for picture element, the smallest element of a raster display, represented as a single point with a specified color or intensity level. The memory alloted per pixel varies from one bit, producing black or white, to 24 bits permitting one out of 16 million possible colors per pixel.
PLOTTER	An output device that graphs data by an automatically controlled device.
POINTER	A small arrow on the screen, most often pointing up and to the left, that tracks the movement of the mouse.
PRINTER, DOT MATRIX	A method of forming characters, shapes or patterns on a dot matrix printer from a pattern of dots taken from a two-dimensional array, usually 5x7 or 7x9.
PRINTER, INK JET	A matrix printer which uses electrostatic technology to first atomize a liquid ink and then control the number of droplets that are deposited on the paper. Does not make multiple copies.

PRINTER, LASER	A plotter which produces display images on photographic film or paper in a raster format, using a laser.
PRINTER, THERMAL	A matrix printer that produces display images on heat-sensitive paper, using a heated print head. Does not make multiple copies.
PROCESSING	The computer manipulation of data in solving a problem.
PROGRAM	A sequence of instructions that commands a computer to perform a step-by-step procedure.
RAM	Random Access Memory. The main memory of the computer. Information and programs can be both written and read out of RAM, and may be changed anytime during processing. When the power is turned off, anything in RAM will be lost. (see ROM).
RANDOM ACCESS	The ability to search data randomly rather than sequentially. It increases the search speed.
RASTER	A rectangular array of pixels.
RASTER GRAPHICS	An image made up of thousands of pixels and displayed on the display screen.

RESOLUTION The precision of a CRT, measured as the number of pixels wide by the number of pixels high that can be displayed on the screen. The more the pixels which becomes smaller, the higher the resolution and the smoother the picture. The fewer the pixels which becomes larger, the lower the resolution and the blockier the picture.
Resolution Ranges:
High resolution: 1024 x 1024 to 4096 x 4096
Medium resolution: 512 x 300 to 1024 x 1024
Low resolution: 300 x 200 to 512 x 300

ROM Read only Memory. This is a kind of memory in which the information is stored permanently by the manufacturer. This information can be read out but cannot be altered. Turning off the power will not destroy the contents of ROM. (See RAM).

SAVE To store information on a disk.

SCAN The operation required to produce an image on a television screen.

SCREEN A surface on which information is displayed, such as a CRT.

SHIFT KEY A key that, when pressed, causes subsequently typed letters to appear in uppercase, and causes the upper symbol to appear when number or symbol keys are typed.

SOFTCOPY Image displayed on a CRT screen.

SOFTWARE	Computer programs. Computers can do only those tasks and processes specified by the software.
SPECIAL CHARACTER	A character that can be displayed by the computer, but is is not a letter or numeral, such as =, $, %.
STYLUS	An electronic pen which is used in conjunction with a graphics tablet to input coordinate information to a computer, or to make menu selections.
TERMINAL	A device usually consisting of a CRT (Terminal Monitor) and a keyboard, connected or on-line to a computer system, used for entering data, programs, or commands into the computer and retrieving and displaying data or programs from the computer.
TERMINAL MONITOR	See Terminal.
TEXT	In general, any data other than numbers.
USER FRIENDLY	A term used by computer manufacturers to suggest that their equipment is easy to use and forgiving of mistakes made by users.
VECTOR GRAPHICS	A straight line drawn from one x-y point to another x-y point.
WINDOW	A portion of the display screen that is dedicated to some special purpose by a computer program.
ZOOM	To scale an image so that it appears to either approach or recede from the viewer.

8-BIT/32-BIT COMPUTER The size of data that can be processed at one time. The most common size byte contains 8 bits. A 8-bit computer has a CPU chip that processes data eight bits at a time and a 32-bit computer processes 32 bits at a time.

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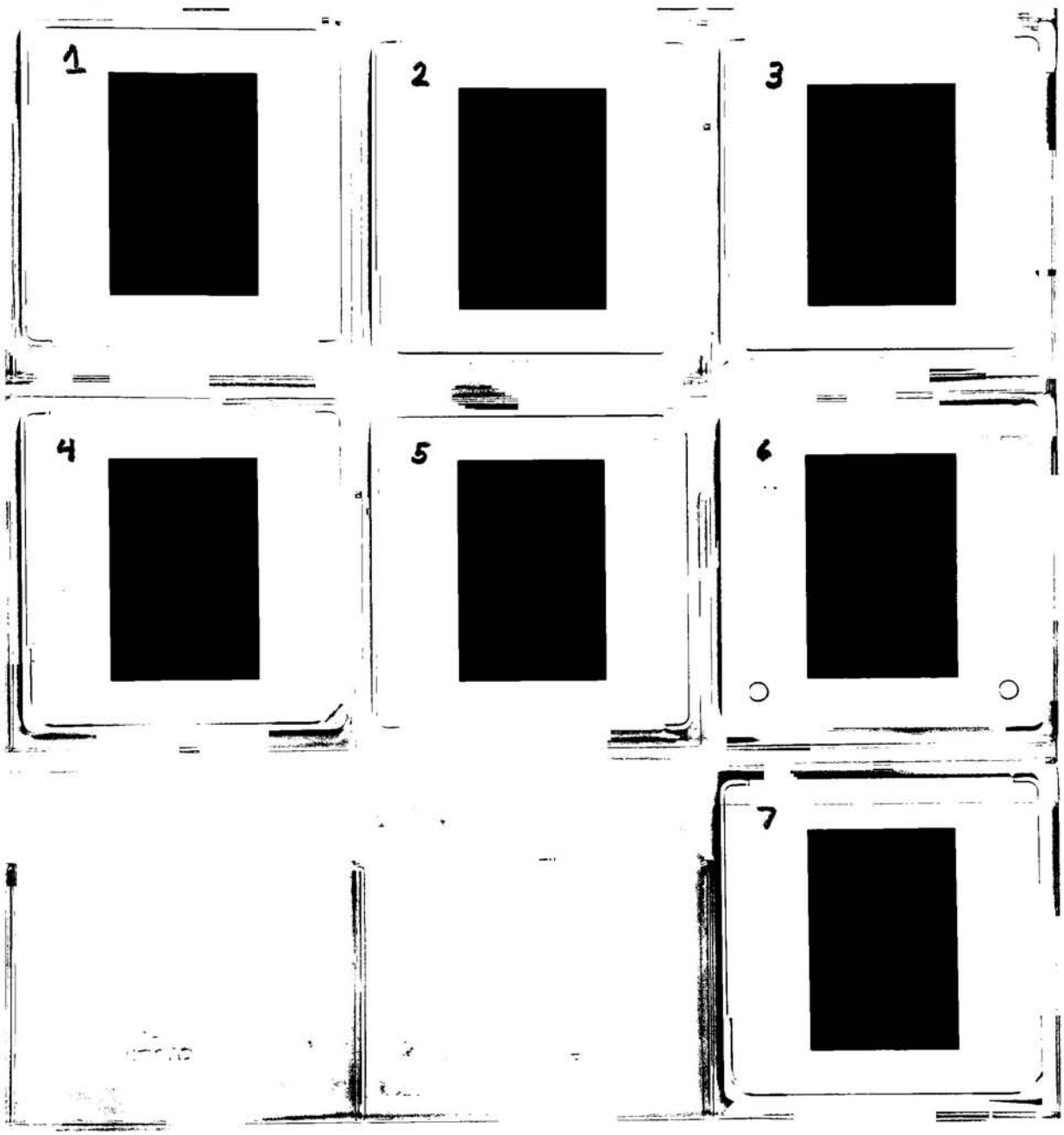
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