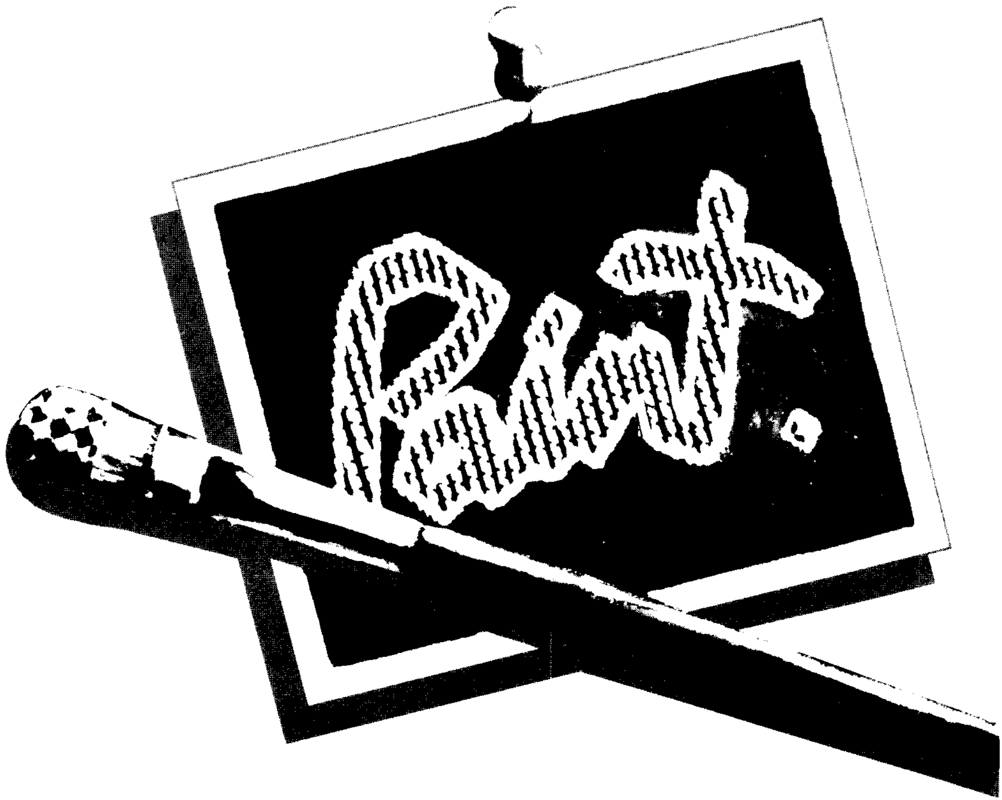
# PAINT*


*SuperBoots™ Software
Developed by
**Capital Children's Museum**
Licensed from
Reston Publishing Company

***DEDICATION***

***To those who have the courage to create.***




Alex Packer, Author
Eric Podietz, Design and Chief Programmer
Jimmy Snyder, Programmer
Mark Scott, Programmer
Guy Nouri, Project Manager
Heather Harney, Research

*SuperBoots™ Software from
**Capital Children's Museum**
Washington, D.C.
Licensed from Reston Publishing Company

ISBN 0-8359-5427-7



## DISCLAIMER

Capital Children's Museum and SuperBoots™ make no representations or warranties with respect to the contents hereof and specifically disclaim any implied warranties or merchantability or fitness for any reason or purpose. Capital Children's Museum reserves the right to revise this publication and to make changes from time to time in the content hereof without obligation of Capital Children's Museum to notify any person or organization of such revision or change.

10 9 8 7 6 5 4 3 2 1

Print in the United States of America.

# CONTENTS

## Tips to Remember

### Brushes

Every time you come from the Utilities screen and go to the canvas, you must set your Brush Width and Shape if you're going to use the Draw function.

### Combination Colors

A color, for a computer, is a set of instructions. When the computer puts two or more colors together, it puts two or more sets of instructions together, and Fills with Combination colors become both beautiful and surprising. Before using Fill, I-Fill, or X-Fill on a painting in progress, it's a good idea to save the painting and test the Fill on a clean canvas (as you would if you were working with actual paint) to discover the effect you'll achieve.

# ACKNOWLEDGMENTS

SuperBoots™, Capital Children's Museum, and the author wish to express their grateful appreciation to the following who have been so helpful and generous: Atari, Inc., A Warner Communications Company* for providing our computers. Richard Bolt for sharing some of the advanced work going on at Massachusetts Institute of Technology. Dan Franzblau who provided the paint program currently exhibited at the museum. Rachel Gellman for her assistance to the project manager. Heather Harney for editorial and production management. Tom Lane for his invaluable assistance to the author. Paul Pangaro for accuracy in the computer science information, and Ann Lewin, the Executive Director of the Museum, for her vision and enthusiasm. Louis Schure for sharing some of the advanced work going at New York Institute of Technology. The enormously willing and helpful staff of Capital Children's Museum. The many pioneers who have explored and experimented for so long in creative computer imaging, and paint systems. And those talented artists, not mentioned, who continue to extend the limits of imagination as they create with computers. Special thanks to the following institutions and organizations for making many of our illustrations possible: Aurora Systems, Byte Books (McGraw-Hill), Digital Effects, The Freer Gallery, Smithsonian Institution, The Frick Collection, The Guggenheim Museum, The Hirshhorn Collection, Smithsonian

Institution, *IEEE Computer Graphics Magazine,* Information International, Leo Castelli Gallery, The Metropolitan Museum of Art, the National Gallery of Art, National Museum of African Art, The Phillips Collection, SIGGRAPH, and VanNostrand Reinhold.

# INTRODUCTION

It's wet, it's dry, it's hard, it's soft, it's rough, it's smooth,
 it's....***PAINT!***

It's big, it's small, it's fast, it's slow, it's high, it's low,
 it's....***PAINT!***

It's long, it's short, it's thick, it's thin, it's round, it's square,
 more....***PAINT!***

It's lines and fills and zooms and thrills and dots, that's right,
 it's....***PAINT!***

It's stripes and zigs and zags and zips, you guessed, it's still,
 more....***PAINT!***

It's you, it's me, it's them, it's we, it's him, it's her,
 it's....***PAINT!***

It's a tree, it's a lake, it's a house, it's a cake,
 it's a storm, it's a mood, it's a dream.

It's a smile, it's a car, it's the Nile, it's a star, it's a bird,
 it's a plane, it's....super...***PAINT!!!!***

Welcome to the world of ***PAINT***. It's a world of the future, here in the present, built upon the past. It's a new frontier and you, the painter, are the pioneer. Like any frontier, its roots can be found deep in history, the history of art and the history of the computer. The breathtaking technological developments of the twentieth century have merged with the flow of man's artistic evolution to create a new art form, a new partnership.

That's the excitement of ***PAINT***. While linked to artists and styles of the past, ***PAINT*** is ready to propel art into the future. ***PAINT*** can be primitive, ***PAINT*** can be surreal, ***PAINT*** can be the pastel dots of Impressionism, or the glossy colors of pop. ***PAINT*** can be the stripes of Noland or the grids of Mondrian, the color squares of Itten, or the symbols of Klee. ***PAINT*** can be the broad brush strokes of DeKooning, the myriad layers of Pollack. ***PAINT*** is all that is known and all that is unknown.

You, the painter, will draw from what you've seen and create that which no one has seen. Be brave and be daring; recognize no limits. Invent and discover. Explore. No one knows the boundaries of this new art form. You are part of the history of art at this very moment. The world, in five years, in ten years, or in fifty years may turn and look at you and say, "He was the first, he saw beyond the limits of the familiar and created something new, he journeyed to the outer reaches of human expression and imagination, he came upon artistic lands never before traveled to show us how to ***PAINT***."

This book can add immeasurably to your enjoyment and understanding of the ***PAINT*** program, which, frankly, is the main reason it was written. Here's how it works.

Chapter 1 tells you How to ***PAINT***. The instructions, which assume that you are neither an airhead nor an

Einstein, will tell you all you need to know about the program's controls and capabilities: how to change brushes and colors, how to fill, zoom and keep pictures, how to use the joystick and joystick button, how to type on the keyboard, how to draw lines, circles, rectangles, how to achieve technical mastery of ***PAINT***. Be sure to read it. Who knows what you might miss without it.

Chapter 2 tells you everything you need to know about How Computers Work in a brief and painless way. Some of the negative myths that surround computers will be addressed so that you'll be in a better position to set people straight when they say that computers are "bad."

Chapter 3 looks at the history of painting through the centuries. The focus is on the relationship between a society's values, history and people and its art forms. Whether by seeing how the expansion of trade routes in the thirteenth century led to an increase in color possibilities for the painter, or how the invention of the computer created computer art, you'll begin to get a sense of the interweaving of art, culture, history and technology.

Chapter 4 provides an overview of computer imaging (computer graphics), the use of the computer to generate pictures. ***PAINT*** is just one of thousands of computer-imaging applications. You'll be amazed at the unlimited possibilities as well as the extent to which computer imaging is already changing your world.

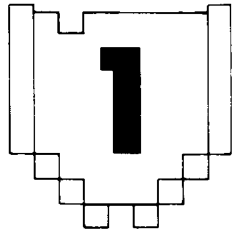
Chapter 5 sneaks a peek at some extraordinary computer artists who are devoting their lives to this new art form.

Chapter 6 is full of it. Creativity, that is. Ideas galore for you to try. Be free and experiment. There's no right or wrong. Games to play, challenges to meet. This chapter is meant to get your creative juices flowing, to give you a nudge when you "don't know what to ***PAINT***," or want to explore the endless possibilities of ***PAINT***. Dive in and be awed. Pretty soon you'll be saying, "Holy Atari! This is fantastic."

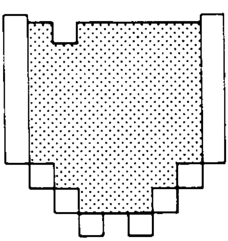
If you put all the chapters together, toss in this introduction and a pinch of concluding remarks, add a glossary and stir well with imagination and bake for an hour in a creative oven, you'll be in a pretty good place—you'll have a sense of where you are, where you've been and where you can go with ***PAINT***.

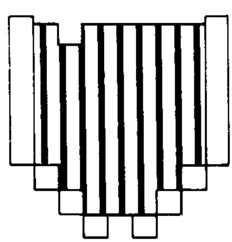
So, forget about turpentine, forget about linseed oil. forget the dropcloth, forget the spills. No more running out of paint, no more cleaning brushes. No more stirring and shaking, squeezing and mixing. No priming, no chipping, no flaking. No waiting for paint to dry, no more insects in your acrylics, no more cat tracks in your oils. No torn canvases, no warped stretchers. Welcome to ***PAINT***!

Pull up a chair, put on your painter's cap, grab the joystick, and HAVE FUN! And, by the way, don't forget to read the book.




# HOW TO PAINT





Some of you have undoubtedly already tried to *PAINT*. You've loaded the program, typed various keys and moved the joystick around. Maybe nothing happened, maybe everything happened. Others of you have turned to this chapter without touching the computer—you want to read all the instructions first. No matter. It's nice that all of you got here, whether sooner or later.

I know you're anxious to *PAINT*, so I've tried to make these directions as simple and straightforward as possible. That was easy since Guy, Mark, Eric and Jimmy, the SuperBoots™ computer team that created this program, put their energy into making the *PAINT* controls clear and consistent. Everything about this program makes sense and is easy to remember.

But don't be fooled. While you can learn how to use the controls of *PAINT* in an hour, it will take longer to master your technique. In fact, it could take years to feel that you've even begun to explore the vast possibilities of this new art form. It's a bit like riding a bike. You can learn to do it in a short time, but you'll never run out of new places to explore or new adventures to seek.

Well, what are you waiting for? Let's get started. Here's how the chapter is laid out:

1. Starting up instructions
2. Hands-on general rules and operation (read while you *PAINT*!)
3. SimplePaint controls and instructions
4. SuperPaint controls and instructions
5. A special "sketching" program *YOU* can type into your computer which will allow you to "sketch" with paddles

# 1. STARTING UP INSTRUCTIONS

We're going to assume that your computer is all set to go. You know, that it's been unpacked and plugged in and cabled together and you're ready to load the *PAINT* program. If, however, your computer is still in the box or under the Christmas tree, you'll have to refer to the ATARI manuals for operation before you proceed.

1. All switches should be in off position.
2. Be sure that the BASIC cartridge is inserted in the left cartridge slot.
3. Turn TV (video screen) on.
4. Turn disk drive on. Wait for BUSY light to go out.
5. Insert *PAINT* disk (label up and closest to you) in disk drive 1 and shut door.
6. Turn computer on by flipping on/off switch on right side.
7. Be sure the joystick is plugged into port 1.

If the volume is turned up on your TV, you should now hear the nifty noises that tell you the *PAINT* program is loading. Approximately twenty seconds later, you will see the *PAINT* logo and the Paint Menu.

PAINT MENU

SIMPLE PAINT

→ SUPERPAINT

ART SHOW

***In order to continue with the next set of instructions, press START for SuperPaint mode.*** If already familiar with *PAINT* operations, you may now alternately choose Art Show or SimplePaint from the Main Menu. On with SuperPaint!

## 2. GENERAL RULES AND OPERATION (READ WHILE YOU *PAINT*!)

It's easy to ***PAINT***. You're in the SuperPaint mode right now. Grab hold of the joystick. Now move the joystick and watch the cursor move on the screen. (The cursor is the little cross that tells you where the "brush" is on the painting.) While you move the joystick, press the joystick button. What do you know, something happened, eh? You're painting. That's right, anytime you want to lay down paint, just press the joystick button while moving the joystick.

Keep painting. Press the letter C for Color and a number, say 4. Just changed colors, didn't you? Now press another number, 2 or 5 or 8, in fact, any number between 0 and 9. Each new number will change the color. You don't have to keep pressing C because you're already in the Color function.

Keep painting. Now press the letter B for Brush and the number 7, for instance. New brush!! Any number from 1 to 9 will give you a different brush. And again, as long as B for Brush was the last letter you pressed, the computer will remember it. You only need to press new numbers in order to change brushes. Okay, now press W for Width and the number 9. What did it do? It should have made your brush wide. To change the brush width again, press any number from 1 to 9.

Are you ready for a real trip? Press S for Speed and the number 9. Move the joystick. I bet your brush is painting across the screen very quickly now since you just increased brush speed to the maximum. Press the number 1 for the slowest speed.

By now you should be getting the hang of it. ***PAINT*** yourself a painting while you experiment with different colors, brushstrokes, and speeds. You only need to press the letter for the control you want once, as long as you "stay" in that control. But if you want to change from the Color control to the Brush control, you'll have to press B and then the number of the brush you want. But once you're in Brush, you only have to press numbers to change brushes. Neat, eh?

So you see, while you ***PAINT***, you can use the keyboard to do all sorts of things: you can choose different colors and brushes; you can Draw instant lines, rectangles, and circles; you can change the speed of the Brush; you can quickly Fill shapes, Erase pictures, and even Zoom in on a part of the screen for close-up work. These are just some of the program controls you have at your command when you ***PAINT***.

You've seen how to change colors, brushes, and speed by using the keyboard. You can also use the joystick and get the same results. Here's how: To change colors, simply move the cursor into the paint pot of the new color you want. Press the joystick button to "register" the new color and you're all set—you're now painting with that new color. Practice moving the cursor in and out of the paint pots to pick up new colors and color textures.

Want to change brushes using only the joystick? Easy as pie. Move the cursor to the Help space marked H and press the joystick button. Move the cursor to the word Brush and press the joystick button. Now you'll see the Brush menu which shows the selections available to you. Move the cursor to the number of the brush you want and, you guessed, press the joystick button again to "register" that brush. Move the cursor to the word Paint and press the joystick button to resume painting. The

Brush menu will disappear, and you'll be back to your painting and the paint pots at the bottom of the screen.

Most Paint functions can be controlled in a similar manner by using the joystick. You'll go "through": the Help space to see the Help index, and you'll choose the control you want to see, the "menu," or selections for that control. When you've made your choice, you can get back to painting by moving the cursor to Paint and pressing the joystick button.

Once you have created finished paintings, there are many things you can do with them: you can Keep (save) your paintings, you can call a picture to the screen, you can Junk (delete) a picture, and you can show up to twenty-four paintings as a continuous display on the screen in the Art Show mode.

The things you can do with your finished paintings are known as Utilities. The things you can do *while* painting are known as Paint functions. The following chart shows the different Paint functions and Utilities you have in SimplePaint and SuperPaint:

## Paint Functions

What you can control *while* painting

| **SimplePaint** | **SuperPaint** | |
|---|---|---|
| Brushes (4) | Brushes (81!) | Mix |
| Colors (4) | Colors (oh, so many!!) | Circle (O) |
| Erase | | Paint |
| Mix | Draw | Quickness of cursor |
| | Erase | Rectangle |
| | Fill | Speed of brush |
| | Help | Width of brush |
| | I-fill | X-fill |
| | Line | Zoom |

## Utilities

What you can do with finished paintings

| SimplePaint | SuperPaint |
| --- | --- |
| Get picture | Get picture |
| Keep (save) picture | Keep (save) picture |
| Junk (delete) picture | Junk (delete) picture |

The instructions that follow are listed alphabetically by the first letter of each Paint function and Utility. These instructions will give you precise directions for any function you wish to control. As you become familiar with these controls you'll begin to see patterns, and it will become easier and easier for you to use them. You'll also discover your own style of painting—you'll learn which functions you prefer to control with the joystick, which you prefer to control with the keyboard, and which you prefer to control with a combination of both.

## 3. SIMPLEPAINT CONTROLS AND INSTRUCTIONS

*From Main Menu, press OPTION until the arrow points to SimplePaint. Press START to select SimplePaint.*

# Art Show

## How to select and display your pictures

1. To store pictures, you must use a spare disk (*not* the *PAINT* disk) with DOS on it.
2. To activate Art Show, you will need to use *both* the keyboard and the joystick.
3. Here's how to select and display your pictures:

BY JOYSTICK

Keyboard necessary to activate Art Show. Joystick is used only to select sequence of pictures for show.

**BY KEYBOARD**

1. **Press START for Main Menu if you are not already there.**
2. **Press OPTION until the arrow points to Art Show. Press START.**
3. **Now, insert your storage disk into disk drive. If you have only one disk drive, remove Master Disk while in Art Show.**
4. **You will be asked to select the disk drive with your pictures. If you have more than one disk drive, you must indicate which disk drive has the pictures you want. Press 1 or 2.**

**5. You will see a list of your pictures.**

6. Move cursor to first picture you want to show. Press joystick button.

7. Move cursor to second picture you want to show. Press joystick button.

8. Continue to move cursor and press joystick button to select all the pictures you want to show. (Up to 24)

**9. Press SPACE BAR to begin show.**

**Press SPACE BAR again if you want to pause at any picture.**

**Press SPACE BAR again to continue, or press SELECT to start show over.**

**To resume painting, remove storage disk and insert Master Disk if only using one disk drive. Press START for Main Menu. Press OPTION to select SimplePaint or SuperPaint. Then press START.**

# Brush

## How to choose and change brushes

BY JOYSTICK

1. Move cursor to desired brush and press joystick button.

**BY KEYBOARD**

# Color

## How to choose and change colors

BY JOYSTICK

1. Move cursor into desired paint pot and press joystick button.
2. Jump up and run around your chair.
3. Pull your left ear and shout, "Hooma-glooma!"
4. Just kidding. All you need to do is Step 1.

**BY KEYBOARD**

*(Also see **Mix**.)*

# Erase

## How to clear the entire screen

BY JOYSTICK

1. Move cursor to Erase space. That's the big E. Press joystick button.

**BY KEYBOARD**

***Note:*** *To erase only part of your painting, choose the background color and paint over the part you wish to erase.*

# Help

## How to get Simple help

BY JOYSTICK

**BY KEYBOARD**

1. **Press the letter H** *or* **press the SPACE BAR.**

**To resume painting, press H or press SPACE BAR again.**

# Mix

## How to change the hue and brightness of the four basic colors in your painter's palette

BY JOYSTICK

1. Move cursor to paint pot of the color you want to mix. Press joystick button.
2. Press joystick button again.
3. Hold joystick to the left and then move it up or down to change hue. Hold joystick to the right and then move it up or down to change brightness

To resume painting, press joystick button or press P.

**BY KEYBOARD**

# Utilities

## How to Get, Keep, or Junk a picture

BY JOYSTICK

**BY KEYBOARD**

1. **Insert your storage disk into the disk drive. If you only have one disk drive, remove the Master Disk while in Utility function.**
2. **Press U for Utilities.**
3. **You will be asked to select the disk drive with your pictures. If you have more than one disk drive, you must indicate which disk drive has the pictures you want. Press 1 or 2.**
4. **Press G if you want to Get a picture**
   **or**
   **Press K if you want to Keep a picture**
   **or**
   **Press J if you want to Junk a picture**
   **or**
   **Press U to change disk drive number.**

5. Type the name of the picture you want to Get, Keep or Junk. (Picture names may be up to 8 characters long. The first character must be a letter; the remaining characters may be letters or numbers.)
6. Press the RETURN to Get, Keep or Junk your picture.

To resume painting, press P.

# 4. SUPERPAINT CONTROLS AND INSTRUCTIONS

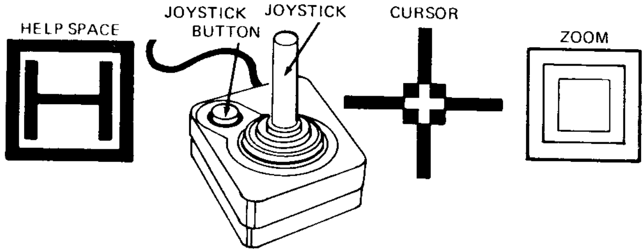
*From Main Menu, press OPTION until the arrow points to SuperPaint. Press START to select SuperPaint.*

***SuperPaint Control Keys***

| | |
|---|---|
| ***START***—Returns you to Main Menu | Accessible from: |
| ***A***—Art Show | (Main Menu) |
| ***B***—Brush | (Paint) |
| ***C***—Color | (Paint) |
| ***D***—Draw | (Paint) |
| ***E***—Erase | (Paint) |
| ***F***—Fill | (Paint) |
| ***G***—Get Picture | (Utility) |
| ***H***—Help | (Paint) |
| ***I***—I-Fill (Internal-Fill) | (Paint) |
| ***J***—Junk Picture | (Utility) |
| ***K***—Keep Picture | (Utility) |
| ***L***—Line Draw | (Paint) |
| ***M***—Mix Color | (Paint) |
| ***N***—No | |
| ***O***—Circle Draw | (Paint) |
| ***P***—Paint | (Paint) |
| ***Q***—Quickness of cursor | (Paint) |
| ***R***—Rectangle draw | (Paint) |
| ***S***—Speed of brush | (Paint) |
| ***U***—Utilities | (Utility) |
| ***W***—Width of brush | (Paint) |
| ***X***—X-fill (External-Fill) | (Paint) |
| ***Y***—Yes | |
| ***Z***—Zoom | (Paint) |

Press space bar once for help index.

Press space bar twice for help menu.




HELP INDEX

| | | | | |
|---|---|---|---|---|
| | | [P]aint | | |
| [D]raw | [B]rush | [S]peed | [C]olor | [F]ill |
| [E]rase | | [U]tilities | | [H]elp |

# Art Show

## How to select and display your pictures

BY JOYSTICK

Keyboard necessary to activate Art Show. Joystick is used only to select sequence of pictures for show.

**BY KEYBOARD**

1. **Press START for Main Menu if you are not already there.**
2. **Press OPTION until the arrow points to Art Show. Press START.**
3. **Insert your storage disk into the disk drive. If you have only one disk drive, remove the Master Disk while in Art Show.**
4. **You will be asked to select the disk drive with your pictures. If you have more than one disk drive, you must indicate which**

**disk drive has the pictures you want. Press 1 or 2.**

5. **You will see a list of the names of your pictures.**

6. Move cursor to first picture you want to show. Press joystick button.
7. Move cursor to second picture you want to show. Press joystick button.
8. Continue to move cursor and press joystick button to select all the pictures you want to show. (Up to 24)

9. **Press SPACE BAR to begin show.**

   **Press SPACE BAR again if you want to pause at any picture. Press SPACE BAR again to continue, or press SELECT to start show over.**

   **To resume painting, remove storage disk and insert Master Disk if using only one disk drive. Press START for Main Menu. Press OPTION to select SimplePaint or SuperPaint. Then press START.**

# Brush

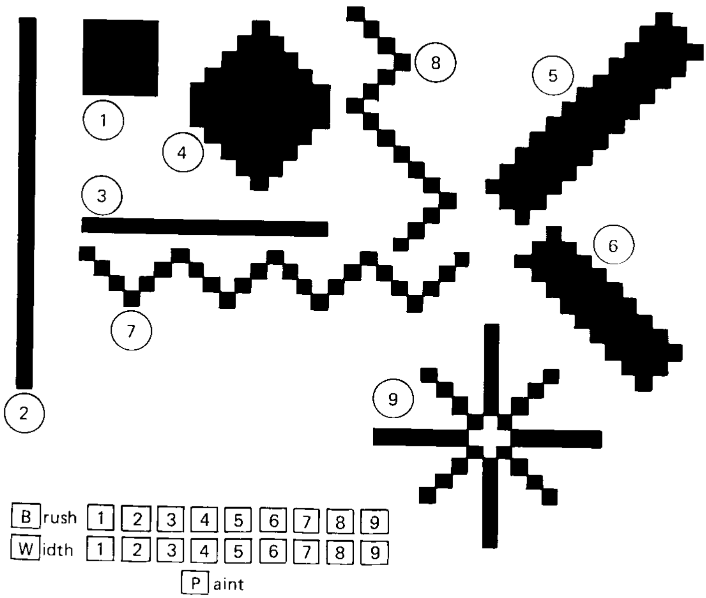
## How to choose and change brushes

BY JOYSTICK

1. Move cursor to Help space and press joystick button to see Help index.

**BY KEYBOARD**

**1. Press the letter B and any number 1-9 for desired brush.**




2. Move cursor to Brush and press joystick button to see Brush menu.
3. Your current brush number and brush width will be flashing. All the brush numbers will be displayed in the currently selected width. The brush you are us-

ing will be displayed in orange.

4. To change brushes, move cursor to desired brush number and press joystick button. The brush you choose will be displayed in orange.

**To see Brush menu, press H for Help and press B for Brush menu.**

To change brush width, move cursor to desired width and press joystick button.

**To change brush width, press the letter W and any number 1-9 for desired width.**

To resume painting, move cursor to Paint and press joystick button.

**To resume painting, press P.**

*(Also see* **Speed of brush** *and* **Width of brush.***)*

# Color

## How to choose and change colors

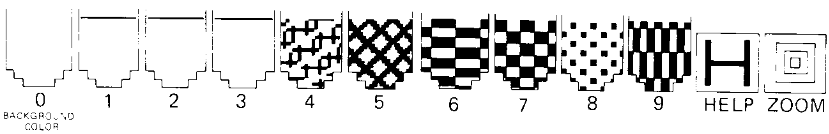
BY JOYSTICK

1. Move cursor into desired paint pot and press joystick button.

**BY KEYBOARD**

**1. Press the letter C and any number 0-9 for desired color.**

PAINT POTS




To see Color menu, move cursor to Help space and press joystick button to see Help index. Move cursor to Color and press joystick button. To resume painting, move cursor to Help space and press joystick button *twice*.

**If C is the last letter you have pressed, you can change colors by pressing a number 0-9.**

**To see Color menu, press H for Help index and press C for Color menu. To resume painting, press P.**

*(Also see **Mix.**)*

# Draw

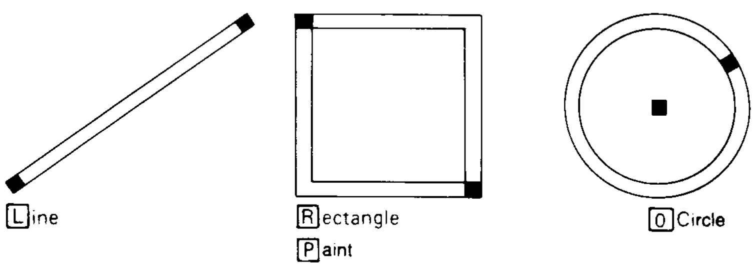
## How to see the Draw options menu

BY JOYSTICK

1. Move cursor to Help space and press joystick button to see Help index.
2. Move cursor to Draw and press joystick button to see Draw menu.
3. Move cursor to Line, Rectangle, or Circle and press joystick button for desired drawing option.

**BY KEYBOARD**

1. **Press H for Help to see Help index.**
2. **Press D to see Draw.**
3. **Press L, R, or O for desired drawing option.**




To resume painting, move cursor to Paint and press joystick button.

**To resume painting, press P.**

*See individual listings for **Line**, **Rectangle**, and **Circle** to learn how each drawing option works.*

# Erase

## How to clear the entire screen

BY JOYSTICK

1. Move cursor to Help space and press joystick button to see Help index.
2. Move cursor to Erase and press joystick button.
3. Move cursor to Yes and press joystick button to confirm your desire to erase.

**BY KEYBOARD**

**1. Press E for Erase.**

**2. Press Y for Yes to confirm your desire to erase.**

**Or, press N if you have changed your mind.**

You are now back in Paint mode.

***Note:*** *To erase only part of your painting, choose the background color and paint over the part you wish to erase.*

*(Also see **Yes** and **No**.)*

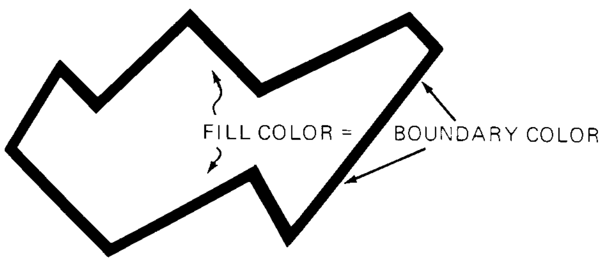
# Fill

## Three different ways to Fill shapes with color

Let's say you want to fill a shape with color. Instead of having to paint the inside of the shape with a brush, you can use the automatic Fills. Here's how they work and when you use them.

### Fill

This will fill a shape with the *same* color as its boundary.




BY JOYSTICK

1. Be sure your color selection is the *same* as the boundary of the shape you wish to fill.
2. Move cursor to Help space and press joystick button to see Help index.
3. Move cursor to Fill and press joystick button to see Fill menu.
4. Move cursor to Fill and press joystick button.

**BY KEYBOARD**

1. **Be sure your color selection is the same as the boundary of the shape you wish to fill.**
2. **Move cursor inside shape to be filled.**
3. **Press F for Fill.**
4. **Press joystick button to fill.**

5. Move cursor inside shape to be filled and press joystick button.
6. Enjoy the show as your shape fills.

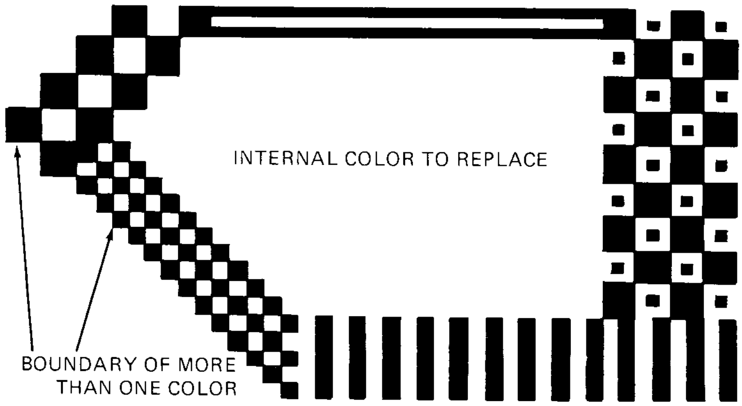
| | |
|---|---|
| To fill more shapes, move cursor inside them and press joystick button. | **To fill more shapes, move cursor inside them and press joystick button.** |
| To stop filling after it has begun, press the SPACE BAR. | **To stop filling after it has begun, press the SPACE BAR.** |
| To resume painting, move cursor to Help space and press joystick button *twice*. | **To resume painting, press P.** |

*You will notice a marker above the paint pots when you are in Fill. This is a "warning" that lets you know you're in Fill. The TOP marker indicates the color of the boundary you are filling to, and the bottom marker indicates the color you are filling with. In Fill, they are the same.*

## I-Fill

## (Internal-Fill)

This will fill a shape or area with a color that is the *same or different* than its boundary.




BY JOYSTICK

1. Move cursor to Help space and press joystick button to see Help index.
2. Move cursor to Fill and press joystick button to see Fill menu.
3. Move cursor to I-Fill and press joystick button.
4. Move cursor to the TOP HALF of the paint pot of the color you wish to replace. Press joystick button.

   There should now be a marker on the top of the paint pot.
5. Move cursor to BOTTOM HALF of the paint pot of the new color you will use. Press joystick button.
6. Move cursor onto shape whose color you will re-

**BY KEYBOARD**

1. **Press I for Internal-Fill and the number of the color to be replaced.**

   **There should now be a marker on top of the paint pot of the color to be replaced.**
2. **Press C and the number of the new color.**

   **There should now be a marker at the bottom of the paint pot of the new color.**
3. **Move cursor onto shape whose color you will replace. Press joystick button.**

place. Press joystick button.

To stop filling after it has begun, press the SPACE BAR.

**To stop filling after it has begun, press the SPACE BAR.**

To resume painting, move cursor to Help space and press joystick button *twice*.

**To resume painting, press P.**

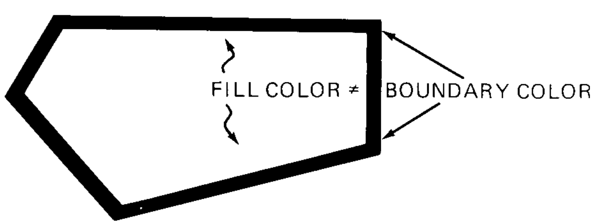
*You will notice a marker above the paint pots when you are in Fill. This is a "warning" that lets you know you're in Fill. In I-Fill, the TOP marker indicates the color you are replacing, and the BOTTOM marker indicates the new color.*

*You will not be able to replace a color with texture colors if the texture color contains the color you wish to replace.*

## X-Fill

## (External-Fill)

This will fill a shape or area with a color that is *different* than its boundary.




BY JOYSTICK

1. Move cursor to Help space and press joy-

**BY KEYBOARD**

**1. Press X for External-Fill and the number**

stick button to see Help index.

2. Move cursor to Fill and press joystick button to see Fill menu.
3. Move cursor to X-Fill and press joystick button.
4. Move cursor to the TOP HALF of the paint pot of the boundary color. Press joystick button.

   There should now be a marker on the top of the paint pot.
5. Move cursor to the BOTTOM HALF of the paint pot of the new color you are filling with. Press joystick button.

   There should now be a marker at the bottom of the paint pot.
6. Move cursor inside shape to be filled and press joystick button.

To stop filling after it has begun, press SPACE BAR.1.

To resume painting, move cursor to Help space and press joystick button *twice*.

**of the color of the boundary of the shape you are filling.**

**There should now be a marker on top of the paint pot of the boundary color.**

2. **Press C and the number of the new color you are using for fill. There should now be a marker at the bottom of the paint pot of the new color.**
3. **Move cursor inside shape to be filled. Press joystick button.**

**To stop filling after it has begun, press SPACE BAR.**

**To resume painting, press P.**

*You will not be able to replace a color with texture colors if the texture color contains the color you wish to replace.*

# Get Picture

## How to Get a picture you have kept(saved) on disk

BY JOYSTICK

1. Move cursor to Help space and press joystick button to see Help index.
2. Move cursor to Utilities and press joystick button.

Keyboard necessary at this point.

**BY KEYBOARD**

1. **Insert your storage disk into disk drive. If you have only one disk drive, remove the Master Disk while in Utility function.**
2. **Press G for Get picture.**
3. **You will be asked to select the disk drive with your pictures. If you have more than one disk drive, you must indicate which disk drive has the pictures you want. Press 1 or 2.**
4. **Type the name of the picture you wish to get.**
5. **Press RETURN and wait while your pic-**

**ture is brought to the screen.**

**To resume painting, remove storage disk; insert Master Disk if using only one disk drive.**

**You are back in the Paint mode.**

# Help

## How to see the Help index and the Help menu

BY JOYSTICK

1. Move cursor to Help space and press joystick button to see Help index.

   To resume painting, move cursor to Paint and press joystick button.
2. To see Help menu, move cursor to Help space and press joystick button; move cursor to Help and press joystick button.

To resume painting from Help menu, press P.

**BY KEYBOARD**

1. **Press H or press the SPACE BAR to see Help index.**

   **To resume painting, press P.**
2. **Press H again or press the SPACE BAR *twice* to see Help menu.**

**To resume painting, press P.**

# I-Fill

*See listing under **Fill**.*

# Junk a Picture

How to Junk or get rid of a picture on your disk

BY JOYSTICK

1. Move cursor to Help space and press joystick button to see Help index.
2. Move cursor to Utilities and press joystick button.

   Keyboard necessary at this point.

**BY KEYBOARD**

**1. Insert your storage disk into disk drive. If you have only one**

disk drive, remove Master Disk while in Utility function.

2. Press J for Junk picture.
3. You will be asked to select the disk drive with your pictures. If you have more than one disk drive, you must indicate which disk drive has the pictures you want. Press 1 or 2.
4. Type the name of the picture you want to Junk.
5. Press RETURN.

To resume painting, remove storage disk; insert Master Disk if using only one disk drive.

Press P for Paint.

# Keep a Picture

## How to Keep (save) a picture on your disk

BY JOYSTICK

1. Move cursor to Help space and press joystick button to see Help index.
2. Move cursor to Utilities and press joystick button.

   Keyboard necessary at this point.

**BY KEYBOARD**

1. **Insert your storage disk into disk drive. If you have only one disk drive, remove Master Disk while in Utility function.**
2. **Press K for Keep picture.**
3. **You will be asked to select the disk drive with your pictures. If you have more than one disk drive, you must indicate which disk drive has the pictures you want. Press 1 or 2.**
4. **Type the name of the picture you want to Keep. (Picture names may be up to 8 characters long. The first character must be a**

**letter and the remaining characters must be letters or numbers.)**

5. **Press RETURN and wait while your picture is being saved.**

**To resume painting, remove storage disk; insert Master Disk if using only one disk drive.**

**Press P for Paint.**

# Line

## How to draw instant lines

BY JOYSTICK

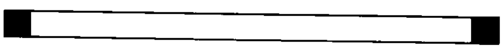
1. Move cursor to Help space and press joystick button to see Help index.
2. Move cursor to Draw and press joystick button to see Draw menu.
3. Move cursor to Line and press joystick button.
4. To draw instant lines, move cursor where you

**BY KEYBOARD**

1. **Press L for Line.**
2. **To see Draw menu, press H for Help and press D for Draw.**
3. **Joystick necessary at this point.**

want one end of the line to be. Press joystick button.

5. Now, move the cursor where you want the other end of the line to be. Press the joystick button, and presto, a line will appear between those two points. Lines will be drawn with the last brush width you used. Change brush width to change the width of your line.



To resume painting, move cursor to Help space and press joystick button *twice*.

**To resume painting, press P.**

*(Also see* ***Draw, Rectangle,*** *and* ***O (Circle).****)*

# Mix

## How to change the hue and brightness of the four basic colors in your painter's palette

It is possible to mix colors in two different ways. You can mix while looking at your painting and paint pots on the display screen or you can mix while looking at the color menu.

## Mixing colors 0-3 while looking at your painting

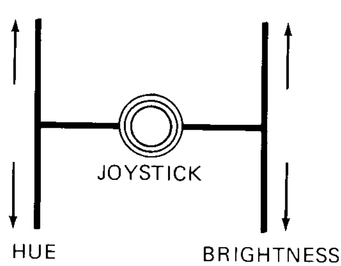
BY JOYSTICK

1. Move cursor into paint pot of color you wish to mix. Press joystick button. The cursor will move to the top of the selected pot.
2. Press joystick button again without moving joystick. Cursor will dip into pot.
3. Hold joystick to the left and then move it up and down to change hue.
   Hold joystick to the right and then move it up or down to change brightness.

To resume painting, press joystick button.

**BY KEYBOARD**

1. **Press C and the number of the color you wish to mix.**
2. **Press M for Mix.**
3. **Joystick necessary at this point.**




**To resume painting, press P.**

*Color textures are made up of the four basic colors in your painter's palette. Mixing a basic color will cause the color textures (colors 4-9) to change.*

***If you try to mix a color texture (colors 4-9) you will automatically see the color menu. It is not possible to mix a color texture except by mixing the four basic colors.*** *But you can select an almost unlimited number of different textures from the color menu. Keep reading this entry to find out how.*

## Mixing Colors 0-3
## while looking at the color menu

BY JOYSTICK

1. Move cursor to Help space and press joystick button to see Help index.
2. Move cursor to Color and press joystick button to see Color menu.
3. Move cursor into paint pot of color you wish to mix. Press joystick button. The cursor will move to top of the selected pot.
4. Press joystick button again without moving the joystick. Cursor will dip into pot.
5. The bar you see shows you the hue and brightness of the current color mix.

**BY KEYBOARD**

1. **To see color menu, press H for Help and press C for Color.**
2. **Press C and a number 0-3 for the color you wish to mix.**
3. **Press M for Mix.**
4. **The bar you see shows you the hue and brightness of the current color mix.**

   **Joystick necessary at this point.**

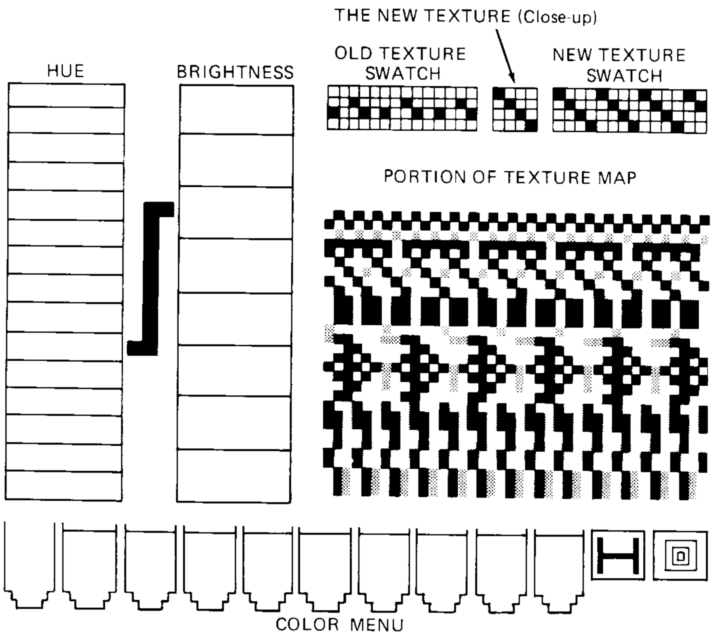
6. Hold joystick to the left and then move it up or down to change hue.

   Hold joystick to the right and then move it up or down to change brightness.

7. Press joystick button when you have the new color you want.

To resume painting, move cursor to Help space and press joystick button *twice*.

**When you have the new color you want, press P to resume painting.**




**The bar on left shows the 16 ATARI colors displayed in the currently selected brightness. The bar on right shows the available brightnesses for the currently selected colors.**

## How to select new color textures

You can change the *color* of color textures by mixing the individual colors that make them up. You can also change the patterns of color textures by scrolling through the texture map on the color menu. Here's how.

BY JOYSTICK

1. Move cursor to the color texture you want to change. (Colors 4-9) Press joystick button.
2. Press joystick button *again*. You will now see the color menu and a square "window" which appears on the texture map.
3. Move the joystick to move the "window."

   A swatch of the new texture will be shown in the rectangle in the upper right corner above the texture map. A *close-up* of this texture will be shown in the square centered above the texture map. The old texture can be viewed in the rectangle in the upper left corner.
4. To replace the old texture with the new texture you have chosen, press the joystick button.

**BY KEYBOARD**

1. **Press C and a number 4-9 for the color texture you want to change.**
2. **Press M for Mix and you will now see the color menu and a square "window" which appears on the texture map.**

   **Joystick necessary at this point.**

To resume painting, or to pick a new pot, move "window" off the texture map. It will become a regular cursor which you can move to the Help space. Press joystick button *twice*.

**To resume painting, press P.**

# No

## How to say No when asked to confirm whether you wish to erase a picture

BY JOYSTICK

1. Move the cursor to No and press joystick button.

   You will automatically return to Paint mode.

**BY KEYBOARD**

**1. Press N for No.**

*(Also see* ***Erase*** *and* ***Yes.****)*

# Circle

## How to draw instant circles

(All right, so circle doesn't begin with an O. You have to admit, though, an "O" sure does look like a circle!)

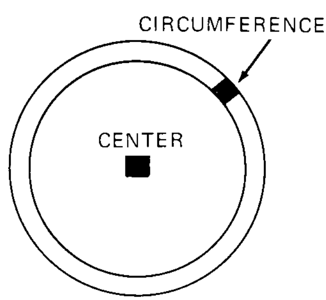
BY JOYSTICK

1. Move cursor to Help space and press joystick button to see Help index.
2. Move cursor to draw and press joystick button to see Draw menu.
3. Move the cursor to Circle and press joystick button.
4. To draw instant circles, move the cursor where you want the center of the circle to be. Press the joystick button. Now move the cursor where you want the circumference of the circle to be. Press joystick button, and presto, a circle will appear.

Circles will be drawn in the last brush width you used. Change brush width to change circle width.

**BY KEYBOARD**

1. **Press the letter O. (That's the letter that's round like a circle.)**
2. **To see Draw menu, press H for Help and press D for Draw.**
3. **Joystick necessary at this point.**



To resume painting, move cursor to Help space and press joystick button *twice*.

**To resume painting, press P.**

*(Also see **Draw, Line,** and **Rectangle.**)*

# Paint

## To resume Painting from other functions

BY JOYSTICK

1. If you *see* the word Paint on the screen, move cursor to Paint and press joystick button.
2. If you don't see the word Paint on the screen, move cursor to Help space and press joystick button *twice*.

**BY KEYBOARD**

1. **Press P for Paint.**

# Quickness of cursor

## How to change the speed of the cursor's movement when NOT painting

This lets you position the cursor on the screen at one speed and paint at another speed.

BY JOYSTICK

1. Move cursor to Help space and press joystick button to see Help index.
2. Move cursor to Speed and press joystick button to see Quickness menu.
3. Move cursor to desired Quickness number and press joystick button.

To resume painting, move cursor to Paint and press joystick button.

**BY KEYBOARD**

**1. Press Q for Quickness and a number 1-9.**

**To see Quickness menu, press H for Help and press Q for Quick.**

**To resume painting, press P.**

(*Also see* ***Speed of brush.***)

# Rectangle

## How to draw instant Rectangles

BY JOYSTICK

1. Move cursor to Help space and press joystick button to see Help index.
2. Move cursor to Draw and press joystick button to see Draw menu.
3. Move cursor to Rectangle and press joystick button.
4. To draw an instant rectangle, move the cursor to where you want one corner of the rectangle to be. Press joystick button. Now move the cursor to where you want the opposite corner of the rectangle to be. Press the joystick button, and presto, an instant rectangle will appear.

   Rectangles will be drawn in the last brush width you used. Change brush width to change rectangle width.

   To resume painting, move cursor to Help space and press joystick button *twice*.

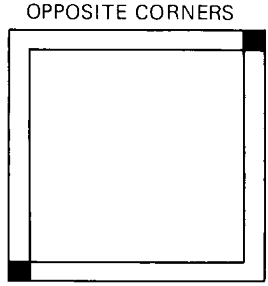
**BY KEYBOARD**

**1. Press R for Rectangle.**

**2. To see Draw menu press H for Help and press D for Draw.**

**Joystick necessary at this point.**

OPPOSITE CORNERS



**To resume painting, press P.**

*(Also see **Draw, Line,** and **O (Circle)**.)*

# Speed of brush

## How to change the speed of the brush when painting

BY JOYSTICK

1. Move cursor to Help space and press joystick button to see Help index.
2. Move cursor to Speed and press joystick button to see Speed menu.
3. Your current speed will flash.
4. Move cursor to number of desired speed and press joystick button.

To resume painting, move cursor to Paint and press joystick button.

**BY KEYBOARD**

**1. Press the letter S and a number 1-9.**

**To see Speed menu, press H for Help and press S for Speed.**

**To resume painting, press P.**

*(Also see **Quickness of cursor.**)*

# Tee-Hee

There is no T, unless you've got a cup.

# Utilities

## To gain access to Utilities and to select different disk drives

*Make sure that you have a spare disk with DOS on it for storing your pictures.*

BY JOYSTICK

1. Insert your storage disk into disk drive. If you have only one disk drive, remove the Master Disk while in Utility function.
2. Move cursor to the Help space and press joystick button to see Help index.

**BY KEYBOARD**

1. **Insert your storage disk into disk drive. If you have only one disk drive, remove the Master Disk while in Utility function.**
2. **Press U for Utilities.**

3. Move cursor to Utilities and press joystick button.

   Keyboard necessary at this point.

**3. You will be asked to select the disk drive with your pictures. If you have more than one disk drive, you must indicate which disk drive has the pictures you want.**

**Press 1 or 2.**

**Follow instructions to Get, Keep, or Junk a picture.**

*See individual listings for* **Get, Keep**, *and* **Junk Pictures**.

# Vee

Vee don't seem to have a V here. Tee hee.

# Width of brush

## How to change brush width

BY JOYSTICK

1. Move cursor to Help space and press joystick button to see Help index.
2. Move cursor to Brush and press joystick button to see brush Width menu.
3. Your current brush number and width will flash. All the brush numbers will be displayed in the currently selected width. The brush you are using will be displayed in orange.
4. To change brush width, move cursor to desired width number and press joystick button.

To resume painting, move cursor to Paint and press joystick button.

**BY KEYBOARD**

**1. Press W for Width and a number 1-9 for desired width.**

**To see Width menu, press H for Help and press W for Width.**

**To resume painting, press P.**

*(Also see* ***Brush.****)*

# X-Fill

*See listing under **Fill**.*

# Yes

## How to say Yes when asked to confirm whether you want to erase a picture

BY JOYSTICK

1. Move cursor over Yes, press joystick button.
   Picture will be erased and you will automatically return to Paint mode.

**BY KEYBOARD**

1. **Press Y for Yes.**
   **You will automatically return to Paint mode.**

*(Also see **Erase** and **No**.)*

# Zoom

## How to Zoom in and out through the two levels of Zoom magnification

BY JOYSTICK

1. Move cursor to the Zoom space and press joystick button.
2. Continue to press joystick button to move through the two levels of Zoom.

**BY KEYBOARD**

1. **Move cursor to the center of the area you want to zoom in on.**
2. **Press Z for Zoom.**
3. **Press Z again to go to the next level of Zoom.**

*You may use all the other Paint functions while in Zoom.*

## 5. "SKETCHING" PROGRAM

When typed into your computer, this special program listing will allow you to "sketch" by rotating the knobs on your paddles to move the "pen" on the screen. The listing is divided into 4 parts:

1. Basic sketching capability
2. Subsection to allow the "pen" to be lifted from the screen
3. Subsection to allow you to fill
4. Subsection to allow you to change ink color

The buttons on the paddles control erasing, filling, and the lifting of the "pen." Discover for yourself which button lifts the "pen"; when the pen is up (off the screen), the other button controls the fill. When the "pen" is down (on the screen), the other button will erase the screen. We don't want to tell you everything—this should be a challenge for you if you've never done any programming before. Here goes!

### Listing #1
### Basic Sketching Capability

First, you'll need to boot a disk of your own with DOS on it. Your paddles should be plugged into port 2. Once the computer is READY, type the following listing exactly as it appears here. Be sure to press RETURN after each line.

```
10 GRAPHICS 7+16
20 SETCOLOR 4,0,11:COLOR 0
30 X=ABS(INT((PADDLE(2)/228)*159)-159)
40 Y=INT((PADDLE(3)/228)*95)
60 SETCOLOR 0,0,4:COLOR 1:PLOT X,Y
70 DRAWTO X,Y
```

```
80 X=ABS(INT((PADDLE(2)/228)*159)-159)
90 Y=INT((PADDLE(3)/228)*95)
100 IF PTRIG(2)=0 THEN 10
120 GOTO 70
```

Type RUN and press RETURN if you want to sketch, or continue to type in the rest of the listings for the full program. The listing you have just typed prepares the screen for graphic use, establishes the grey background color, sets the x and y coordinates for the first sketching point, instructs the computer to receive data from the paddles for subsequent x and y coordinates and provides for the erasing function.

## Listing #2
## Adds the Option of Being Able To Lift the Pen Up, Move It Around the Screen, and Put It Down in a New Location.

If you typed the first listing and started to sketch, press the BREAK key and your computer should be READY for more programming. If you are typing all four sections at once, simply continue to type this listing right after the first.

```
110 IF PTRIG(3)=0 THEN FOR I=0 TO 150:NEXT
    I:COLOR 1:GOTO 200
200 LOCATE X,Y,K
210 X1=ABS(INT((PADDLE(2)/228)*159)-159)
220 Y1=INT((PADDLE(3)/228)*95)
225 IF X1=X AND Y1=Y THEN BK=1-BK:COLOR
    BK:PLOT X1,Y1:GOTO 250
230 COLOR K:PLOT X,Y
240 X=X1:Y=Y1:GOTO 200
250 IF PTRIG(3)=0 THEN FOR I=0 TO 150:NEXT
    I:COLOR 1:GOTO 120
270 GOTO 210
```

Type RUN and press RETURN if you want to sketch, or continue to type in the rest of the listings for the full program.

**Listing #3**
**Adds the Fill Option**

```
5 DIM A(2000),B(2000)
260 IF PTRIG(2)=0 THEN COLOR K:PLOT
    X,Y:GOSUB 300:GOTO 200
300 P=1:A(P)=X:B(P)=Y:COLOR 1
310 GOSUB 350:IF P THEN 310
320 RETURN
350 A=A(P):B=B(P):IF A<0 OR A>159 OR
    B<0 OR B>95 THEN P=P-1:RETURN
355 LOCATE A,B,KK: IF KK=1 THEN P=P-
    1:RETURN
360 PLOT A,B:IF P>1995 THEN RETURN
380 A(P)=A:B(P)=B+1:A(P+1)=A-1:B(P+1)=
    B:A(P+2)=A+1:B(P+2)=B:A(P+3)=A:B
    (P+3)=B-1:P=P+3:RETURN
```

Type RUN and press RETURN if you want to sketch, or continue to type in the final listing.

**Listing #4**
**Adds Ink Change Option**

```
50 INK=1
60 SETCOLOR 0,INK,4:COLOR 1:PLOT X,Y
```

Type RUN and press RETURN and you will have the full sketching program at your service.

To change Ink color, simply retype line 50, substituting any number between 0 and 15 for the number 1.

2

# HOW COMPUTERS WORK

It seems to me that there are two types of people in the world. The first type, upon hearing that this chapter is about How Computers Work, will feel a heart-pounding excitement that electrifies the senses, a surge of elation that will cause these people to rise up, beat their fists against their chest and proclaim in a Tarzan-like scream, "Lemme at it."

Their parched minds thirsting for knowledge, these people hunger for the technical scoop as if it were a Rootbeer Slurpee® on a hot August afternoon. These folks like to take things apart (enjoy varying degrees of success in putting them back together) and can often be found dissecting insects and small animals without turning green.

The second type of people in the world, upon hearing that this chapter is about How Computers Work, will close the book and feel a sudden sickening deep in the stomach. As a cold sweat envelops their bodies, these people will sink to their knees and hear voices from deep within pleading, "I can't learn this, I don't want to learn this, why should I have to learn this, I won't learn this!"

Their protestations for justified ignorance continue. "I don't have to know how my hair dryer works to use it. And you can drive without knowing how a car works. SO WHY DO I HAVE TO KNOW HOW A COMPUTER WORKS!?!??"

Thought you'd never ask. There are quite a few good reasons why you should know something about How Computers Work.

## REASON #1 TO KNOW SOMETHING ABOUT HOW COMPUTERS WORK

Nothing, with the possible exception of fire, acne, the wheel and sex, will have a greater impact on your life than the computer. It is next to impossible to think of any part of your world that *isn't* touched by computers. Go ahead, try. The morning newspaper? Typeset by computer. Classes at school? Scheduled by computer. Breakfast? Food marketed by computer, priced with codes read by computer. Walk to a friend's house? Traffic lights timed by computer. Banking, TV, medicine, business, transportation, architecture, engineering; the list of fields undergoing revolutions courtesy of the computer is enormous. Writing your boyfriend or girlfriend? Letter sorted by computer. Calling your boyfriend or girlfriend? Phone call switched by computer. Kissing your boyfriend or girlfriend? Ahhh, at last. Take that, computer.

How can you *not* know about a machine that is going to change the world and the quality of your life over the next few decades?

## REASON #2 TO KNOW SOMETHING ABOUT HOW COMPUTERS WORK

Knowing a bit about computers will make it easier for you to use a computer, to understand and correct your errors, to make the computer work for YOU. You won't feel helpless if something goes wrong. Like most anything, the less you know, the less you can do and the less you can imagine doing. The more you know, the more you'll be able to do.

Sure, you can drive a car just by learning how the controls work, the brake, the gas pedal, the steering wheel. But knowing the mechanics of a car's operation can help you to keep it in better shape, which in turn will make it safer. Knowing how a car works inside and underneath will help you to be a more skillful driver since you'll understand the limits of the machine.

## REASON #3 TO KNOW SOMETHING ABOUT HOW COMPUTERS WORK

The basics of How Computers Work are simple. Prove to yourself that you're not. Prove to yourself that you can understand something you thought you couldn't. That always feels good.

So here we go.

A computer is an absolutely amazing machine that can accept and manipulate information. Data, such as names, addresses, lists, 0's and 1's, or a's, b's and c's becomes *information* when it is organized for human purposes and understanding. The computer will take the information you give it or PUT IN (INPUT) and then compare, sort, combine, correlate, organize, equate, eliminate, change, substitute, store, transform or otherwise PROCESS the information in order to PUT OUT (OUTPUT) the results you want. This all happens at superhuman speeds with incredible accuracy.

But how does the computer know *what* to do with the information?

The computer will know what to do with the information *ONLY* if a human being has already given it a set of *instructions* and predetermined procedures that tells it what to do. This set of instructions is known as the PROGRAM. The program must be told to the computer in a language the computer can accept and understand.

You can't just walk up to a computer, put your arm around it and say, "Hey, computer baby, I want you to take the list of names and addresses I gave you last week and tell me all the people who live on streets named for trees," or, "Hey sweetheart, how about painting?" Instead, you have to use a *computer program* to give those instructions. This is what computer programmers do. They program, or give instructions to the computer in one of the many specialized languages developed for computers such as PILOT, APL (A Programming Language), BASIC

(Beginner's All-Purpose Symbolic Interpretive Code), COBOL (Common Business Oriented Language), or FORTRAN (Formula Translation). Inside the computer, these instructions or source-codes are translated into what is called MACHINE CODE, which is the most precise and fundamental language understood by the computer. Now it would be quite a nuisance if you had to type a program everytime you wanted to use the computer. Luckily it's possible to store instructions on what is called a *disk*. In the same way that inserting a scroll of paper tells a player piano what music to play, you can insert the disk in the computer to tell the computer how to behave.

So, now you've given the computer the program which tells it how to act. How does information then get processed? How does the computer remember things?

The secret of a computer's incredible ability to process information is that it can count to one. You heard me, it can count to one. It can detect the absence or presence of an electronic impulse. If the impulse is absent, the computer counts zero (0); if the impulse is present, the computer counts one (1). These impulses can be transmitted at speeds close to the speed of light through the circuitry of the computer and can be stored in banks of switches that are tripped either off (0) or on (1). These switches make up the memory (RAM, standing for Random Access Memory) and can send electronic impulses again and again when asked to do so.

So the computer can count to one. Big deal. How does that help me to understand how it works?

Well, here's how. The computer uses a Binary Numbering System. You're already familiar with the Decimal System which counts from 0 to 9 in the units or ones column and then, if you add another digit, carries to the next position to the left, which is the tens column. The "ones" column starts at 0 again. In the Binary System it's just the same except you count from 0 to 1 and then carry. Adding a one to a column will reset it to 0 and carry 1 to the next column to the left. Each column is stated in terms of powers of 2 rather than powers of 10.

So we have a computer that can register 0 or 1 in the form of electronic impulses that are either off (0) or on (1). And we have a numbering system that can represent any number by strings of 0's and 1's. By inventing a *code* in which patterns and sequences of 0's and 1's in the form of electronic impulses stand for letters, numbers and symbols, it is possible to communicate with the computer.

Circuits within the computer translate the electronic code from the off/on language the computer can understand to the words and numbers you see on the screen. This interaction between human language (which we understand) and the bits (binary digits, 0's and 1's which the computer understands) is what allows man and machine to communicate with each other.

But how does the computer DO IT?

Let's divide the operation of a computer into three aspects mentioned before: INPUT, PROCESSING, and OUTPUT. All computers have to be able to accept information. Devices which allow a human being to give information to the computer are called INPUT devices. These include joysticks, punch cards, video cameras, data-tablets with electronic pens, and typewriter-like keyboards that enable you to communicate with the computer. No matter what INPUT device is used, the information is translated by the special circuits mentioned earlier into binary codes the computer can work with.

The information is then processed according to a program's instructions by the grand and glorious CPU (Central Processing Unit). There is no computer without the CPU. It is the "guts" of the computer. The CPU is an incredibly tiny, complex component of computer circuitry that receives its directions from the program and, in a manner similar to a traffic cop, initiates and controls the flow of information (traffic) through the system. This information, which, you'll remember, is in the form of electronic impulses, traveling near the speed of light, is processed under the direction of the CPU in the computer's Random Access Memory (RAM, also known as core). The CPU may also have to call upon information that is not in the Random Access Memory. This information is stored on magnetic media such as *disks* outside of the computer itself. These disks can be inserted in the disk drive when the computer needs to access (get) their contents. Data is transferred from the disk (storage) into the RAM (memory) as the computer needs it.

After the information is processed it gets transformed from the binary code back into understandable characters and is displayed on the video monitor. These results of the computer's work are known as OUTPUT. OUTPUT devices present the information to the human in the form of paper printouts, visual displays on the CRT (cathode ray tube or TV screen), sound, or stored information filed on disk.

You'll hear a lot about memory when people are talking about computers. There are two types of memory: RAM (Random Access Memory) which is the active, high-speed "working" memory of the computer itself where processing occurs, and ROM (Read Only Memory) cartridges, on which data can be removed and stored outside the computer. Programs and data can also be stored outside the computer on disks or cassettes which increases the computer's storage capabilities by a tremendous amount; the trade-off is that disk-stored information takes longer to access than ROM data.

The amount of RAM is a major determinant of a computer's capabilities and cost. If a computer has more RAM, it can run larger and more complex programs. Think of the shelves you have in your bedroom as Random Access Memory. The books on them are instantly available, they're part of your "system" and in seconds you can find any information you want. But there's going to be a limit to how many shelves you can have in your room. You need to choose carefully which books to have on your shelves, in your personal library or RAM. But let's say you need access to some information that you don't have on your shelves (RAM). Then what do you do?

Fortunately, there are public libraries (like disks) with thousands of shelves available to store more books. Only trouble is that it'll take you a little longer to get to them, just like it takes longer for the computer to get information off the disks. But you will be able to find material in the public library that you couldn't keep at home. In a similar way you can store all sorts of programs and data not needed at a given time on the disk.

While disks are an important method of external storage, it is also possible to store material outside the computer on cassettes, ROM cartridges (for Read Only Memory), punch cards, magnetic tapes and hard disks. Each of these has different advantages and disadvantages in terms of expense, storage capacity, longevity and speed of access. Hard magnetic disks look like shiny, metallic LP records, and the more flexible, floppy disks resemble 45-RPM records (***PAINT*** is on a 5-inch floppy). Both are covered with magnetic material which holds the on/off bits of data that can be read by a phonograph-like "arm" that moves in the disk drive. The arm can move to the desired spot (sector) on the disk to get the information requested.

So, let's summarize everything you now know about How Computers Work. A computer is a machine that...

1. Accepts information (INPUT)

2. Processes information in RAM as patterns of electronic impulses under the direction of a CPU (PROCESS)

3. Prints, displays or stores the results (OUTPUT)

4. According to a pre-determined set of instructions, (PROGRAM).

Ta-da!! That wasn't so hard, was it?

Now you have a general understanding of How Computers Work. Let's take a look at what's going on in there when you ***PAINT***.

Suppose you painted a picture of a mountain landscape. The computer doesn't hold mountains and meadows and forests in its memory (RAM). Instead, the computer only remembers individual pixels (picture elements). You recall pixels, they're the tiny rectangles (up to 12,800 of them) that you see on the ATARI ***PAINT*** screen.

The computer remembers what color each pixel was painted and stores that information as a number in a register, which is a bank or group of on/off switches. Whether all the colored pixels add up to a picture of a tree or a chilidog is no business of the computer's. The bits stored in memory are sent to the video display screen by a special microprocessing unit which translates them from the computer's memory into a form that can be understood and accepted by the video screen. The inside of this picture screen is coated with red, green, and blue phosphors that glow in different combinations when hit with electrons. A special "gun" in the TV scans the entire screen every 1/30 of a second, "shooting" a stream of electrons at the phosphors that make up each pixel. The glowing of red, blue, and green phosphors will create the perception of various colors. The combinations of pixels create the complete picture you see on the screen and reflect the contents of the computer's memory. Of course, it's not quite as simple as all this, but you don't really need to know much more to use and enjoy ***PAINT***.

## THE MYTH ABOUT COMPUTERS

Mention the word computer to some people and they look like they've just seen a ghost. To these people, computers are cold, rigid, impersonal, dehumanizing, ruthless, scheming, relentless machines that take sadistic pleasure in putting people out of work, destroying their privacy and fouling up their bills. Furthermore, these machines want to TAKE OVER THE WORLD. Any day now you can expect to look up from the breakfast table to see a leather-jacketed gang of computers pull up your driveway, storm into your house through the kitchen wall and announce (in a sinister, perfectly modulated but slightly nasal tone), "Okay, we're taking over here, NOW!"

You may be surprised to hear that some people feel this way. You've grown up with computers and have probably spent countless hours enjoying computer games and marveling at the many things a computer can do. You're aware of the miraculous breakthroughs made possible by the computer in the fields of science, education, entertainment and medicine which have saved lives, increased man's knowledge and added to the quality of his life. Seems strange, doesn't it, that some people would have such a hostile feeling towards computers.

Well, there are reasons a lot of people don't like computers. By giving you an idea of how some of these negative myths might have developed, I hope that you'll become an ambassador of computer goodwill. If you should run into someone who doesn't like computers, talk to him, provide some facts, and maybe you'll be able to show that computers aren't bad, they're just machines.

Yup, a computer is a machine, nothing more, nothing less. Like any machine, it follows the instructions of the human beings who use it. If *we* operate according to values that celebrate freedom, art, love, trust, individuality and generosity, the computer can share in and help us act upon such pro-life goals. And sadly, if we operate according to values that glorify power, greed, control, money and deceit, the computer can be made to work toward those ends as well. The computer does our bidding. We can use it to save lives or destroy lives, to share wealth or hoard wealth, to enhance the resources of nature or plunder them.

If you don't like the way a computer is being used, don't blame the computer, blame the people or blame the society. You wouldn't fault the typewriter if someone sent you a nasty, typed letter, would you? Now that you have an idea How Computers Work you realize that human beings control every single action and use of a computer. Perhaps the computer has become the scapegoat for ways in which humans have decided to use it.

How have other aspects of the computer's identity developed? A lot of it has to do with people's attitudes toward machines in general. Many people don't understand machines. They are intimidated by a machine's complexity and feel a sense of powerlessness should something go wrong that they can't fix. This lack of knowledge can make people hostile toward machines. People fear what they don't understand and computers are no exception. The situation has probably been made worse by the amount of specialized language, or jargon, associated with computers— bits, bytes, RAM, core, raster graphics, CPU, pixels, algorithms. Computer people have developed their own language, one that is practically incomprehensible to the layman. You almost get the feeling that some computer folks want it that way.

What has contributed to the sense of mistrust and fear some people feel toward computers? I think it's a general ignorance of computers combined with the degree to which some computer professionals have tended to create a "secret" body of inside information that only they know.

Television and movies haven't helped much either. While computers behind the scenes are often responsible for some of the most dazzling effects you'll ever see on TV, the computers in front of the cameras are often in the hands of the bad guys. These evildoers with their armies of computers are able to threaten to destroy New York City unless $1,000,000,000 ransom is paid in unmarked, one-dollar bills. In the movies anyone intent on ruling the world, obliterating space colonies or turning the entire human race into two-headed chickens often has winking, blinking banks of computers. In fact, James Bond usually finds it necessary to destroy the enemy's computers well before he gets around to the enemy. It's easy to forget that these computers only do what people tell them and are not inherently good or bad. How sad to think of all the movie computers that have lost their (ahem) lives because of an evil programmer.

Another reason for the negative image computers have might have to do with the ways in which they are scapegoated for human failings. The computer becomes a symbol for the sense of frustration people feel when they are unsuccessful in their dealings with a corporation or bureaucracy. In point of fact, the computer makes it possible for much faster and more personalized service in many areas of life. However, when a problem occurs, the computer becomes a handy excuse, as if it had a mind of its own. Rather than place the responsibility for a problem on the programmer, or the computer operator, or the corporate policy that determined a procedure, you'll find people blaming the computer.

Sometimes, though, the computer does deserve the blame. Computers are extraordinarily complicated and sensitive machines. Like any high-technology product, they *can* break and they *can* cause problems. "Our computers are down," you'll hear, which means you can't make your airline reservations or do your banking or find out the asking price for a share of stock. When this happens, people get angry and frustrated.

There are also companies that have become so dependent upon computers that personalized service has disappeared. (It makes you want to fold, mutilate and spindle the company!) Customers feel devalued and ignored; it seems impossible for them to deal with other human beings—the computer has all the information. If the computer malfunctions or loses a customer file, it could take months to sort everything out. Every time this happens, the computer may make another enemy.

I think you can see how there are two sides to computers. On the one hand, computers *have* created a depersonalization in many aspects of our society, and they *have* caused frustration, anger, confusion and feelings of powerlessness in many people. They *have* been used in some cases to diminish the quality of human interaction, to facilitate social and corporate policies that devalue the individual human being. And they do break down and go haywire from time to time. However, on the other hand, computers *are* miraculous machines that have improved the quality of life for millions of people. Computers save time, save money and have opened vast domains for human exploration. Computers can help people achieve their noblest ambitions.

You can find good and bad in just about anything and the computer is no exception. But the most important thing to keep in mind is that computers are first and foremost, just machines, fantastic machines that follow human instructions. Some of the instructions computers are following these days are given to them by artists. Throughout history, people have used the technology of their time to create new art forms. In the next chapter, *Cave to Computer*, you'll begin to get a better understanding of the relationship between a society and its art. Onward!

3

# CAVE TO COMPUTER

Art is probably responsible for causing more arguments than hair length, homework, allowances and bedtimes combined. What is art? What isn't art? What is good art? What is bad art? You'll hear about the art of cooking, the art of loving. Is cooking art? Is loving art? Then there are the liberal arts, the performing arts, the forgotten arts, the art of medicine, the art of politics and the artful dodger. What's art? What's an art? Let's ask an artist. What's an artist? Should we ask an artistic soul? Or perhaps just someone with an artistic temperament. Is the art of one culture art to another culture? What creates change in art? Why did man of the 18th century "see" differently from man of the 3rd century B.C.? Humans have had the same set of eyes for thousands of years. Is a painting of a Campbell's® soup can art? Is the soup can itself art? Is a sunset art? Is a painting of a sunset art? Is a photograph of a sunset art? If it's computer-generated, is it art? If a tree falls in the middle of a forest and there is no one around to hear it, did it make a sound? If a painting hangs on the wall of a darkened and deserted gallery at three in the morning with no one to see it, is it still art?

Yes, no, yes, yes, maybe, hmmm, I don't know, could be, yes, no, no, yes, yes, kind of, oh, who knows?

Indeed! Who knows? The arguments get going when one person says, "I know, it's like this," and another person says, "No, it isn't, it's like *this*," and yet a third proclaims, "Uh uh, you're both wrong, *this* is how it is."

Well, let's see if we can get a few things straight for the purposes of this chapter. There are no absolute answers. There are probable answers and there are generally agreed-upon answers. There are widely held theories and narrowly held theories. There are best guesses and scholarly conclusions. There are eminent art historians in sound agreement on one point and violent disagreement on another.

Perhaps the confusion can be softened if you think of some of the similarities between art and love. Both have been around for thousands of years and (if we can keep from blowing each other up) will be around for thousands more. Both art and love seem to spring from basic needs deep within the evolution of man; needs such as food to nourish the body, shelter to protect from the elements, sex to reproduce the species, and love and art to nurture, ignite and satisfy the spirit.

Both art and love are hard to define but we know they exist. Both have sustained humans through times of suffering and despair; both have caused suffering and despair. Both vary in expression and form in response to the history, values and technology of a given culture. Both have led man to create life and destroy life, to dedicate, to sacrifice, to become obsessed, to commit crimes. Art and love have been studied, researched, documented and sung to; yet, in the end, the only definitions we can accept seem broad and hazy, definitions large enough to accommodate everyone's interpretation but too large to define it for you or me. Ultimately, art, like love, is something you have to experience for yourself, know for yourself, and define for yourself.

You are about to paint, you are about to express yourself as an artist, you are about to work with a new medium that suggests new art forms and breakthroughs in the flow of art history over the centuries. History is something we think of as being in the past. Yet there are moments when you sense, when you know, that the present will prove to be of enormous historical significance, whether in six weeks, six years or 600 years. The possibilities of computer painting suggest just such a moment. You and your ***PAINT*** program may influence the evolution of art just as much as the French Revolution or the fall of the Roman Empire did.

This chapter is not meant to give you answers nor to teach you about art. Rather, its purpose is to give you a context, to help you create your own sense of what art is, to get you arguing and involved.

The word *art* originates from the Latin (doesn't everything?) word *ars*, and means skill, way, or method. Over time, however, the meaning has evolved to one that emphasizes aesthetic enjoyment, appreciation through the noble senses of sight and sound. Thus art is not intended to be functional; its function or purpose is to please and stimulate the senses and the intellect.

Does that definition mean that art can't be functional, that if something can be used for a purpose it can't be art? Here come the arguments. Is architecture art? After all, buildings have a purpose and you just said art doesn't have a purpose except to please and stimulate the senses. What about ancient pottery? Pots just hold water and wine. That's functional. But many pots have exquisite and elaborate designs painted on them. Are they not art?

It all depends on *how* an object serves its purpose. Did an artist conceive and create an object just to do its job or does it go beyond that? Let's say an architect is asked to design an art gallery. He designs a boxy sort of building with a lot of wall space for paintings, courtyards for sculpture, and puts in all the necessary offices, bathrooms, giftshops, workrooms, plumbing, heating, and air-conditioning. The building serves its purpose, but it doesn't do much more. It's not ugly, but it doesn't really say "Hey, look at me." It doesn't affect people's thoughts and feelings—it's just there. Most people would say that the building is not art.

On the other hand, let's say a different architect is asked to design the same art gallery. He, too, satisfied all the practical requirements of a gallery. But at the same time he gave a life and beauty to the building itself. Visitors feel something when they walk in—a sense of space and light that awakens the senses, quickens the heartbeat and soothes the soul. Magical interplays of pink granite and glowing sun, shadows and reflections, structural virtuosities that dazzle the imagination. This building also displays art, but it does it in such a magnificent way that something has been added to the experience, an aesthetic stimulation and enjoyment. This building, while serving a function, addresses the human senses in a conscious and direct manner. Most people *would* call this building art. See Figure 1 on the next page.

Similarly, pottery that just holds water would not be art to most people. But pottery that has been painted or shaped or glazed to hold water in a beautiful, aesthetic and original way is art. It's the difference between saying, "Ho, hum, I'm just pouring myself a drink from this vessel whose function is to hold water," (not art) and saying, "Holy Giotto, here I am pouring myself some water from this gorgeous pitcher that knocks me over with its beauty and intricacy of design. Would you look at those colors, and that handle, oooh, it feels so good just to hold it in my hands! WOW, are my senses titillated."

I'd say a Campbell's® soup can is not art. Some of my friends say it *is* art. How about a painting of a Campbell's® soup can? What would you say?

It should also be pointed out that whether you like an object, a painting, a building, what have you, isn't the point. It's not art if you like it and not art if you don't. (Try saying that a hundred times fast!) Art is either art or not, it is either affecting your senses and intellect or not. A powerful work of art is bound to please some and displease others. Whether a painting compels you to love it or hate it, you're responding to it as art.

Well, what if I punch you in the face? That affects your senses, is that art? Or what if I light off a stink bomb

**FIGURE 1.**
**Exterior View of the Solomon R. Guggenheim Museum.**
*Photo: Robert E. Mates. Architect: Frank Lloyd Wright. The Solomon R. Guggenheim Museum, New York.*

In the center of New York City, the Solomon R. Guggenheim Museum is a building that does more than just house art.

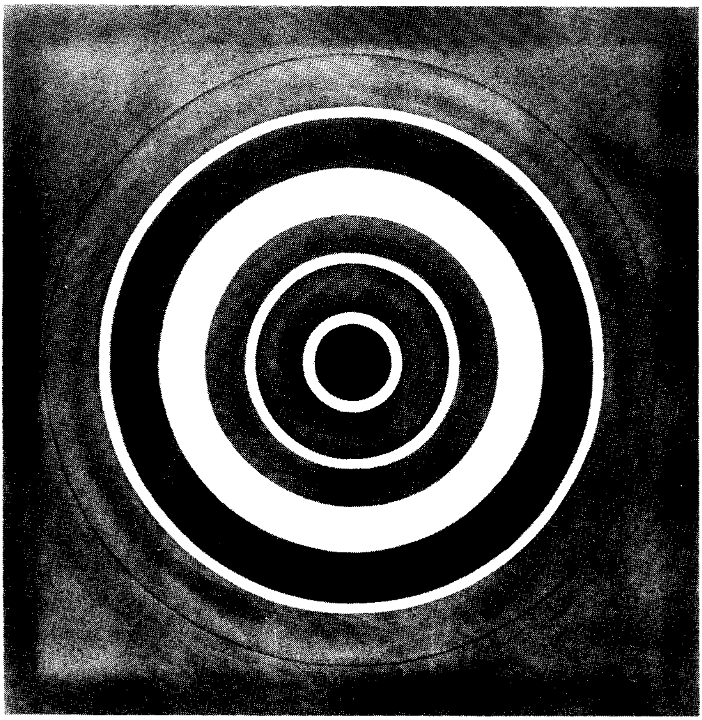


**FIGURE 2.**
**LOTUS, Kenneth Noland, 1962.**
*The Hirshhorn Museum and Sculpture Garden, Smithsonian Institution, Washington, D.C.*

No, this is not a dartboard! It is a painting by one of the leading figures in contemporary 20th century art. How do you react to it?

in your house? That affects your senses too, is that art?

Oh, for goodness sakes. I guess I forgot one other component. You have to use common sense; you have to look at the work, the motivations of its creator, the era in which it was produced, the permanence or repeatability of the object, then make an *intelligent* decision for yourself. So, pipe down, take a seat and keep reading.

**FIGURE 3.**
**Album of Flowers, Birds, Insects, and Fish, by Chu Ta, 17th century, Ch'ing Dynasty.**
*Courtesy of the Freer Gallery of Art, Smithsonian Institution, Washington, D.C.*

The careful handling of the brush and the delicate nature of this handscroll are quite contrary to the heavy frames and canvases of much European art. What does this example of zen brush painting say to you about the philosophy of the 17th century Chinese people?

If you read the introduction (and if you didn't you'd better go do it right now) you may be getting tired of hearing me refer to computer art as a new form, a new development in the centuries-old evolution of art. But it is and your enjoyment of ***PAINT*** and your understanding of art and history will be much greater if you have a sense of how art forms change and develop.

Think about the different styles of painting. Why would art reflect religious motifs for centuries and then suddenly (relatively speaking) shift from spiritual content to scenes of common man and everyday life? Why is it that up to the 20th century art was representational, that is, it depicted recognizable things—people, landscapes, animals, historical events, and then, perhaps for the first time, in the 20th century, many people started to paint non-representational, non-objective, or abstract art? What accounts for changes such as these? Why would one culture paint royalty and another paint peasants? Why would one culture delight to portraits and the next thrill to still lifes of fruit and flowers? Why would one society express its art on vases, and another on walls and ceilings? Why, why, why?

The history of art is a reflection of the people, values, beliefs, experiences and technologies of societies over centuries of time. Similarly, the art of one particular culture can be seen as a mirror of that culture—its gods, its pleasures, its fears, its forces, its scientific advances.

One *can* trace evolutions of art. One can see the relationship between art and politics, art and war, art and religion, art and technology, art and artists, art and morals, art and economics. One *can* draw many interesting and undoubtedly accurate conclusions. But, a word of caution: art is a living force.

Art is the summit of mankind's creativity, which embodies all of mankind's visions, realities and relationships. Art is all that is conscious to man and all that is unconscious. Any force so powerful, so continuous and so living can be explained and quantified only up to a point. Human creativity is far too dynamic and unpredictable to be labeled and interpreted according to any single formula.

Think of a child for a moment. It seems obvious that the development of children will reflect the world in which they grow. The people close to children—parents, teachers, siblings, friends—and the environment close to children will have a recognizable impact on their lives. The degree of peace, creativity, tension, failure, love and stability surrounding children will influence their lives just as markedly as genetic makeup, health, and nutrition. But, there are always going to be exceptions. There are children who will rise from the most sordid, unloving, and decayed environments to lead warm, rich lives. There are children who will come from the most generous, creative, and intelligent families who lock the world out and lead lonely, despairing lives. There's a point at which all the theories of psychology, education, biology, and child-raising don't provide the answers. There's a point at which children's actions simply defy the rules. Their behavior doesn't fit the known patterns; there is no logical explanation. You can only say, "Beats me. I guess we just don't know."

And so it is with art history. When all the theories and explanations are explored, when a cause-effect relationship proves accurate time after time, something will happen that breaks the mold and you get to a point where you can only say, "That's not it, there's got to be some other reason." You'll look at a painter or a school of art and say, "How do you account for *that*?"

Sometimes, you can't. You can't because you're dealing, whether in the case of a child or the history of art, with life, the life of a single individual or the life of a culture. Fortunately, humans with their infinite creativity defy categorization. But that doesn't mean we can't try now and then.

Let's take a speed-of-light flight through centuries of art history to get a sense of the relationship between art and the society that produces it, art and the technology of the time, art and the values and beliefs of citizens of the culture.

We'll start with cave paintings since you can't go back any further than that. People painted on the walls of their caves as far back as 30,000 B.C. (Just to show you how much has changed, try painting on your living-room walls and see what happens!) This type of cave painting is representative of the medium known as *fresco*. A "medium" is basically what you're using to create the art. Medium originally referred to the pigment ground to a powder which was the source of color in paints, but in modern usage the word medium has expanded in meaning to include not only the pigment but the vehicle by which it is held together and thinned (such as oil), the surface on which you're painting, and the tools and techniques used. Anyway, back to the cavemen.

Animals and hunting, certainly a major focus of the caveman's life, were the subjects of many early cave paintings. These paintings were often hidden deep in the caves, accessible only by narrow, twisted passageways. There is reason to believe that these remote, painted chambers were used for ceremonies of ritual and magic. Signs and symbols appear consistently in many cave paintings, suggesting an early form of visual communication. Pigment, such as blacks from bone and charcoal, or browns from clay earth, was ground to a powder and mixed with water to form early paint. Feathers, frayed twigs, and fur pads were used as "brushes." Black sticks of wood charcoal were also used for drawing. Clearly this art reveals its society. It shows what the caveman knew best, survival and hunting. While his tools were as primitive as his life, the caveman used them to create astonishingly skilled works of lively, rhythmic art.

Moving right along, we get to the early Egyptians. They believed that the human soul would live if the body were preserved, and statues and art work relating to one's life were placed in the tomb. Only the pleasing aspects of life were carried to the graveside, therefore, Egyptian art showed people at their best, without warts or faults, engaged in joyful eating, fishing, dancing, singing, hunting.

When you think of Egyptian art you probably think of rigid figures looking lifeless and artificial. And well you should, for to our eyes, the figures do look rigid and lifeless. Why might that be? Does the lifeless quality reflect the fact that much art was meant for tombs, for the dead? Did the Egyptians not "see" people the way we do now? Why didn't the Egyptians give air and space and light to the figures in their paintings? Why did it take thousands of years for a sense of perspective and distance to develop in painting?

Perhaps the Egyptians did see and feel their art to be full of life. Perhaps the Egyptians weren't striving for reality as we conceive of it. Perhaps it wasn't important to them. Perhaps they responded to their depiction of reality in an excited and uplifted way. What might someone 3000 years from now think of our culture if shown some abstract art consisting of paint thrown at canvas? It makes you wonder.

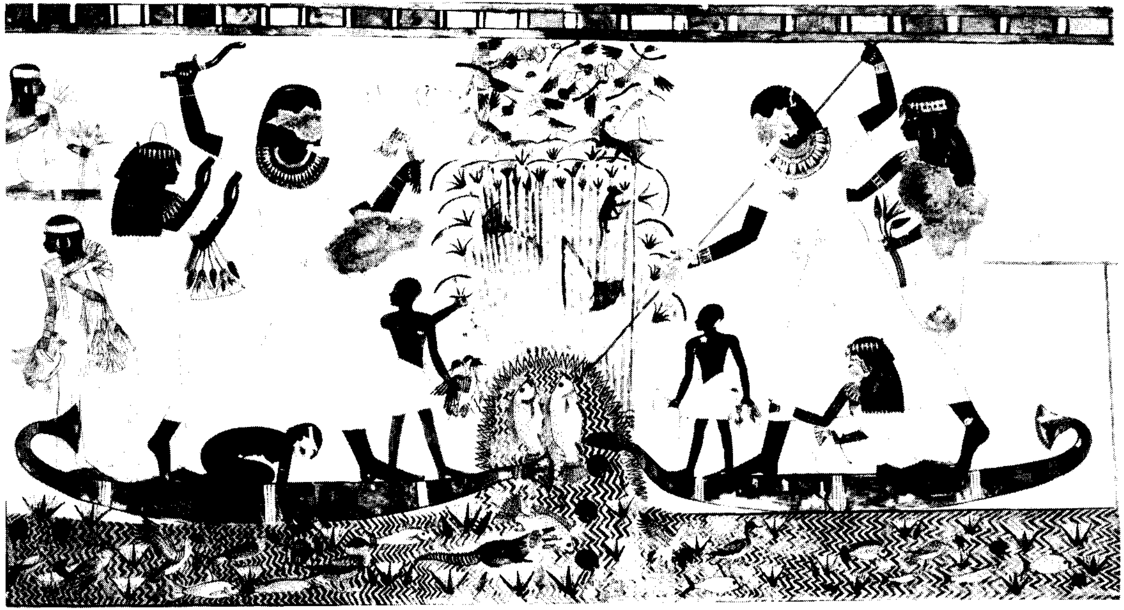


**FIGURE 4.**

**Wall Painting: Fishing and Fowling, Dynasty XVIII Thebes. Copy in tempera from the Tomb of Menena, Scribe of the Fields of the Lord of Two Lands. (c. 1914)**



The Egyptians often glorified everyday events like fishing and hunting by painting them on the stone walls of their tombs.

**FIGURE 5.**
**Ngaady a Mwaash Mask from Kuba, Zaire.**
*National Museum of African Art, Eliot Elisofon Archives. Photo: Eliot Elisofon.*

Painted African masks, like this one glorifying the first Queen of Kuba, are worn by men of the Kuba tribe in ritual ceremonies.

While the history of painting leads to a focus on Greek, Roman and Western European societies, many different civilizations throughout the world were creating art based on the customs and people of the land.

African art represented scenes from tribal life and ritual—art to ward off evil spirits, art to glorify a princess or queen. Elaborate and terrifying masks were created for religious ceremonies.

Sometimes, two cultures located thousands of miles from each other would share similar art forms and technologies even though no evidence exists to suggest contact between the two. Such is the case with a method of casting employed by the Ife artists of Nigeria. This method of creating heads and busts, using wax, molten metal and clay molds, is similar to one invented by Bronze Age man in the Mediterranean world of antiquity. It's quite possible that each civilization made this discovery independently, taking advantage of the available tools and technology at the time.

The art of the North American Indians was of enormous variety; baskets, tepees, shields, clothing, pottery, carved figures and sand painting were produced. Many of the complex, colorful, geometric designs painted on tepees and woven into blankets bear striking resemblance to 20th century abstract art. Like African art, the art of the Indians reflected the magic of tribal traditions and ceremonies and was most often found in ancient temples and burial chambers.

The ancient Greeks loved animals and nature. The Mycenaeans hunted and fought, and the art of the time is full of battle scenes, bulls and mythological creatures pursued by brave warriors. As Greek civilization evolved into the mightiest and most advanced of its time, changes can be found in its art. The Greeks worshipped many gods, each god overseeing a different aspect of human life: Ares, the god of war; Aphrodite, the goddess of love. The development of strong and separate Greek city-states encouraged competition to see which state could have the most beautiful temples adorned with the most beautiful art. Gods and Greek myths were the subject of the statues and paintings

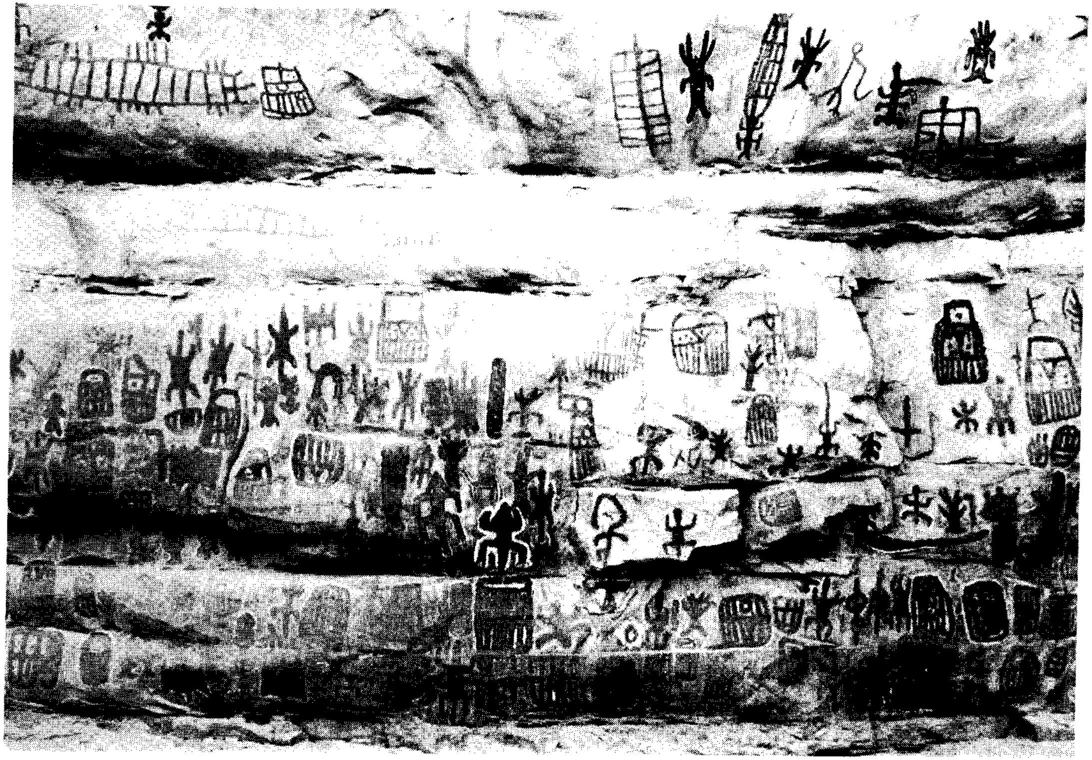


**FIGURE 6.**
**Rock Art from Dogon, Mali.**
*National Museum of African Art, Eliot Elisofon Archives. Photo: Eliot Elisofon.*

**Rock Painting is still practiced in Africa. This cliff in Mali is ceremoniously re-painted periodically as a ritual honoring the passage into male adulthood.**

**PLATE 1.**
**INVITATION TO THE SIDESHOW,**
**Georges Pierre Seurat, 1887–88.**



Our eyes blend Seurat's many different and separate points of color to create one solid, vibrating impression. (Refer to Chapter 3.)

**PLATE 2.**
**THE OLIVE ORCHARD,**
**Vincent van Gogh, 1889.**
*National Gallery of Art, Washington.*
*Chester Dale Collection.*

Repeated brushstrokes and unusual color create a scene which can affect the viewer in an intense and disturbing way. (Refer to Chapter 3.)

**PLATE 3.**
**CHILD WITH BLOND HAIR, Auguste Renoir, 1895-1900.**
*National Gallery of Art, Washington.*
*Ailsa Mellon Bruce Collection.*

Renoir used color to create the impression of light, leaving little need for exact detail. (Refer to Chapter 3.)

**PLATE 4.**
**WOMAN WITH AMPHORA AND POMEGRANATES, Henri Matisse, 1952.**
*National Gallery of Art, Washington.*
*Ailsa Mellon Bruce Fund.*

Matisse combines cutouts of solid color to create a precarious balance. (Refer to Chapter 3.)

**PLATE 5.**
**STAIRS IN THE ARTIST'S GARDEN,**
**Pierre Bonnard, c. 1935.**
*National Gallery of Art, Washington.*
*Ailsa Mellon Bruce Collection.*

You can experiment with color. Ironically by using vibrant color, Bonnard has created a peaceful garden. (Refer to Chapter 3.)

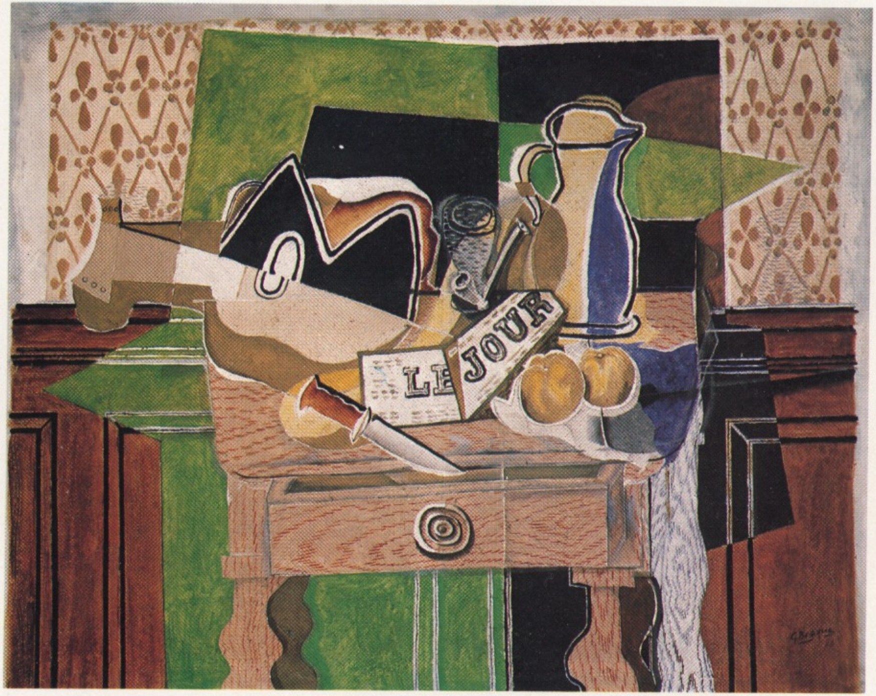



**PLATE 6.**
**STILL LIFE: LE JOUR,**
**Georges Braque, 1929.**
*National Gallery of Art,*
*Washington.*
*Chester Dale Collection.*

Braque uses distorted combinations of everyday shapes. How does that make you feel? (Refer to Chapter 3.)

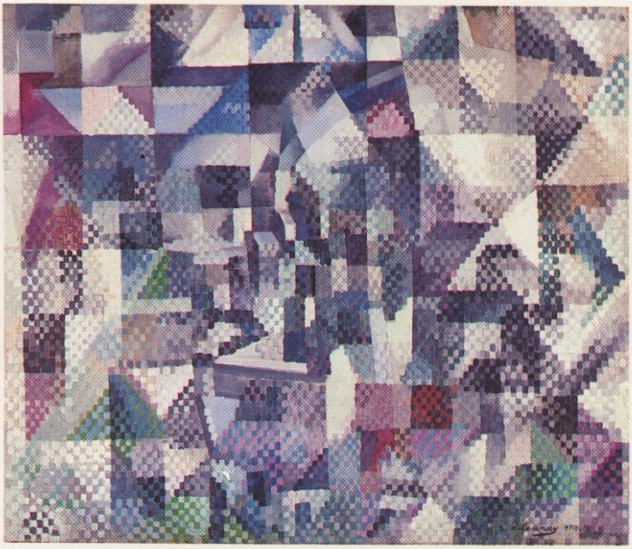


**PLATE 7.**
**WINDOW ON THE CITY,**
**NO. 3, Robert Delaunay, 1911-12.**
*Photo: David Heald.*
*The Solomon R. Guggenheim Museum, New York.*

Power to the pixel! This painting was made decades before the first computer screen. Isn't it amazing how "computer-like" the tiny squares of color look? (Refer to Chapter 3.)

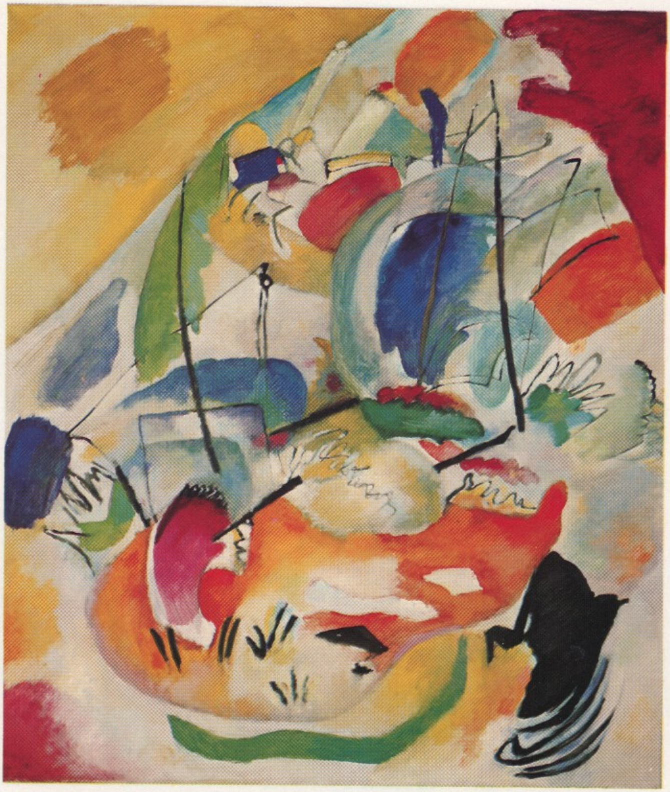


**PLATE 8.**
**IMPROVISATION 31,**
**Wassily Kandinsky, 1913.**
*National Gallery of Art, Washington.*
*Ailsa Mellon Bruce Fund.*

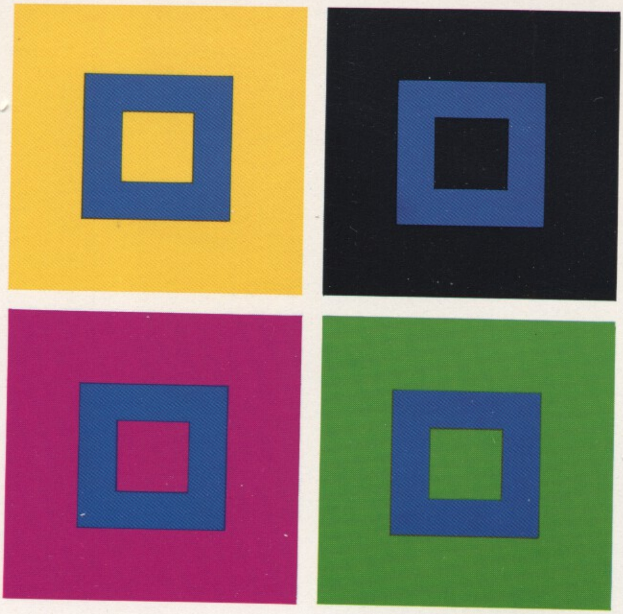
Kandinsky lets go of everyday images. He explores how color and line can create emotions perhaps stronger than that of a real image. What do you think? (Refer to Chapter 3.)

**PLATE 9.**

**From THE ART OF COLOR**
**by Johannes Itten.**



Itten taught the foundation course at the Bauhaus School in Germany. He encouraged his students to experiment with the basic elements of their art so that they could actually master each of those elements. Here is an experiment with the color blue and how it can appear to change when it is combined with opposite colors. (Refer to Chapter 3.)



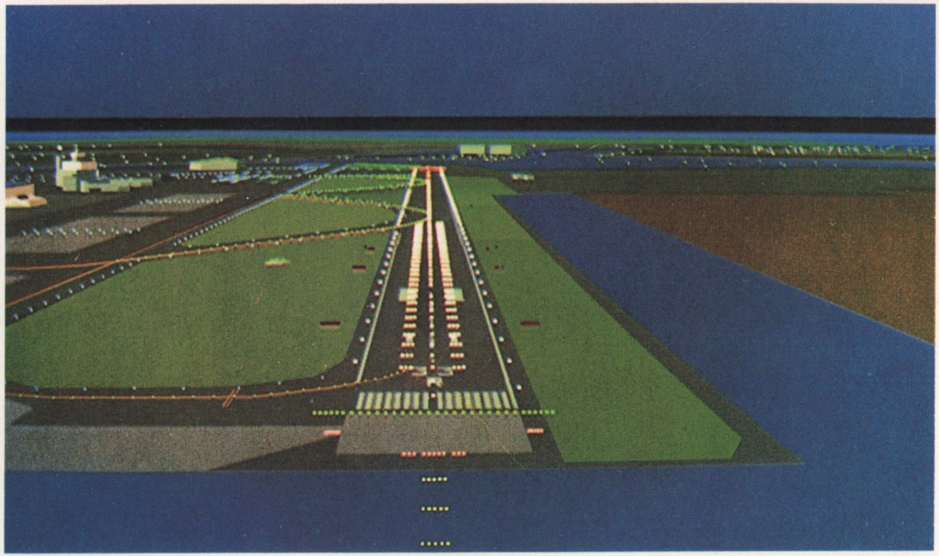


**PLATE 10.**
**Flight Simulator.**

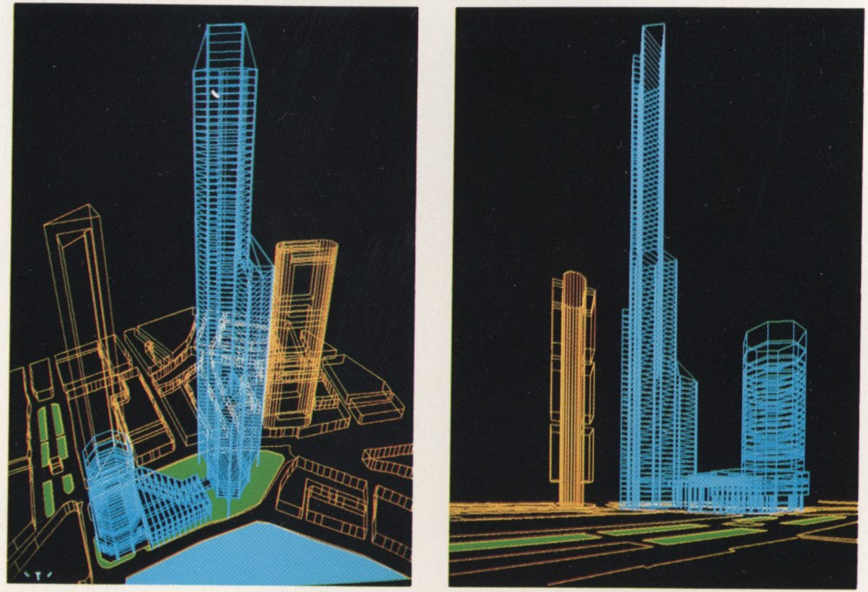


It's hard to believe that this realistic airport scene is created by computer and will change as the pilot "flies" the flight simulator. (Refer to Chapter 4.)

**PLATE 11.**

**Architecture Simulation.**

*Copyright ©1981. Reprinted, with permission, from "Computer Graphics and the Practice of Architecture" by Donald R. Fullenwider and James P. Lefever appearing in* IEEE COMPUTER GRAPHICS AND APPLICATIONS, *Vol. 1, No. 4, p. 19, October 1981.*



The same buildings can be re-drawn by computer to show how they would look from different vantage points. (Refer to Chapter 4.)

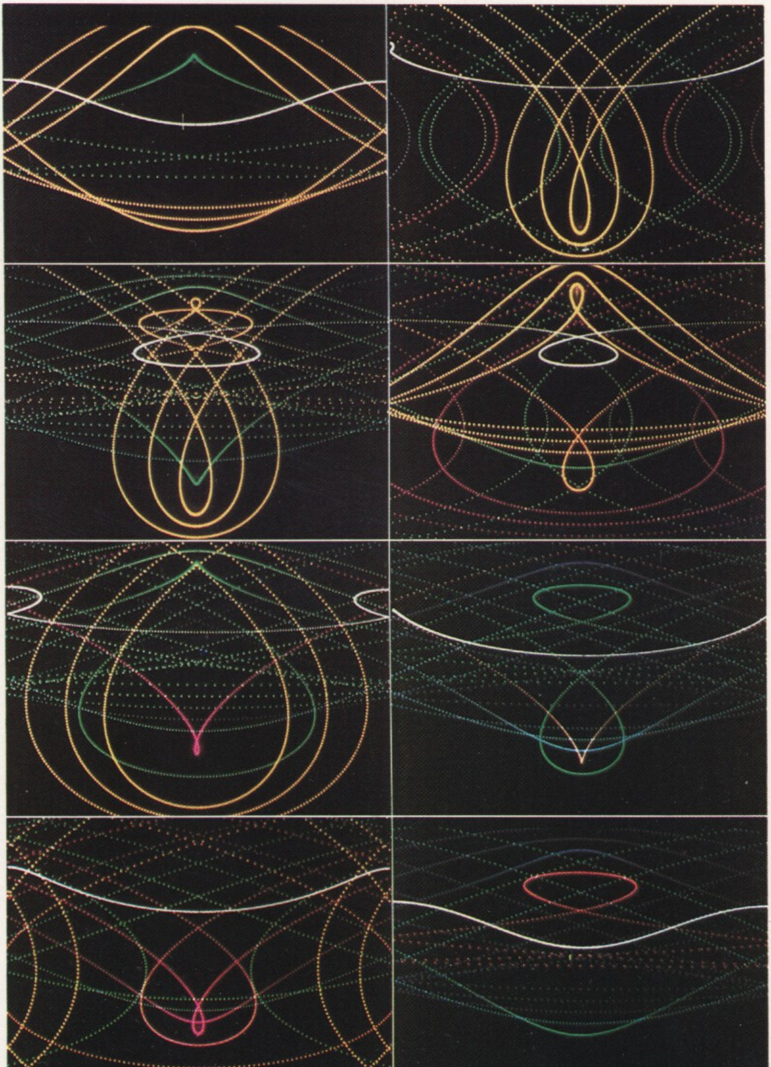

1 6
2 7
3 8
4 9
5 10

**PLATE 12.**
***(opposite)***

**From *Arabesque*,**
**John Whitney, Sr.**

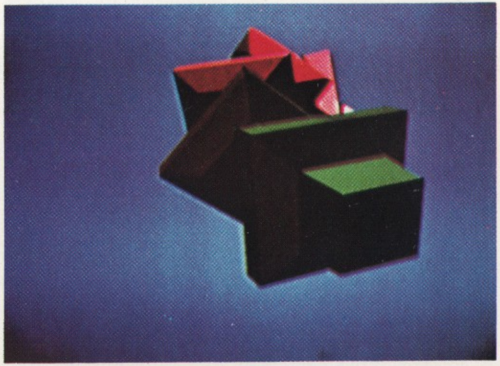
*Reprinted with permission of BYTE Books, from* DIGITAL HARMONY, *by John Whitney, Sr.*

A sequence of still photographs from Arabesque, a movie by computer artist John Whitney, Sr., shows how changing light and color create rhythm. (Refer to Chapter 5.)

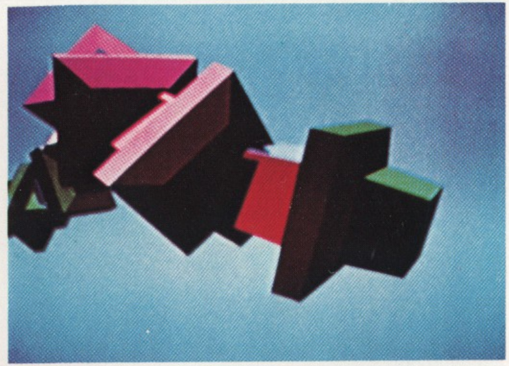

**PLATE 13.**



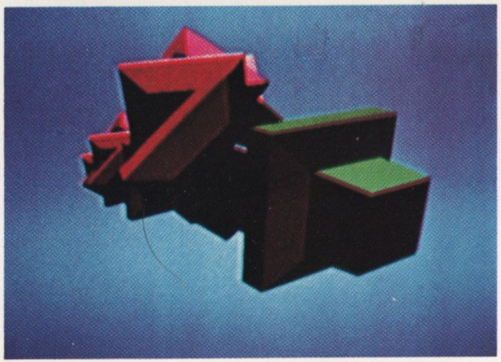
Computer graphics can achieve many different three-dimensional effects. (Refer to Chapter 4.)



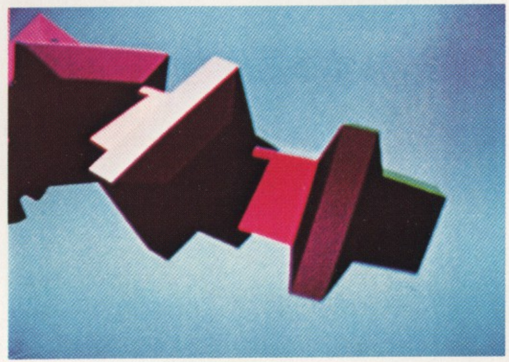
1



4

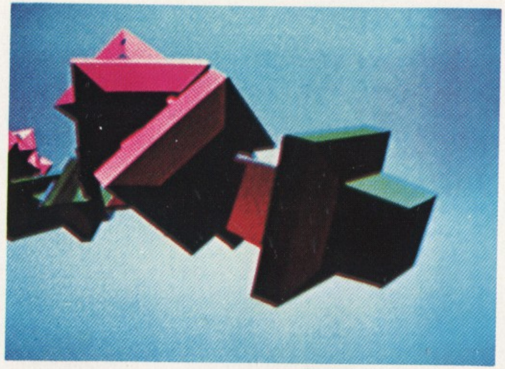


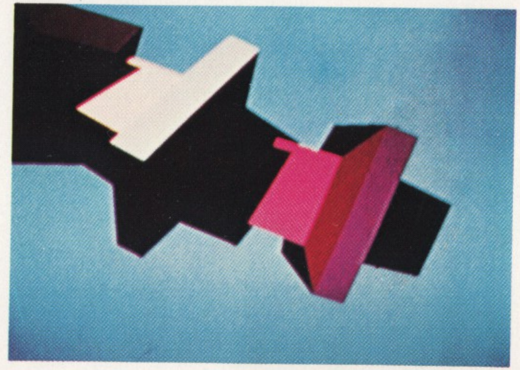
2



5

3





6

**PLATE 14.**

**From *Curious Phenomena.***
*Computer Programming by Richard Weinberg,*
*Realized by Stan VanDerBeek.*

The artist no longer attempts to imitate light; now he paints with light. These still photographs from the film ***Curious Phenomena*** show the transformations a solid object makes as it moves through space. (Refer to Chapter 5.)


**PLATE 15.**
**New York Subway.**
*Created from the Digital Effects paint system, "Video Palette" by Mark Lindquist and Digital Effects Inc.*

This painting of "writing of the wall" was created from a computer paint system. Quite a step from a cave painting! (Refer to Chapter 4.)

**PLATE 16.**
**Mt. Fuji.**
*Drawn by Aurora Systems artist Damon Rarey on an Aurora/100 Video Graphics System installed in Tokyo in October 1981.*

This painting of Mt. Fuji in Japan was painted on a microcomputer paint system. Do you see any resemblance to the Chinese brush painting in Chapter 3? (Refer to Chapter 4.)

of this classical period of the 5th century B.C. The Greeks' love of beauty, and particularly the beauty of the male form and the athlete in motion, was glorified in brilliantly painted marble statuary.

As the Greek city-states declined, fewer great temples were built. Rather than make statues of flawless gods and swift athletes, artists spent more time creating works of art for private homes and gardens. Art began to reflect everyday life instead of idealized god-figures. Young people became favorite subjects for sculptures, and the simple activities of a child's life were portrayed: a boy removing a thorn from his foot; a girl playing with an animal. As artists experimented with new subject ideas, the portrait came along. For the first time, an attempt was made to show people as they really were.

The light of Greek civilization faded and the vast Roman Empire spread across Europe. (Told you this would be a fast tour.) Roman conquerors brought vast treasures of Greek art back to their homeland with them. Statues were displayed in temples, public squares, and private dwellings. Roman artists copied the Greek art, adapting it to their own purposes. Military conquests were relived on vast marble reliefs, and colorful paintings covered the walls of many homes in what would now be Italy. As Rome's influence spread, so did its art, and you find artists in what are now Spain and France working in the tradition of Roman art, which itself grew from Greek contributions.

The Roman empire began to crumble (so soon?). It was hard to keep such a huge empire united in days of slow communication and transportation. Barbarians, envious of the great wealth of the Empire, began to attack towns along the borders of the Empire's domain. It became harder and harder for the Romans to defend themselves and the Empire disintegrated. The most powerful landowners in each town began to accumu-

**FIGURE 7.**
**Foot Race, detail.**
**Greek-Attic, Late VI Century.**


The Greeks often painted on buildings and pottery. This foot race shows the importance that Greek society placed on athletics, physical grace, and beauty.

late more and more power, and the medieval system of feudalism developed. As the unity and glory of the Roman empire dissolved, art, too, suffered a parallel transformation.

The turmoil of life, the advent of new languages and customs brought by the Barbarians, and the feudal society structure meant that fewer people were being educated by the state; the value placed on art by the culture diminished.

The Church, however, grew in importance, causing religious education and art to thrive. Gothic cathedrals were built with each one trying to outdo the next in height, in lightness of structure, in decoration, and in art. These magnificent buildings were adorned with reliquaries, crowns, staffs, murals and sculptures of religious significance. The art of stained glass work reached its height at this time.

In 1341, Petrarch, a humanist poet and scholar, suggested that the Barbarians might be on the way out and that a rebirth of secular art and creativity might be around the corner. In 1451, a Florentine humanist named Manetti wrote an influential work entitled *On the Dignity and Excellence of Man.* Manetti disagreed with those Medieval theologians who denigrated man's worth in the eyes of God. Instead, Manetti proposed that man was really hot stuff, that there wasn't anything man could not do with his intelligence, creativity and beauty. "The world was created, not for God who had no need of it, but for man."* This represented to many a new way of thinking, and not surprisingly,

---

*Hartt, Frederick. *ART: A History of Painting, Sculpture, Architecture.* Vol. II, p. 24. Englewood Cliffs, N.J.: Prentice-Hall, Inc.; New York: Harry N. Abrams, Inc., 1976.

**FIGURE 8.**
**THE ADORATION OF THE MAGI,**
**Fra Angelico and Fra Filippo Lippi, c. 1445.**
*National Gallery of Art, Washington. Samuel H. Kress Collection.*

You can see how 15th century people viewed Christianity as they flock to see the son of God.

was embraced by many who liked the idea of being dignified and excellent in the eyes of God.

By this time a number of other not too insignificant events had taken place. The Crusades had opened people's eyes to the treasures and adventures of the East. Increased explorations and trade created new towns and a demand for skilled craftsmen. Curiosity was piqued, and the unification of Europe under the Church brought a relative level of stability and education to the society. A great age of learning and rebirth of cultural values and excitement emerged out of this combination of historical factors and personalities. You may have heard of it as the, ta-dah... RENAISSANCE.

People's confidence and horizons expanded with a new sense of worth and a revived interest in the world. This contributed to the rise of *nationalism*, where people in Europe developed feelings of allegiance to the land, language and customs of the area where they lived. Regional pride and identity caused "schools" of art to appear where artists and styles could readily be associated with a given place.

As you might imagine, the arts flourished. Increased trade created increased wealth; national pride encouraged a sort of cultural competition. The Church was no longer the only patron of the arts; instead, wealthy nobles wanted to support the arts, to bring the best painters to their city, to hang the best paintings in their homes. Guilds of artists formed, apprenticeships taught young children to paint. Art reflected the learning and lust of people feeling their oats. Religious and epic subjects continued to dominate, although portraits of rich families and noblemen became favorite subjects as well.

Out of this climate, where beauty, learning and art were valued so highly, came such extraordinary figures as Leonardo da Vinci, Raphael and Michelangelo. Their work was treasured by their society; Michelangelo, by age 20, was the most renowned artist in all of Italy. The Pope even threatened to attack Florence if the Florentines did not send the young painter to the Vatican to work for him. (They sent him.) The Renaissance celebrated the triumphs of human creativity and intelligence. The society valued pleasures of the eye, the ear, the mind, and the flesh; increased economic wealth supported a class of artists and craftsmen whose work reflected the power of the ruling classes and the important role

**FIGURE 9.**
**SAINT GEORGE AND THE DRAGON, Raphael, 1504-1506.**
*National Gallery of Art, Washington.*
*Andrew W. Mellon Collection.*

The legend of St. George and the dragon comes alive in this painting by one of the masters of the Italian Renaissance.

of the Church, and, at the same time managed to thrill the common person. It is no wonder that the Renaissance launched an explosion of scientific, artistic and geographical discoveries rarely seen in the history of mankind.

As time passed, the distinct schools of art, reflecting more particular aspects of a local or national culture, grew stronger.

Out of the north of Europe, in what are now the Netherlands and Belgium, came Rembrandt and Peter Paul Rubens. It is interesting to look at the development of their work to see how two men of similar background could produce such different art. Both Rubens and Rembrandt grew up in wealthy environments, were well-educated, and enjoyed early and immediate success as painters. Both married beautiful young women and produced families; both purchased magnificent homes and filled them with fine furniture and art objects.

The happiness and security Rubens found in his life can be seen in his work. Rubens' huge canvasses burst with action and vivacity; they were full of light, vigorous action and brilliant colors. Rubens had an immense studio and his many assistants and apprentices helped him to keep up with the demand for his work.

The Dutch, who were more interested in fine portraits than the huge historical scenes Rubens painted to decorate churches and palaces, quickly adopted Rembrandt as the portraitist in Amsterdam. But, the early success and happiness Rembrandt enjoyed began to change over time. He grew tired of painting the beautiful and the wealthy, the titled and the powerful. He wanted to portray human life, including the suffering, the mystery, and the shadows. He found beauty and depth of human experience in the old, the simple, the lonely. As his own life filled with tragedy, Rembrandt no longer cared about the trappings of success. What meaning was there in money and fine clothes when those you love are dying? He began to paint the despair and sadness of human experience with the same passion that Rubens painted

**FIGURE 10.**
**Self Portrait, Rembrandt van Ryn.**
*COPYRIGHT THE FRICK COLLECTION, NEW YORK.*

This self portrait of Rembrandt shows how he layered paint upon paint to produce surprising light from within a shadow. What does his expression tell you about him?

his works of happiness, indulgence and triumph. By the time Rembrandt died, he was a poor old man who painted essentially for himself since the public was no longer interested in his work. People did not want to be reminded of the misery and suffering that surrounded them; they wanted art to be a source of inspiration and pleasure.

Rembrandt's later work did not reflect the needs of his culture and was ignored. However, his painting did address *his* needs, and he produced what many consider some of the greatest art of all time. The psyche and emotions of one man, one master, one Rembrandt, who painted to satisfy himself, influenced the course of art as profoundly as the psyche of an entire culture. Rembrandt's work, born out of his sense of despair, became a benchmark for many artists who followed.

The Church and the ruling classes endured as the primary patrons of art; paintings continued to glorify royalty and religion. However the disparity between the wealthy few who abused their powers and lived in isolated splendor and the poor masses became too great for containment. The King of France grew more unpopular as living conditions worsened for the French citizens. Tensions multiplied and the seeds of revolution were planted. By 1789 the peasants and middle class of France rebelled and the French Revolution resulted in the beheading (ouch) of Louis XVI and Marie Antoinette. The leisurely lifestyle and incredible riches of the aristocracy disappeared from French society. Napoleon came to power and France set out to reconstruct its society after the model of the Roman Empire. Art, architecture, furniture and clothing imitated what the French thought was "Roman" and a style called *Empire* was born. David, the most famous painter of the time, when not painting portraits of Napoleon and subjects of his court, painted scenes from classical Greek and Roman history and mythology. Once again art continued to echo the social and political upheavals of a society.

After the fall of Napoleon, another revolution occurred in French art that reflected the newer, more democratic form of government. The aristocratic classes no longer

**FIGURE 11.**
**THE GIRL WITH A RED HAT, Jan Vermeer, c. 1660.**
*National Gallery of Art, Washington.*
*Andrew W. Mellon Collection.*

Vermeer was a younger and less respected contemporary of Rembrandt. His delicate, almost photographic treatment of light put his style ahead of its time.

demanded art for palaces and great public buildings, and the middle class filled the void as patrons. The people of the middle class could forget the tedium of their lives by hanging a quiet village landscape on the walls of their houses. Pleasant country scenes and peasant-life replaced royalty and epic moments as the subjects of much painting. At the same time France was flooded with tales of adventure from faraway lands in North Africa and the East that had recently been opened to exploration. Colonists and explorers described an exciting and romantic life in these little-known parts of the world, and a new style of painting known as *Romanticism* grew out of these yearnings for travel and romance. Great moments of history, vivid scenes from the lives of Arabs, and swashbuckling adventurers became the subjects of the Romantic painters, one of the greatest being Eugene Delacroix.

Once again, the dreams and realities of a society helped to shape the expression of its art. Delacroix died in 1863. In the next 100 years, art forms would change more than they had over the thousands and thousands of years since the first cave paintings. The speed with which these changes occurred was phenomenal, perhaps mirroring the awesome speed with which so many aspects of life changed during this period. All of a sudden, the subject of a painting didn't matter; a painting could consist of lines of color, bursts of paint. For the first time in the history of art, people began to paint non-representational art, art that was not a portrait, a battle scene, a religious event, art that did not have a recognizable subject. How did these monumental changes come about?

Strangely enough, a number of painters wanted to make art *more* real, to show (more) exactly what the human eye sees. They also felt that the only worthy subjects for a painting were scenes from everyday life. These painters were not interested in posed figures or mythical events. They wanted to paint glimpses of human life, moments of time caught on the canvas. Gustave Courbet worked in this manner. He brought sunlight and candid life to his art, thus inspiring many young painters. One of them was Edouard Manet. Manet also wanted to capture sunlight and color above all else. He noticed the nature of light and natural color; he recognized that the eye combines thousands of colors at a glance to create the appearance of a solid color. He knew that if you looked at a tree you'd see green leaves and a dark brown trunk. But upon closer examination, you'd see that the leaves are not all green, instead hundreds of different colors combine to form an overall impression of green. Similarly, the tree limbs that appear to be a solid dark color include hundreds of shades of browns, black, yellows, green and white that appear solid to the eye. Manet painted everyday scenes in which he used strokes of many colors to create the overall impression of the reality he sought.

Manet and Monet, Renoir, and Degas were known as *Impressionists* because they tried to create an "impression," a glance, a glimpse of real life by putting light and colors together. Thousands of distinct colors and brushstrokes merged into one realistic impression of life that the eye could recognize as a little girl with a watering can, or a dancer, or a pastoral landscape. By painting colors instead of objects they achieved a greater degree of reality in their work than many artists who strived for precision and exactitude of a likeness. (See color plates 1 and 3.)

It is interesting to note that the Impressionists' work was originally rejected by the public and the critics. It was so new and different that people laughed, taunted and refused to exhibit the work. Only over time was this work accepted and its style adopted by a new generation of painters.

The painting of the Impressionists gave liberty to a group of artists to experiment even more with light, color, brushstroke and composition. Painters like Cezanne, Van Gogh and Gauguin realized that the "impression" of a painting came, not so much from the precision of an outline of the exact realism of a subject, but from the shapes, colors, and designs used to represent the subject. In their efforts to heighten the realism of a scene they sometimes distorted a figure, used an unexpected, unreal color or employed a tortured and twisted new brushstroke. (See color plates 2 and 5.) Other painters wanted to emphasize the emotion of their work; they were more interested in the *feeling* a viewer got from their painting than in the correctness of the likeness. It didn't matter if the water were red and orange, if a face were purple, if the details of clothing were omitted; what mattered was the emotional response triggered by the painting. These painters were more interested in the reality of a viewer's reaction to their work than they were in the realism of their work.

This attitude was carried even further by artists such as Kandinsky, Braque, and Picasso. Maybe it wasn't necessary to have a recognizable subject at all. Perhaps emotions could be stimulated by colors, by design, combinations of light and dark, movement and change. Perhaps paintings of shapes, colors, patterns and textures could provoke feelings just as powerful as those aroused by "real" subjects. (See color plates 4, 6, and 8.)

This experimentation led to what is known as abstract art, where the artist paints his vision of a "subject," mood or feeling without representing anything recognizable. Abstract art broke many accepted rules and launched the tremendous artistic explorations of the 20th century: the Bauhaus, surrealism, pop art, op art, minimal art, conceptual art. (See color plate 9.)

Whew, let's catch our breath for a minute and see what this all means. First of all, it *is* possible to look at the evolution of art and see how it has been influenced by the history, values and technologies of different societies. A society that worships gods will paint gods, a society rooted in epic myths will record those myths in its art. A society unified around one god and

**FIGURE 12.**
**SUCCESSION,**
**Wassily Kandinsky, 1935.**
*The Phillips Collection, Washington, D.C.*

**Here is a good example of how our emotions can be stimulated by figures that seem to move and change. How does this painting make you feel?**

**FIGURE 13.**
**CONVERSATION AMONG THE RUINS, Giorgio de Chirico, 1927.**
*National Gallery of Art, Washington.*
*Chester Dale Collection.*

Just a painting of an ordinary everyday conversation in a room with no walls in the middle of nowhere. Like Dali and other surrealist painters, de Chirico used common scenes to create uncommon realities.

religion will find itself reflected in paintings that represent those beliefs. A society that glorifies the beauty of the male form will paint male figures, and a society that celebrates female beauty will paint female forms. The degree to which art is supported or controlled by the church, the wealthy, the aristocratic or the middle class will be reflected in the subject matter of paintings of that culture. Societies of hunters painted animals and hunt scenes; great conquerors wanted their triumphant battles immortalized in art. Wars, trade and explorations brought new stimulation to lands and their artists, allowing the art of one region to influence that of another.

Societies of stability, wealth, and unity were able to place their resources behind the development and glorification of art; societies in turmoil and disintegration were not. When people were full of life, lust, learning and spirit, so was their art. The art of one age helped to create the art of the next. One painter, or school of painters, would experiment with a new form, a new use of color, a new interpretation of reality, which in turn provoked the next generation of artists to embrace and continue or sometimes to reject and abandon a style.

Integral to the evolution of art are the technological discoveries and capabilities of an era. As technology expanded possibilities, painting became more and more flexible, portable and reproducible. The earliest paintings were on cave walls, or marble temples or church ceilings. Paintings became somewhat more portable when artists started to paint on wood panels. After all, you couldn't exactly move somebody's ceiling from town to town.

Egg tempera and oil paints brought a greater range of color and technique to painting. The use of canvas made paintings more durable and portable. A canvas painting could be rolled up, brought to a different city,

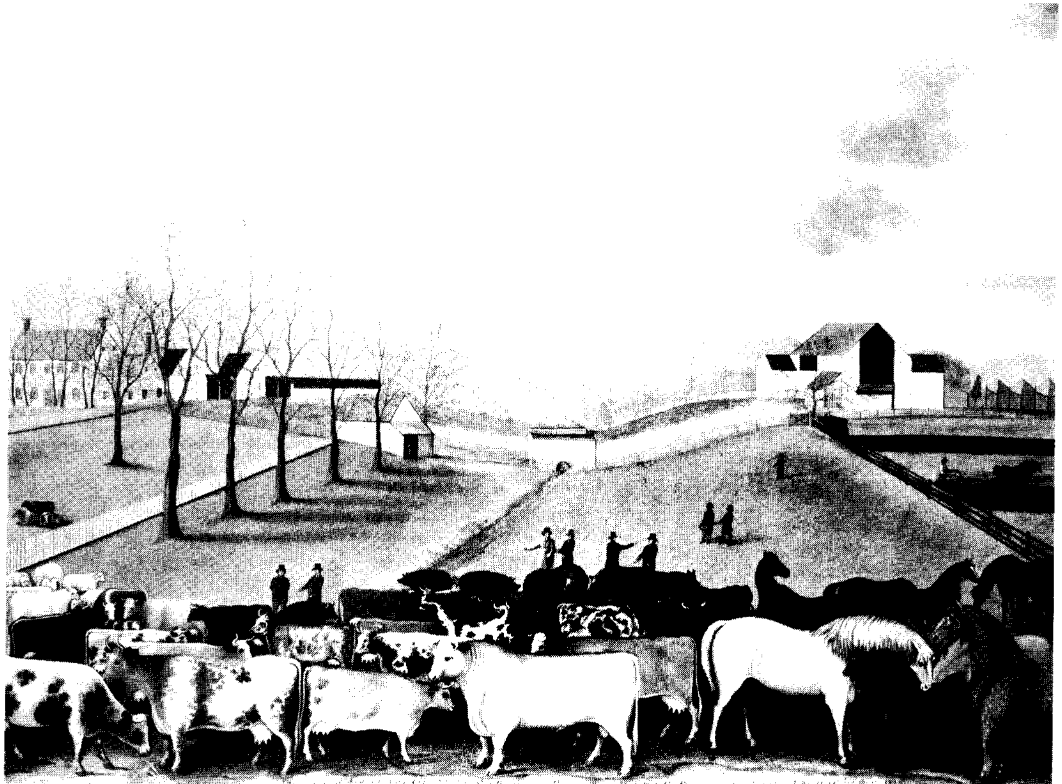


**FIGURE 14.**
**THE CORNELL FARM,**
**Edward Hicks, 1848.**
*National Gallery of Art,*
*Washington.*
*Gift of Edgar William and*
*Bernice Chrysler Garbisch.*

**Look closely to see a primitive view of the prevalence and importance of agriculture in early America.**

and reframed without any damage to the paint. In fact, the huge, heavy gilded frames you see on many old paintings were intended to discourage theft just as much as they were meant to provide a "window" for viewing.

The development of trade routes made it easier and cheaper to obtain pigment for paints. The advent of large-scale manufacturing of paper in Italy and Germany in the 1300s undoubtedly contributed to the popularity of etching and prints. The development of bright, quick-drying acrylics in the 20th century certainly influenced painting techniques as artists experimented with this new medium.

Surely a flow can be traced through time which says a lot about how and why painting evolved to where it is today. There is a continuum, but it has many starts and stops, periods of dramatic change and periods of relative inactivity. You can see how the whole of a culture affected its art as well as how one single, visionary painter could affect the course of art history.

The experience and vision of one generation teach the next; one society's experiments and discoveries provide new and more enlightened vantage points for those who follow. In the same way that the experiences of a child build from day to day so that he can understand and see what was visible yet incomprehensible to him years earlier, the collective experiences of an entire culture add up over the years so that those who come later see and understand more.

So, here we are in the 20th century, We're smack in the middle of the art "history" of our own age, which makes it hard to draw any final conclusions. It does seem, however, that the pattern of interaction between art and society continues. The 20th century has seen an explosion of technology that has transformed life. Electricity, telephones, airplanes, TV, newspapers, and satellites have altered forever our

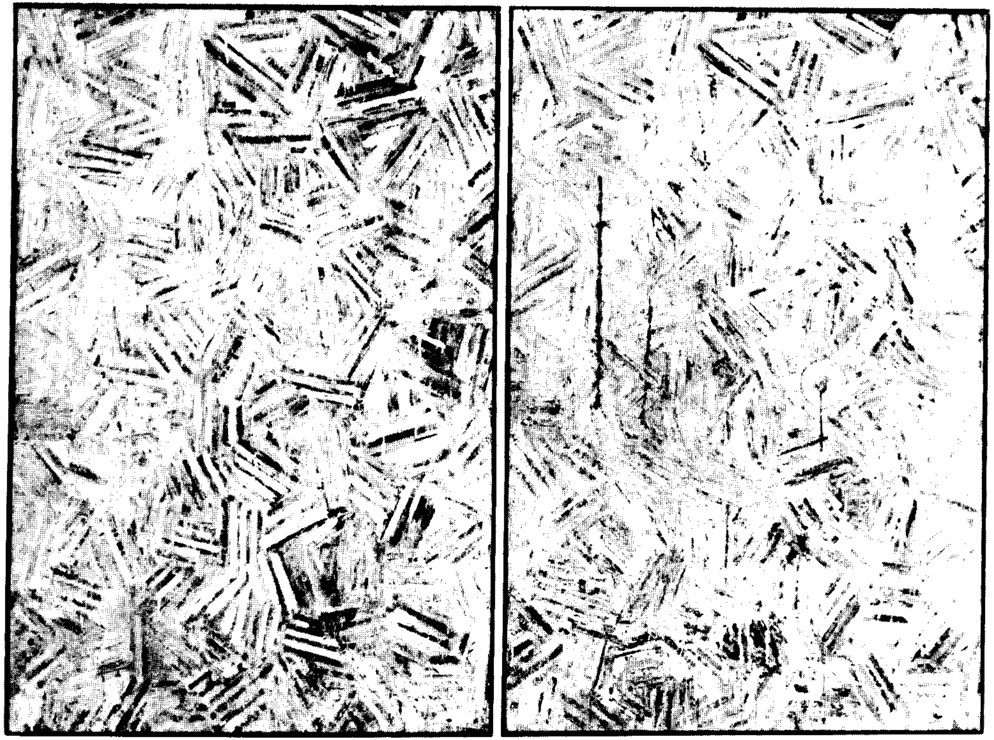


**FIGURE 15.**
**THE DUTCH WIVES,**
**Jasper Johns, 1975.**
*PHOTO COURTESY OF LEO CASTELLI GALLERY, NEW YORK.*

Like Rembrandt, Jasper Johns uses layers of paint in a new way to create light and shadow. He even mixes his paint with wax to give it a new texture. How does this painting make you feel?

perception of the world. Concepts of time and distance have changed as it becomes possible to fly across the Atlantic in three and a half hours, to speak with someone on the other side of the globe within seconds, to watch as an assassination or wedding takes place thousands of miles away. The access people have to information, to current events, to tools and skills has opened options beyond comprehension. Life is fast, changeable, more controllable and more uncontrollable than ever before. We enjoy greater health than any society, yet we live with the knowledge that we could be caught in the nightmare of nuclear war at any moment. Life has become slam, bang, rich and full, intense, mobile, dynamic, instant, disposable, recyclable, experimental, individualistic. We can barely keep up with the pace of the dramatic history unfolding before us.

What of our art? Perhaps the breakneck pace of invention and movement in our age is echoed by the enormous diversity and suddenness of change in 20th-century styles and art forms. Art has become fast, individualistic, bold, cathartic, personal, technological. The growth and pain and flexibility of our civilization can be seen in our art. And now we have the computer and computer art—the next step in the evolution of painting. (See color plate 7.)

Is computer-generated art a new art form? Absolutely. There are bound to be people who will disdain computer art, who will jeer just as loudly as those who mocked the Impressionists, who will say it's not art. New ideas take time to assimilate. Many great paintings and new styles of art were rejected at first.

It only seems appropriate that a culture so thoroughly linked to technology and machines should create art with the ultimate machine of our times, the computer. The computer is an artist's tool. Instead of a chisel, a brush, a stick or a trowel, the artist paints with a

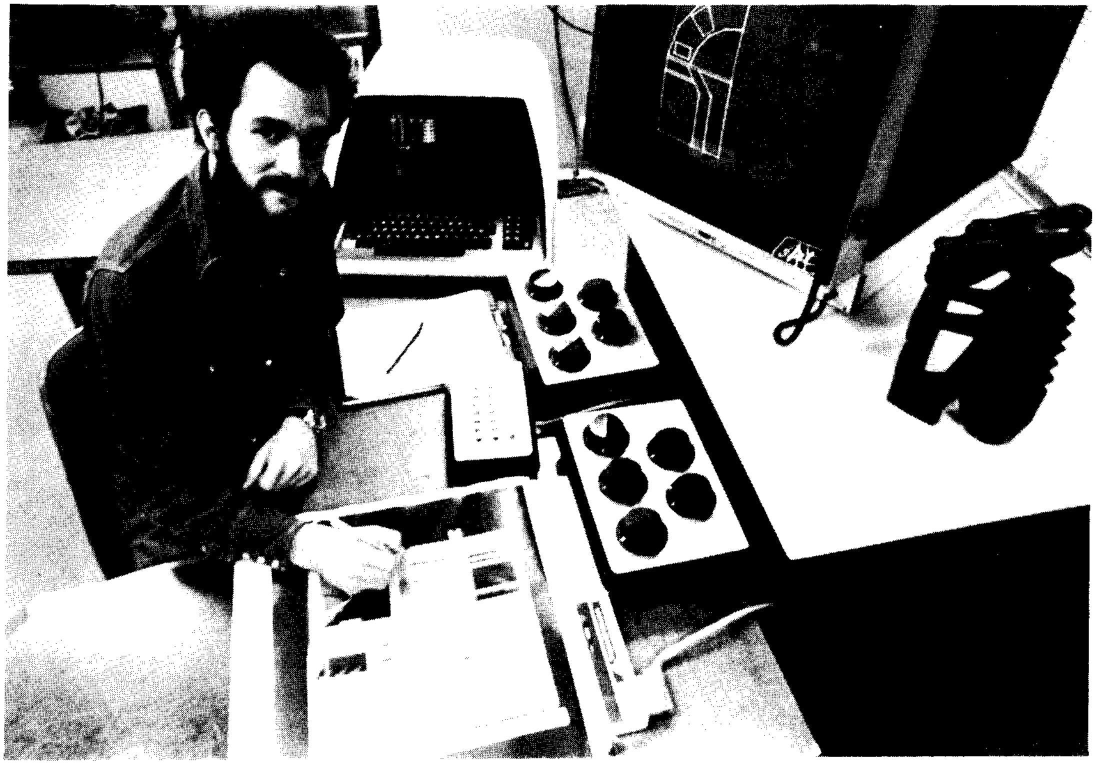


**FIGURE 16.**
**Larry Cuba.**
*©Solid State Animation.*

Larry Cuba, a leading computer artist, surrounded by some of his tools.

computer. Instead of oil paints, acrylics, pastels, charcoal or sand, the artist paints with electronics. Instead of canvas, plaster, wood, marble or paper, the artist paints on a cathode ray tube; light is the medium. Throughout history, the breakthroughs of science have been integrated, directly and symbolically, with art forms.

The computer symbolizes the age of the machine, the age of electronics, the age of rapid communication. The vision, creativity and intelligence of the human spirit can be found in today's uses of the computer. If art is the creation of images to be experienced and enjoyed through the senses, the computer is ready to help man create such images.

Where will it lead? Nobody knows. It will take years to explore the expanded creative flexibility and techniques offered by the computer. The computer allows an artist to see results faster than ever before. The artist can alter time, space, and perception with the computer. Every piece of computer-generated art is an original, and that original can be presented by the computer in identical forms over and over. Computer art can be transmitted via telephone to any part of the world in seconds. An artist can paint one work, save it, paint another, save it, make changes, add, subtract, test, experiment, without destroying the original. An artist can conceive and then, with the computer, create. An artist can program the computer to display works of art in sequence, over and over; the art is not a single, static painting to be viewed on a wall, but rather a dynamic experience over time.

At this point we can only speculate as to the impact of computer-generated art on the history of art. As artists embrace the possibilities of computer-generated painting it is only a matter of time before human genius expands the scope of art to the next steps in its evolution. These new artists will take their imagination and vision

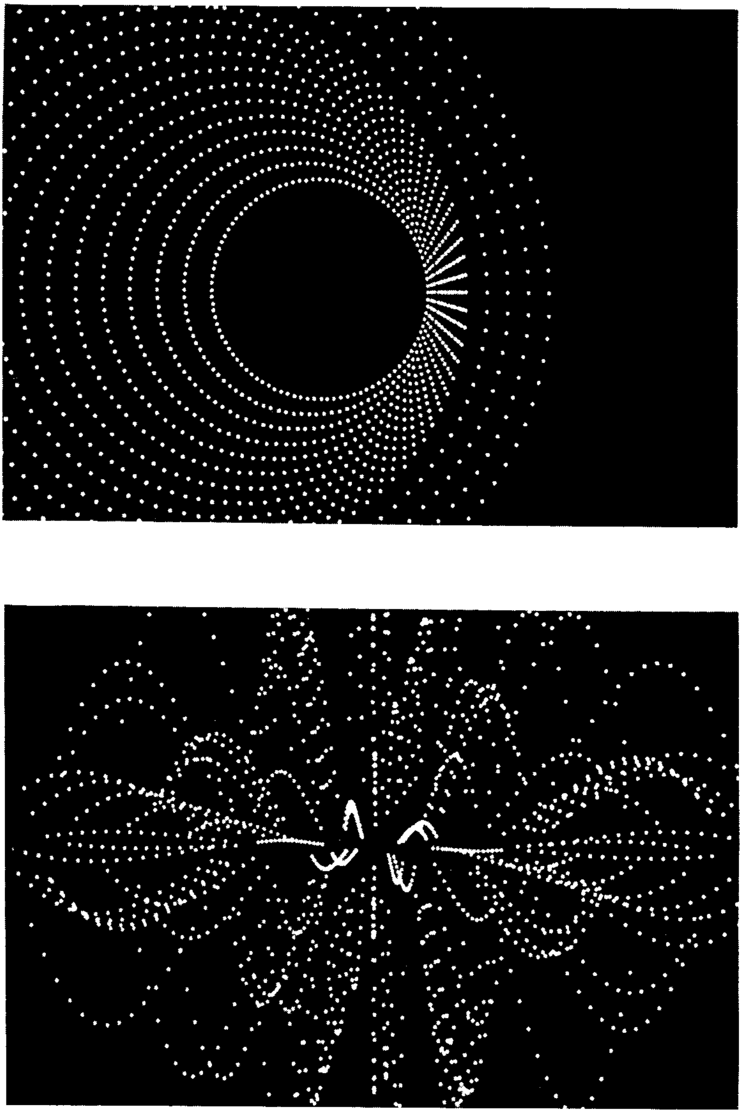


**FIGURE 17.**
**From *3/78*, Larry Cuba.**
*©Solid State Animation.*

Light moves through time and space. A moment is frozen here in these still photographs from Cuba's film ***3/78***.

and combine them with a sophisticated knowledge of computers and programming to create art as it has never existed before. In fact, you may be one of them.

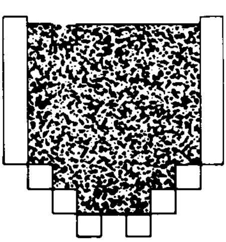
Whoa, let's slow down for a minute. I don't know about you, but I'm exhausted. Scholars have devoted their entire lives to the study of art and civilization, and here, we just covered thousands of years of history in a few brief moments. But that's all right. I'm not an art historian, and as I said at the beginning of the chapter, my purpose is not to teach you about art. Instead, I want to get you tingling, excited, and curious. I want you to feel a link with *all* human beings who have ever lived. I want you to see your ***PAINT*** program as another step in the evolution of art.

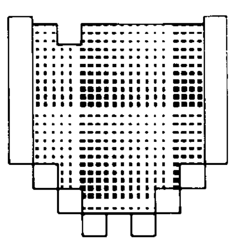
Maybe you're inspired to create a painting right now, or maybe you want to rush off to the art gallery. Maybe you want to go for a walk in the woods and think about some of the ideas in this chapter. Maybe you want to keep reading the book. In any case, I hope you feel closer to art. Art is rich and real and alive—art is there for your enjoyment. Don't feel you have to analyze every painting you see. Find the paintings that interest you. You may like art right now. As you learn more about art, you'll be able to *appreciate* the art you like even more.

Here's to your art!

# 4

# COMPUTER IMAGING





If you've been to *Star Wars*, you've seen it. *Superman*? You would have seen it there, too. In fact, it's all over TV now. Everytime you watch a TV commercial where cars rotate in space, Life Savers® fly out of their pack, old geezers truck down fantasy lanes in Levi's®, or aspirin speeds to cough control centers, you're seeing it. The color-coded election maps on the news are another good example of it. What is it? Computer imaging. What's computer imaging? The creation and manipulation of pictures with the use of a computer.

*PAINT*, of course, is an example of computer imaging, but it is just one of thousands of ways in which this new technology is changing our world. Everywhere you look, in practically every field and profession, in art, medicine, architecture, manufacturing, business, education, entertainment or aviation, you will see dramatic and seemingly magical transformations thanks to computer imaging.

The reasons for the meteoric rise in the use of computer imaging can best be summed up in one statement: A picture is worth a thousand words. As the processing speed and reliability of computers increased drastically over the past decade, the ability of the computer to produce output also increased. People who used computers found themselves swamped with more and more written data. It became so easy to feed material into the computer and to ask the computer to do all sorts of analyses, comparisons, and computations that the output threatened to overwhelm the user's ability to absorb and digest the information. If only ways could be found for the computer to turn all this data into pictures so that, for instance, dozens of pages of statistics could be expressed by one graph or chart. How much easier and faster it would be for the computer and human to interact.

Let's say your family moves to a new house and you want to describe it to your friends who live in another city. You could write them a letter, taking pages and pages to tell them about the style of architecture, the construction materials, the colors, proportions, locations of rooms, landscaping. Or you could take a few snapshots to send them. While there are certainly times when the written word may be preferable to pictures, how wonderful to have the option of choosing. The development of computer imaging offers just such an option. Let's look at some of the fascinating applications of computer imaging.

## AUTOMOTIVE DESIGN

Suppose you're working on the development of a new car. You've made sketches, you know what the car looks like and you've constructed a full-scale clay model. To put it simply, by using a special camera as an input device for the computer, you scan the clay model. The camera translates the image of the car into mathematical points that can be stored in the computer's memory. The car is now "in" the computer and a picture of it can be called up to the display screen at any time. Using the computer, you can rotate the image of the car to look at it from underneath, from above, from any angle. You can alter the car's design in any way by programming new information and instructions, and then watch the changes on the screen. Instead of having to build hundreds of models to reflect each possible change, you can create hundreds of stored pictures. The effects of design changes on the car's stability, weight, handling and performance can be studied with ease and precision. The computer can even give instructions to another machine that actually builds a model that can be used for wind-tunnel tests!

Now, let's say it's time to market the car. The car was designed to be inexpensive, small, and economical to operate. The people who seem to be the most likely purchasers, according to research done by your company, would be students over eighteen, single adults in their twenties and young married couples. You want to find out where the greatest concentrations of these potential buyers live so that you can locate dealers for the new car in those areas.

Fortunately, your company has access to many data-base services, so it can get the raw material the computer needs. A data-base service (DIDS, Domestic Information Display System) provides information and statistics to computer users, who can purchase hookups to these vast depositories of stored data. There are data bases for financial and stock market information, for sales and product information, for historical and geographical statistics, for population distributions by almost any conceivable determinant such as age, sex, income, education, or job. If you can think of it, it's probably stored in a data base!

So, you are able to get the information that will tell you where the greatest numbers of students, single people and young married couples live. Imagine if this information were printed out in a written form by the computer. You might have thousands of pages to read in order to learn where these people are. The computer might list every county, every town, every state, giving the desired material.

However, with the use of computer-imaging techniques, you could program the computer to create a map of the United States, and to place a colored dot anyplace 1000 or more potential buyers live within a ten-square-mile area. The computer prints one map and the concentrations of color produce dark areas which show you where the best locations for dealerships might be. The more color, the better the market. You could then program the computer to break this information down into state maps or according to zip code locations. Maybe you learned that Chicago would be a good market area for the car. But where in Chicago? This time you could use a data base with information about Chicago citizens. By repeating the process you used to *target* Chicago, you could find out which parts of the city and suburbs have the most students, singles and young couples. And again, one easy-to-understand map would take the place of reams of paper.

The amount of time saved by this use of computer imaging is staggering. You can see how valuable these capabilities could be to business. A rock group planning a tour wants to know where its records have sold best, or a medical research agency wants to know where cases of a rare disease have occurred to try to discover patterns in its outbreak. This type of information can be displayed graphically by maps, making it quicker and simpler for people to understand the material and to make appropriate decisions.

A company drilling for oil could produce maps which reflect data on existing wells, seismic occurrences, land and water characteristics in order to improve the odds for finding new sources of oil. A lumber or paper company with vast holdings of forest land could use computer-generated maps to help manage its acreage, seeing from the maps the best places to plant new forests or cut existing trees. (Sorry, nature lovers!) Logging mills even have computer-controlled saws! The computer "looks" at a log and tells the saw which way to cut it for the maximum amount of usable lumber.

When you think of all the purposes that computer-generated maps alone could serve, you begin to get an idea of how vast the whole field of computer imaging really is. Here are some more amazing applications.

## AVIATION

Let's say you need to teach pilots for your airline to fly a brand-new, more sophisticated airplane. These pilots will be flying the new jets all over the world, encountering every imaginable weather condition: fog, snow, sleet, rain, thunderstorms. In addition, some of the airports they'll be using have difficult landing conditions created by nearby mountains, short runways, turbulent crosswinds or high altitude. How would you train all these pilots? It would cost a fortune to provide a jet, an instructor, and fuel for each of dozens of pilots. If you wanted the pilot to practice landings at the Lima, Peru, airport, you'd have to fly there. And, since these pilots would be flying unfamiliar aircraft and learning many things for the first time, they would be sure to make mistakes. "Oops," says the student pilot as his aircraft heads straight for the terminal building. "I guess I missed the runway." Crash, bang, smash!!

Sound the bugle, for here comes computer imaging to the rescue. By using a flight simulator, a pilot can sit safely on the ground in a mock-up of a real-life jet cockpit and "fly" the airplane. The "windows" are computer-display screens and the pilot sees exactly what he would see if he were truly flying the plane. He even feels the same sensations as the "cockpit" turns and the "g's" or gravity forces change by computer control! (See color plate 10.)

The pictures on the display screen react to the information sent to the computer by the manipulation of the controls. If the pilot pushes in the throttle and pulls back the control wheel to climb, the position of the horizon will change on the screen and the ground will get further and further away. Whether the pilot banks, dives or bounces, he will see (and feel) the actual effects of his actions. In addition, it is possible to program different weather, visibility and other traffic conditions so the pilot can practice under a variety of situations. You can program different airports into the simulator so that the pilot can "land" in Mexico City, Athens, or Cairo without ever leaving the ground.

These incredible simulators are used by the military as well. For instance, Navy pilots can practice landing on a jet carrier without the risks involved in real landings. NASA can teach astronauts to fly spacecraft with the use of simulators. Ship captains are able to practice navigating in treacherous water conditions or on foggy and dangerous nights with the help of simulators. A particular harbor with dangerous sand bars and low bridges could be programmed to allow ship pilots to experience and overcome these dangers in total safety.

Needless to say, the sophistication, complexity and skill involved in the programming of computer flight simulators represent state-of-the-art computer technology. And it's being done, now.

## ARCHITECTURE AND DESIGN

Computer imaging is altering the way people design. Using an electronic drafting tablet as an input device, an architect can draw a building and see it on the computer-display screen. He can rotate the image to see how the building would look from across the street or from the forty-story skyscraper one block to the south. (See color plate 11.) The computer can produce a detailed drawing in minutes that would take the architect hours or days to draw. On other computer-graphic systems, the architect can view the building as it would be if built with brick and then can experiment with different materials: steel, glass, wood, concrete. He can even see the building as it would look in winter, in summer, in daylight, and at night. How would it look in the late afternoon shadows? What effect would the addition of three more stories have on the proportions of the building? An answer can be seen on the screen. Different window treatments, site orientations and color schemes can be conceived by the architect and created by the computer.

The computer can also be employed to generate working drawings for the contractors. The construction of a building requires hundreds and hundreds of complex drawings that show not only the relationship of spaces but the designs for the plumbing, heating, air-conditioning and electrical systems. Let's say the client comes to the architect after all the working drawings have been completed and says, "I want to have another elevator in this corridor." In the days before

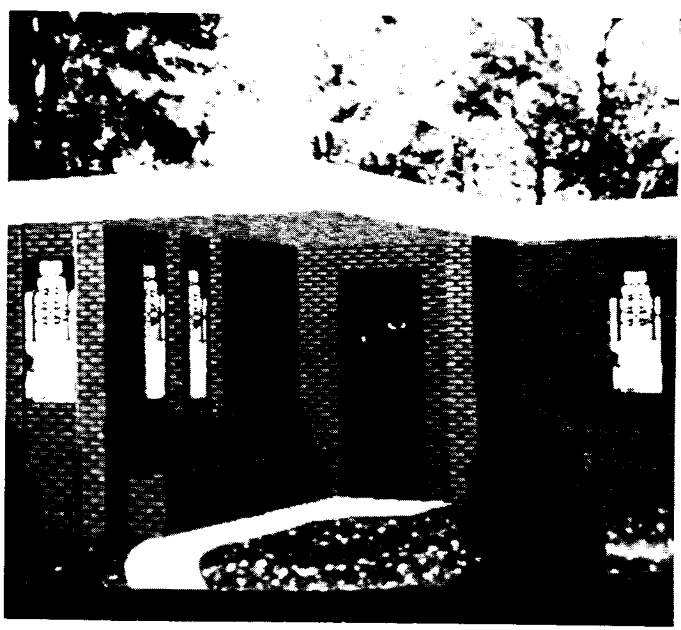


**FIGURE 18.**
**Entrance to a House Made with Textured Polygons.**
*Developed by Eliot Feibush, Marc Levoy, Rob Cook.*

This example of computer graphics almost looks like a photograph of a house.

computer imaging, every drawing would have to be redone or individually altered to reflect the change. Now, the computer can be used to make the necessary changes on all the drawings in a fraction of the time. The architect now has the ability to interact with his design concepts, to say, "What if....?," and to see the idea seconds later on the display screen.

The structural engineers involved in the design of the building can use the computer for their tasks as well. They can see the effect of wind or an earthquake on the structure. They can "put" 100 tons of snow on the roof and examine how much stress is generated by watching the display screen.

Meanwhile, the electrical engineers can use computer imaging tools to design and produce drawings for the complicated electrical circuitry; the mechanical engineers can experiment with the best system for ventilation or building security. Prospective tenants can study computer-generated floor plans to get an idea of how their business or firm might function in different spaces. Offices and furniture can be drawn and then rearranged at will.

A new type of partnership combines the unique creativity and vision of the architect with the untiring ability of the computer to display his ideas. This is the direction of the future for the design profession. Instead of Brick, Brown and Glasstower, Architects, we'll be seeing Brick, Brown, Glasstower and Computer, Architects.

Scientists, teachers, and researchers are also using computer imaging to do things never before possible. Biologists can create and manipulate models of molecular structures displayed in 3-D on the computer screen. Astronomers can watch the heavens on their computer display. They can stargaze at the "sky" as it would look from Northern California on a July evening and then, without leaving the computer desk, see how the sky would look in December, or from Indonesia. They can watch the planets orbit the sun or chart the journey of a space satellite before it ever leaves the earth. Mathematicians can manipulate geometric constructions and teach calculus; physicists can discover the effect of given forces on the motion of an object with the use of computer imaging. What could once only be imagined in the mind's eye can now be seen on the computer's display screen. What once took days to produce can now appear in seconds. In fact, and hold onto your hats for this, it is now possible to create images that represent a reality you can see and your emotions can feel that doesn't exist and couldn't exist in the real world. Nowhere is this more true than in the use of computer imaging in movies and TV. Read on.

## ENTERTAINMENT AND THE MEDIA

Remember the opening title sequence of the movie *Superman*? You're traveling through the universe at the speed of light and every few seconds huge, blue block letters zoom into view, hover long enough for you to read the actor or director's name, and then roar off into infinity. Well, I'm not aware of any large letters flying through space listing movie stars. Furthermore, I'm not aware that any large block letters *can* fly through space. But I saw it on the big Hollywood screen. It was real, even though it couldn't be. But if it couldn't be real, how could it be photographed? Once again, it's computer imaging. The location of a picture created by computer can be expressed in mathematical and logical terms understandable to the computer. Sophisticated computer film-making techniques make it possible to create almost anything. Since computers operate free of the laws of physics, they can create images and movements that couldn't exist in the real world, which must obey the laws of physics. We can watch the glorious results, taking joy in the computer's ability to ignore gravity and friction; the computer only needs to obey the laws of mathematics and logic by which it functions.

The scene in *Star Wars* where Luke Skywalker pursues the enemy in and out of narrow space canyons at dizzying speeds was made possible by computer camera control. In many scenes such as this, the computer controls every function of the camera as it films detailed models of science-fiction landscape. You see many other good examples of the computer's defiance of "reality" on television. If you were to walk into your backyard one morning, look up and see a car suspended fifty feet above the ground, rotating in mid-air, held up by nothing, you'd probably pinch yourself a few times and wonder what was in the orange juice you had for breakfast. Cars don't float in space. (Give'em a few years, though.) But they do float in space in TV commercials and they do on computer-display screens. Again, the computer remembers the picture as a collection of mathematic points expressed as electronic impulses. The computer can move these points to any "what if" location on the display screen, even if it couldn't happen with a real car.

The special effects now possible via computer imaging will dazzle your eye and imagination. Soon it may be possible to create computer-generated pictures of human beings that are so lifelike they will look like real actors. Imagine the possibilities–people could fly through space, walk through walls, leap canyons, turn inside out or be stretched to twice their length. And that's just the beginning.

An equally incredible revolution is taking place in animation. As you know, any "moving" picture or film is really a collection of many still pictures. When enough still pictures are moved quickly past the human eye, we see what appears to be continuous motion.

This is the principle behind animation. Any action that looks continuous has really been broken down by the animators into hundreds of individual steps, each drawn and photographed and then run in continuous motion. Up to now, *every movement* had to be represented by hand-drawn and painted images. Two cartoon characters throwing a burning stick of dynamite back and forth that might take up thirty seconds of time on TV may require hundreds of drawings! Each drawing would show the characters in a minutely changed position. The background may have been drawn over and over, too. You can imagine how laborious and time-consuming this whole process was.

But along comes, you guessed it, computer imaging. (See color plate 16.) Using one of the most advanced paint programs in the world at New York Institute of Technology on Long Island, artists and animators can now create drawings by machine. With a technique called key-frame animation, artists can draw a "beginning point" sketch, showing the cartoon character in one position. They can then create an "end point" drawing showing the character in a different position. Artists tell the computer how many drawings to make to connect the first and last frames. Presto, the computer will make all the drawings in-between, saving days of labor, allowing the artists to concentrate on the art, spared from much of the repetitive drudgery of animation. These super-super-super paint programs allow artists to draw and paint in ways that seem to be straight out of science fiction.

The artists sit at a computer with an electronic pen and data tablet. By using just the pen and keyboard they can choose from millions of colors, thousands of brushes and textures. (See color plate 15.) They can create practically any brush at all. For instance, they could engage the "make brush" mode and paint a tree. The computer now recognizes the tree as a brush stroke and will paint a tree everytime the artists use that particular brush stroke. Think how great this would be for drawing forests—instant trees! The artists can then come along and change the color of some trees to add more variety. They can zoom in on any part of the screen to incredible levels of magnification; they can enlarge objects. They can erase any part of their drawing; they can use the same background over and over again. They can draw half a design and the computer will draw the other half automatically in perfect symmetry. They can flip objects over, or they can paint a scene set in daylight and the computer will change it into night. The computer can fill any shape in a fraction of a second and color in the most intricate line drawings. The artists can store, call and eliminate any drawing or part of a drawing. They can create and place letters, and they can tell the computer to turn a drawing upside down or to flip right for left. They can tell the computer to go out and get two cheeseburgers, french fries and a soda for lunch. Not really, but that's about the only thing these computers *can't* do.

It is also possible to create the illusion of three-dimensional objects with the full range of computer assisted animation programs. (See color plate 13.) Many of the robots, monsters and space crafts soon to be seen in movies will not be models, but computer pictures. The speed, brilliance and detailed resolution with which the computer obeys and reflects the artist's commands is dazzling beyond words. It will be a long time before the open-mouthed sense of awe one feels is diminished.

Are you ready to have your mind boggled even more? Listen to this. At the Architecture Machine Group's laboratory at MIT is a special area called the Media Room. Among the many projects in the room is one called the *Spatial Data Management System*. Here's how it would work if it were in your home. Who knows, in a few years it may be possible for you to have one.

Let's call it the Family's Home Spatial Data Management System. Picture a wall-sized projection screen, 8' x 12' in your family room. On the screen are dozens of color pictures of familiar objects: a telephone, a shopping cart, a calculator, a Rolodex®, maps, books, movie reels, calendars, date books. Each picture represents a category of information or a set of functions common to your household. In other words, the telephone symbolizes making phone calls, the Rolodex symbolizes address information, the shopping cart stands for shopping catalogues, and so on.

In the middle of your family room is a comfortable lounge chair. Joysticks and touch-sensitive pads are located in each arm of the chair; touch-sensitive color TV monitors are situated on either side of the chair within easy reach. Loudspeakers in the walls surround you and special input equipment allows you to give instructions to the computer by voice. Computers of today can be programmed to understand some human speech. Someday it may be possible to communicate naturally and "talk" to the computer.

The basic idea of the room is this: People can retrieve information and tell the computer to perform various tasks by *going* to where the information is in a personal and recognizable spatial world. To put it another way, instead of having to type series of words or letters on a keyboard to get information, you can find what you need by "going" (via cursor, touch or voice) to the place on the screen where you see the picture and know the information to be. This makes it so much easier for a human to interact with the computer. For example, suppose you want to make a phone call. You're sitting in the lounge chair. You can let the system know your intention in several ways: (1) use the joystick to move the cursor to the telephone on the screen, (2) touch the picture of the telephone on the smaller TV monitor next to your chair or (3) talk to the computer, "I'd like to make a phone call, please." A picture of a touch-tone telephone will appear on the

TV monitor. You could press the "buttons" on the TV image of the phone to make the call, or if the name of the person you wish to call is active in the auto-dialer, you can simply say, "Please call Clark Kent," and the computer does the rest. If you need a phone number, you could get it by calling up the Rolodex® picture, stroking the touch pad by your arm to flip the cards and then telling the computer the number.

Well, you're through with your call and you want to finish your math homework before dinner. You move the cursor to the picture of a calculator, and now it appears on the TV screen where the telephone used to be. You could also have said, "Take me to your calculator," or "What is 22 times 39.6?" The computer would automatically know to access the calculator mode.

Time to do some Christmas shopping? Summon the shopping cart and tell the computer *clothing*. A catalogue appears on the screen with all the clothing you could ever wear. You turn the "pages" by stroking the touch-sensitive pad in the arm of your chair. Using the computer's telephone in conjunction with the catalogue, you "dial" your order into the phone by pressing the buttons which correspond to the order number of your purchase, your family's secret ID number, and your credit card account number. A few days later, your purchase arrives by mail.

The beauty of this system is in the ease of human-machine interaction. How much more natural it is to say, "I want to shop," or "I want to plan a trip," or "I have to do banking," than to learn and type series of complicated instructions via keyboard. We're all much more comfortable with the idea of finding things in real space. We can remember spatial locations.

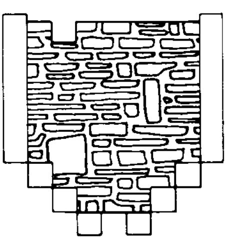
"Billy, where is the slip of paper with Julie's address I gave you the other day?"

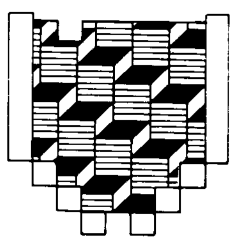
"It's in my room, near the wastebasket, on top of the box of sparklers which is between some books underneath my navy sweatshirt, Mom." Exactly.

I think you can see from these examples how computer imaging is helping to make the impossible possible and the possible easier. People in business, science, medicine, education and entertainment are using these techniques to open new doors just as fast as the human mind can create them. But I've left out one whole domain of computer imaging—the exciting world of the computer artist.

5

# COMPUTER ARTISTS





Just what are computer artists, anyway? Computer artists are *computers* that like to paint. WRONG! Hmm, let's try again. Computer artists are, uh, let's see, uh, people who paint pretty pictures of computers? WRONG AGAIN!! Then what are they?

The best definition would be this: Computer artists are people who use computers to create art. Defining an artist like that by a medium doesn't tell you much about the art, though. It would be like saying, "Oil paint artists are people who use oil paints to create art." Wouldn't tell you much about the people or the art. Computer art and computer artists are hard to define because the computer is an artist's tool, an integral part of the process of creating a work of art. This process can lead wherever the human imagination takes it, and it does! If you looked at the work of different computer artists you'd find such a vast array of artistic expression that it would be hard to believe that one medium, the computer, was common to all.

The field of computer art is so immense that it defies labels and categorization. Computer art can involve elements of filmmaking, photography, dance, painting, sculpture, music, animation, design, science and mathematics. Any form of computer-generated art must, however, work in conjunction with a program, or set of instructions, the artist gives to the computer.

Computer images are based on mathematical structures. Music can be expressed in mathematical terms, the rules of perspective operate according to mathematical principles, and even human perception of pleasing proportions and aesthetic qualities sometimes follows mathematical formulas. While the technology may be new, the merging of the computer and art follows the historic tradition in which science and mathematics influence the development of new art forms.

The computer will change the face of art in ways we can barely imagine at this time. One hundred years ago, photography was a slow, cumbersome medium that reflected discoveries which were then new. In those days, photography was limited to professionals and a small group of enthusiasts. Now, of course, photography is a universally popular medium accessible to practically anyone. Computer artists predict that the same thing will happen with computer art; a whole new world of art and visual language will become as available and open-ended as photography thanks to the growing popularity of home computers. ***PAINT*** certainly brings you and many others a lot closer to that reality.

More and more, artists are choosing to experiment with computer art, technological art, combining the infinite possibilities of computer imaging with the creative yearnings of the artist. People like John and James Whitney, Lillian Schwartz, Harold Cohen, Stan VanDerBeek, Larry Cuba, Tom deFanti, Ken Knowlton, Ed Emshwiller, to name just a few, are blazing previously unknown trails into the future history of art. We're going to take a brief look at three artists to see the different attitudes and interests they bring to their work.

## STAN VANDERBEEK

Stan VanDerBeek is an artist of the future. He is a pioneer, an inventor, a filmmaker, a painter. His art reflects his society, a society that is increasingly machine oriented, a society that bombards its citizens with visual information. VanDerBeek is at the forefront of a small but growing group of artists who are experimenting with the technology of the 80s to create new visual images and media experiences. His tools? Computers, satellites, telecopiers, and cameras.

Like many computer artists, VanDerBeek never set out to be one. He began as a filmmaker, studying art and design at Cooper Union in New York and Black

Mountain College in North Carolina. VanDerBeek worked as an animator for many years and invented the process known as collage animation in which cut-out figures are moved to create the animation that would otherwise have to be achieved through thousands of painstaking drawings.

Most filmmakers are interested in plot and character development and in heightening the realism of a scene or emotion. Not VanDerBeek. His films explore light, motion, time, and space. The tools of high technology allow him to create images never before possible. Similar to the brave painters who began to experiment with abstract art when everyone else was painting recognizable subjects, VanDerBeek is an abstract filmmaker who has turned his back on traditional techniques of film narration.

A good part of VanDerBeek's enthusiasm for the marriage of science and art comes from the vast possibilities for exploration and experimentation in the relationship. No one knows where it will lead but one thing seems clear: more people are gaining access to means of visual communication, cameras, video, TV, and computers. VanDerBeek sees a world of the future where forms of visual communication between individuals and between nations will become as commonplace and important as verbal and written communication are now.

VanDerBeek's exploration of new art forms has led him to many fascinating projects. His "Movie-Drome," first built in the 1960s at the Stony Brook campus of New York State University, is a dome-shaped theatre conceived for the presentation of multiple visual images. Members of the audience lie on their backs to view images that are projected over the entire interior surface of the dome. Each viewer's experience is unique, since no two people would select from or respond to the many images in the same way.

With the computer, VanDerBeek creates what he calls optical paintings. The computer has been programmed to perform mathematical operations to produce incredibly complex transformations of light and movement on the screen. Individual frames may be isolated to create computer prints, or may be shown in sequence at high speed as an animated film of dazzling beauty and intricacy. (See color plate 14.)

The computer can simulate action and images impossible to generate in any other medium. This is the key to the unique nature of computer art. The impact this will have on the fields of animation, photography and filmmaking is only beginning to be felt.

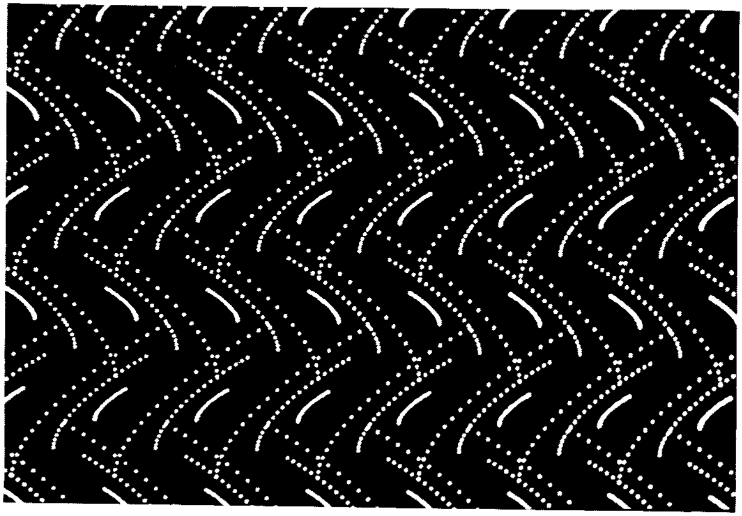
VanDerBeek believes that the computer's capacity to generate elaborate designs and patterns in a matter of seconds will lead to a rise in the practice and enjoyment of decorative arts. In fact, he suggests, it may not be long before a new wave of computer-generated fabric, textile and fashion design sweeps across the world—Computer Deco, as he calls it.

While VanDerBeek wants to experiment with as many aspects of technological media art as possible, Larry Cuba is taking a different approach.

## LARRY CUBA

Larry Cuba is another artist to become a leading computer filmmaker. Unlike VanDerBeek, Cuba had no background in animation or computers. His experimental films, which have won numerous awards, represent the visual images of mathematical structures and relationships programmed into the computer.

Cuba has focused his interest on the program itself and the visual images that can be generated. It is the language of the program that allows him to create through the computer. A program might tell the com-



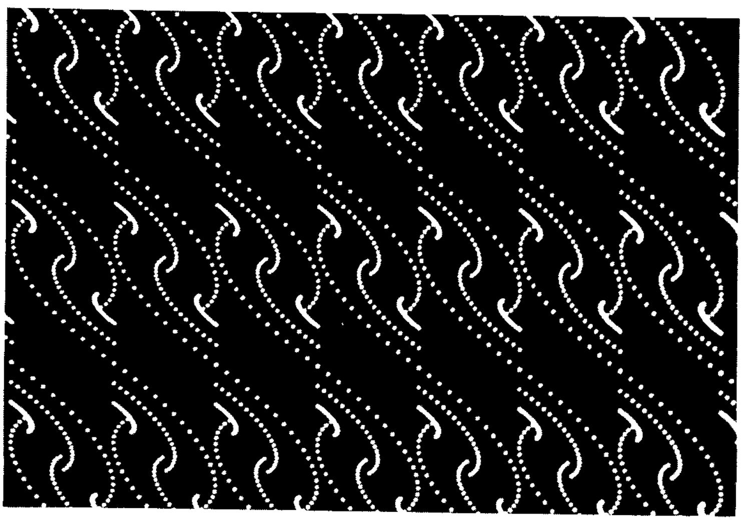


**FIGURE 19.**
**From *Two Space*, Larry Cuba.**


Two still photographs from Cuba's moving computer film, ***Two Space*.**

puter to take fifty concentric circles (circles with the same center point but different radii) and to reduce the largest to the size of the smallest while making the smallest become the size of the largest. Next, the second largest becomes the second smallest, the second smallest becomes the second largest, and so on until all circles have gone through this transformation. While this occurs, the computer has been programmed to rotate each circle 360 degrees along its vertical axis. The result is a magical sequence of geometric permutations that lifts you to another way of seeing.

What the computer can do is limited only to the extent that the program is developed and explored by the artist. It should be no surprise that Cuba is working on the design of a new programming language that would permit greater experimentation in computer animation and graphics. Often Cuba doesn't know what an image will look like until it appears. The excitement is in the discovery. Everytime the boundaries of programming language can be expanded, new possibilities will emerge for the artist, and Cuba is creating these possiblities as fast as anyone. It is next to impossible to describe his beautiful, rhythmic films in words since his work deals with movement and images beyond most people's experience. Unlike some artists who are interested in single frames of light and pattern, Cuba is more concerned with the flow of those images over time.

Cuba first became interested in experimental animation during his years as a student at Washington University in St. Louis. The young man soon moved to the West Coast to pursue his art and to meet John Whitney, Sr., the respected "grandfather" of computer animation who was living in California. Cuba enrolled at CalArts and, scrounging computer time whenever he could find it, began his first experiments with computer animation. The result was a prize-winning film entitled *First Fig* which explored the movement of no, not figs, but geometric shapes in space. Cuba also worked with Whitney on *Arabesque*, one of Whitney's most famous computer films.

Over the next several years, Cuba moved between Los Angeles and Chicago. He was first attracted to Chicago by the chance to use GRASS (Graphic Symbiosis System) a new computer language developed by Professor Tom deFanti at the University of Illinois for the creation of graphic images. While this system offered many advantages for graphic production, it was not what Cuba was looking for and he returned to Los Angeles to do pioneering programming work for computer-generated television commercials and titles. He did, however, come back to Chicago to make two more films with GRASS, *3/78* and *Two Space*.

It wasn't long before Cuba won a contract to create a sequence for the film *Star Wars*. This was one of the first times computer animation was used in a feature film, and Cuba was thrust into the front ranks of this dramatic new field.

While Cuba pursues his dream of a new, graphically oriented computer programming language, John Whitney leads yet another charge into the barely explored world of computer art.

## JOHN WHITNEY SR.

Without question, John Whitney is one of the giants of 20th century technological art. His work (along with that of his brother James) has led to the development of brand new creative fields and art forms. A pioneer in computer imaging, Whitney is responsible for inventing many of the cinema techniques that have led to the fabulous special effects you see today in film and television. He discovered the principles of slit-scan motion control which made possible the star-gate corridor sequence in *2001: A Space Odyssey*. His work is also represented in *Star Wars*, as well as *Superman*, where his discoveries made possible the streak titles sequence I mentioned in the last chapter. Over the years Whitney has received grants and awards from IBM, the National Endowment for the Arts, and numerous foundations. He is currently on the faculty at UCLA and works at his studio in Pacific Palisades on incredible computer-generated films that are his creative passion.

Whitney's films are visual music. (Huh? Let me try to explain.) Whitney has always been fascinated with the relationship between music and art, music and the visual world. Music structures time; music is movement. One note, just like one letter of the alphabet, doesn't do much for you. But many notes, chosen by a composer to represent patterns of sound and change, create music, just as many letters, when structured into patterns and sequences, create words and sentences. For a human to experience these patterns, this music, takes time. It wouldn't be much of a song if there were no change, no movement, if it consisted of just one note. Therefore, you could think of music as patterns of movement (change) of notes (sound) which happen over time. Of course, music is much more than that. Music engages a listener; music presents an emotional experience for the listener. I'm sure you know songs that make you feel sad or tired. Music may grate on your nerves or make you tense. That's because of the emotional content of music. When artists take elements that could exist randomly in any order (like notes or letters of the alphabet or color) and give them a structure, an order, they can create an emotional experience for another human.

A part of this musical experience involves the creation of an expectation for the listener. You know songs where a whole passage seems to be building to that fabulous chord or solo you like so much. The harmonies and structure of the music lead you to *expect* that chord or resolution. Imagine if it weren't there, if it never happened. You'd feel cheated, off balance, as if you were promised something that was never delivered. How about the musical scale. Do—Re—Mi—Fa—Sol—La—Ti—Do. Sing it to yourself. Very nice. Now, what would happen if you left off the last note, if you sang, Do—Re—Mi—Fa—Sol—La—Ti__________. The expectation you had for the scale to be completed isn't met. A sense of tension or frustration is created.

Whitney's films translate the patterns and movements of music into the visual world. With techniques of computer imaging, he creates hauntingly beautiful reflections of the harmonies, tones and motion of music. Whitney discovered that the structures of the musical world can be mirrored exactly in the visual world. (See color plate 12.) His films do not consist of images that "look nice" as you listen, or that "act like" the music; his films *are* the music, expressed visually instead of aurally (with sound). If this sounds far out, it is! You should try to see his films. If a picture is worth a thousand words, and one film is made of, say, 100,000 pictures, that's, hmm, let's see, well that's a lot of words you'd save me.

As you can see, some incredibly exciting art forms are unfolding as more and more artists make use of the possibilities of computer imaging. Some of their work is so new and uncharted that we don't have words or labels to describe it. While Stan VanDerBeek, Larry Cuba, and John Whitney all use the same medium, the computer, they approach their work and their tools in very different ways. VanDerBeek is exploring as many different areas of technological art as he can: dome theatres, film projected on steam, art transmitted via telecopier and telephone, visual images used as therapy for terminally ill patients.

Cuba sees computer language as the key to expanding the possibilities of his art and is focused on creating better ways to communicate the graphic and mathematical concepts to the computer for his films. And Whitney, as you've just read, is exploring the relationship between music and the visual world, the ear and the eye.

Three computer artists, three creative paths. There are many others who could be mentioned. Perhaps *your* creativity will make you one of them.

# 6

# IDEA SHOP

These ideas are for you. They're meant to ignite your imagination, catalyze your creativity, animate your artistry and titillate your technique. They might also free your thinking from the cobwebs that sometimes settle in the mind. Use these ideas any way you'd like; you can't be right or wrong with them. Change them, combine them, play with them. They're all yours.

***PAINT*** what you think
the insides of a tomato
a telephone switchboard
a bolt of lightning
a stomach
or a broken heart would look like.

***PAINT* 10,000 of something and PROVE IT!**

***PAINT*** A LIE.

***PAINT the beginning of the world.***

***PAINT*** *the end of the world.*

MAKE the world's skinniest
tallest
shortest
fattest
thinnest
biggest
smallest
or silliest
***PAINTING***.

Listen to your favorite piece of music. Shut your eyes and ***PAINT*** to the music.

***PAINT* trust.**

You're staring at the ceiling.

- How long have you been lying on your bed?
- Has it been 15 minutes or 15 hours?
- You know every crack in the paint, every dead insect in the light fixture above your head.
- Staring, lying and thinking. What has been going through your head?
- You feel weighted to the bed by your thoughts—pinned down by strange feelings.
- You're not quite sure what it is. Are you sad, depressed, confused, tired? Are you trying to avoid something?

***PAINT*** your thoughts. ***PAINT*** your feelings.

*Make up some WILD hair styles, put them on some CRAAAZY people and **PAINT** them.*

Invent a secret code
and ***PAINT*** a message
for a friend.

**Create a *PAINTING* to let your Mom<br>Dad<br>brother<br>sister<br>friend or<br>pet<br>know how you<br>feel about them.**

| | |
|---|---|
| ***PAINT*** *the world's CORNIEST painting.* | *(Why don't people tell secrets in corn fields? Because there are too many ears! Oooooh, that's corny.)* |

Create a ***PAINTING*** that is made up of **opposites.**

***PAINT*** **a World's Record.**

***PAINT*** a fear
a hope
a prayer
a birth
a death.

INVENT a creature—be it bird, fish, animal, child, foreign, man-made, woman-made, all of these, none of these.

Think about your creature....

Where did it come from? What does it look like? Does it exist for everybody? Can it die? Does it grow? Where does it live? What does it eat? Do you have an itch?

Now that you know your creature, ***PAINT*** it!

**Make a *PAINTING* of the strongest man in the world.**

**POWER...**

What is power to you?
Is it speeding down a hill on a bicycle?
Is it making your brother or sister cry?
Is it lifting something very heavy?
When do you feel powerful?
How do you know when you have power?
Which is more powerful, your conscience or the President of the U.S.?
Do you want power?
Do you feel powerful?

***PAINT*** your power.

***PAINT*** 330 B.C. *1492* 1776 **1984** **2201.**

*PAINT the world in which you would most like to live.*

***PAINT a people-eating tree.***

Create a *PAINTING* to make you feel

button-popping EXCITEMENT

*or*

smile-stretching HAPPINESS

*or*

nail-biting IMPATIENCE

*or*

blood-curdling TERROR

*or*

tear-wrenching SADNESS.

Make a floorplan of your room. Try rearranging the furniture by *PAINT*.

**Draw your house. *PAINT* it a different color. If you like it, try to convince your parents to change the color.**

AWKWARDNESS...

Have you ever felt as though your feet were made out of clay?

Or your fingers were made out of boiled carrots? Have your arms ever been too long, your legs 270 too short?

Have you had days where you run into walls, drop glasses, misplace things and run into yourself coming and going?

How about awkward social situations...
Not knowing what to say...
Having an itch you can't scratch...
Uncomfortable silences...
Saying something that you knew you shouldn't
have said the second you said it...
Having to be nice to people you can't stand.

***PAINT*** your awkwardness.

*Bury a treasure. **PAINT** a treasure map and see if your friends can find it.*

***PAINT*** a land where there are two of everything
an ocean made out of molasses
a city where the buildings are made of marshmallows
a desert where the sands are made of sugar.

***PAINT*** your best quality.

***PAINT** your worst quality. (Well, pretend you have a worst quality.)*

**Make the most awful, yicccchy, bleccchy *PAINTING* you can think of to make someone feel DISGUST.**

*A **PAINTING** to make you feel warm inside...*

*A **PAINTING** to give you goosebumps all over...*

*A **PAINTING** to make you dizzy...*

THE WALLS ARE CLOSING IN ON YOU.

They are getting closer and closer. You have nowhere to turn. All of your options are disappearing. No matter what you do you're going to be in trouble. You want to scream for help but there is no one to listen. You have never felt so trapped in your life. There is no one to help you except yourself.

Have you ever been in a situation where you've felt this way? As if all the walls in your life were closing in on you?

***PAINT*** it.

*Make a* ***PAINTING*** *of a super, sneaky, sleuthy, sinewy, suspicious, special spy.*

***Invent the meanest, scariest, most dangerous, terrible, horrible, vicious, ferocious, MONSTER and PAINT it.***

Create a ***PAINTING*** that makes you think of something you've always dreamed of doing...

skiing down Mt. Everest?<br>
falling in love?<br>
building a treehouse?<br>
sailing across the sea?<br>
beating up a bully?<br>
becoming an actor?<br>
having a family?<br>
not having a family?<br>
living by yourself?

***PAINT* some unlikely combinations...**

a 400-pound bicycle racer
a giraffe and a turtle who get married
a hot fudge sundae with ketchup on top.

*PAINT a sneaker.*

*PAINT your favorite meal.*
*Yum, yum.*

*PAINT your family.*

*PAINT a self-portrait.*

*PAINT a portrait of*
*yourself at age 2*
*age 10*
*age 18*
*age 40*
*age 100.*

***PRIDE...***

***You felt so proud you wanted to jump out of your skin. You were bursting with that warm, pulsating feeling of satisfaction. You achieved some great goal. Your accomplishment was seen and praised by others.***

***When have you felt that proud?***
***What was it you did?***
***How did people react?***

***PAINT your pride.***

*PAINT* the inside of your head.
Be sure to show your emotions.

***PAINT*** *your birthday.*

**PAINT a recent trip you took.**

***PAINT*** a recent trip you didn't take.

***PAINT a happy dream you had. PAINT a nightmare.***

Create a ***PAINTING*** that reminds you of your favorite holiday of the year.

*Put on some good dancing music.*
***PAINT*** *while you dance!!!*

***PAINT*** *while being tickled. Ho, ho, hee, hee, ha, ha, hee, hee, oh stop, hee, hee, I can't stand, heee, heee, it, ho, ho, help, HELP!!!*

**FRUSTRATION...**

**You were so frustrated you felt like exploding, like breaking everything in sight. Like screaming and running before all that energy inside of you blew up.**

**Why were you so frustrated? Did you keep trying and trying to do something without success? Were you at the end of your patience? Was everyone else getting in your way?**

***PAINT*** **your frustration.**

***PAINT* a Rube Goldberg machine. If you don't know what a Rube Goldberg machine is, ask a friend.**

Pick an object.
Now ***PAINT*** it from a distance of 2 inches
and 2 feet
and 200 feet
and 200 miles.

*Create a **PAINTING** and hide the following in your **PAINTING**:*

*your name*
*your birth date*
*the most beautiful thing you can think of*
*the ugliest thing you can imagine*
*two opposites*
*five questions*
*a top-secret secret*
*something to make people curious*
*something to make people furious*
*three jokes*
*something romantic*
*something scary*
*something dangerous*
*your greatest fear*
*your greatest desire*
*something from the past*
*something from the future*
*something from nature*
*something soft*
*a mystery*
*a lock of your hair*
*a mistake*
*a message*

***PAINT* hate.**

***PAINT* love.**

***PAINT* boredom.**

***PAINT* war.**

***PAINT* peace.**

***PAINT* War and Peace.**

Have you ever...

awakened because of an emergency like a fire or hurricane or a cartoon show you wanted to watch?
awakened with a yell of terror?
awakened from a nightmare?
awakened to find you slept through an important appointment?
awakened and been too tired to get out of bed?
awakened early and hated it?
awakened early and loved it?
awakened and felt sick?
awakened and not remembered where you were?
awakened to find a strange person, animal or object in bed with you?
not awakened?

***PAINT*** an awakening.

**Invent...**
**a love seat for two**
**people who can't stand**
**each other**

*or* **a salt shaker for someone who hates salt**

*or* **a wash basin for someone who hates to wash**

*or* **a car for someone who hates back seat drivers**

*or* **????????**
**????????** **and *PAINT* it.**

*Write a story about FEAR...*

*What frightens you?*
*Everyone is afraid at times.*
*Are you afraid of people?*
*Are you afraid of being foolish?*
*Of showing you don't know?*
*Of dying?*
*Are you afraid of losing a friend?*
*Are you afraid of being lonely?*
*Are you afraid of failing or losing?*
*Are you afraid of lightning?*
*Darkness? Snakes? Bugs?*
*Are you afraid of your parents?*
*Are you afraid of yourself?*
*Are you afraid of what you feel or think at times?*

***PAINT** your fear.*

EMBARRASSMENT...

Just about all of you
can remember a time
that you would prefer
to forget. It was
the most embarrassing
thing that ever
happened to you. What
was it? Don't be
embarrassed.

Did you forget to
bring a present to
the birthday party?

Did you ask everyone
to watch you on your
bike and then crash
into a tree?

Did you wet your pants?

Did you forget to do
something you promised
you'd do?

Were you caught in a
lie?

Did you spill food at
a fancy party?

Did you trip over your
feet just when you
were trying to act
most cool?

Did you swear you were
right only to be
proven wrong?

***PAINT*** your
embarrassment.

Think of the role of fire over the years...

Fire to cook
Fire to light the way
Fire to stay warm
Fire to please the gods
Fire to scare away the spirits
Fire from war, cannons, bombs and explosions
Fire from car crashes, plane crashes
Fire to clean and sterilize

Think of the strong associations different fires bring to mind...

Fire from candles
Campfires
Old oil lamps
Smoke signals
Roaring fires in big hearths
Matches
Flic of a Bic™

Fire has had an impact on people in every society: pioneers moving westward, astronauts blasting into space, families fleeing burning homes. There are burning fires deep inside a person, fires of rage, fires of love, fires of desire.

Look at a fire. What do you see? Flames that cavort and play with each other, ashes that breathe red hot, sparks that flitter skyward to a cold death. Squint your eyes when you look. Do you see people, cities, or futuristic worlds twinkling in the ashes?

*PAINT* a fire.

***Feeling foreign, alone, out of place.....***

***When have you most felt that way? Have you ever been the only child amongst hundreds of adults? The only short person amongst hundreds of tall ones? Have you ever walked into a village of poverty, where you make more than a whole family LIVES on for a year?***

***Have you ever been out of gas 10 miles from the nearest town? Have you ever been the only person in a group who feels a certain way? Have you ever had everyone else against you? Have you ever felt as though all eyes were staring at you, as though a thousand spotlights had you frozen in their glare?***

***PAINT your feeling.***

## SUPERPAINT MASTERY IDEAS

These ideas will sharpen your painting skills and expose you to some of *PAINT*S infinite possibilities.

### Art Show

Have an opening! Show your work. Invite family and friends. Make it black tie and real fancy. Serve food and drink and look like the artist you are.

*Show your paintings. Ask the guests to make up titles for them.*

- Create a series of paintings especially for Art Show display.

- Create and display a series that tells a story in a series of pictures like a forest fire or a kidnapping or an afternoon at the beach.
- Create and display a series that shows the same scene in different seasons.
- Create and display a series that portrays important moments in your life.
- Create and display a series that shows before and after.
- Create and display a series in which you change one item from each painting to the next. Let your friends try to guess the change.

## Brushes

**Fill the entire screen in the fewest possible brushstrokes.**

(A brushstroke is any repeatable and continuous motion of the cursor to lay down color. No brushstroke can be greater than the height or width of the screen.)

*How many different horizontal (going from left to right or right to left) brushstrokes can you create on the screen at the same time?*

*How many different vertical (going from top to bottom or bottom to top) brushstrokes can you create on the screen at the same time?*

***Create a painting made entirely out of one repeated brushstroke.***

*Create a painting made entirely out of one repeated brushstroke in which you vary brush width.*

Choose the single-pixel brush. Create a painting composed entirely of single-pixel dots with no brush stroke greater than one pixel. Use as many colors as you wish.

**The *Georges Seurat Pointalist Award for Patience* goes to anyone who fills the entire screen pixel by pixel. You could end up with a fabulous painting as well as a set of tired eyes.**

***The* Vincent Van Gogh Stroke Award for Almost as Patient *goes to anyone who fills the entire screen by using a 4 by 4 pixel brushstroke.***

Create a painting using a diagonal brush. Does the brush change depending which way you move it?

## Colors

Create a painting using only TWO colors.

**Create a painting using only THREE colors.**

*Create a painting in which you lay down those colors that make you feel SLEEPY.*

Create a painting using only two shades of the same color.

**Choose colors carefully to create 4 paintings: SPRING, SUMMER, FALL, and WINTER. Keep**

**your pictures and ask someone to try to guess which is which. NO RECOGNIZABLE OBJECTS ALLOWED!**

**(In other words, no clues like sleds or tulips, or skiing. Show the season with colors, only!!)**

Using colors, and no
recognizable objects,
create a painting of:

ROLLING
COUNTRYSIDE

*or*

OUTER SPACE

*or*

MIDNIGHT

*or*

HIGH NOON

*or*

THE SEASIDE.

| | |
|---|---|
| *Lay down colors that say DANGER!!!!* | Lay down colors that say PEACE. |

Make a color square about 1" by 1" out of any solid color. Now surround the square with a larger square 3" by 3" in a different color. Make another small square out of the *same* color as your first small square. Surround it with a larger square in a *different* color than the first large square you made. Keep making little squares of the same color and surround them with big squares of always different colors. Look at the small squares of similar color. Does the color look the same or does it change depending on the background? Does the size of the small square look the same? See how many color relationships you can make that *change* your perception of the *same* color.

*How many LAYERS of color can you create in a painting? When you're all done you should be able to sense the depth of the painting.*

- **How many different color textures can you get on the screen?**
- **Experiment by painting one texture over another. What happens?**
- **Use a diagonal brush. Paint a texture color along one diagonal. Now paint the same texture color along the opposite diagonal. Anything happen?**
- **Go to it! Explore the effects of different *brushes* and *brushstrokes* on texture colors.**

We interrupt these ideas to bring you a special bulletin on color.

Hey, chicken, what's a matta, yà yellow or somethin'? Oh dear, I hope that question didn't make you see red or put you in a black mood. Maybe you're just a little blue? No? Well, then, are you green with envy? Wait! I didn't mean it, please don't fly into a purple rage. All right, since I'm bright, I've just seen the light. You want to know more about color. Okay, here goes. I'll try to be as colorful as I can in presenting it to you.

Color can be many things. Color can be a symbol or sign that triggers an association or emotional response in us. There is natural color which surrounds us in the world of nature, the blue sky, the green grass. There is the perceptual world of color where colors interact with one another to create relationships and contexts that can be studied and expressed according to consistent scientific principles: color in terms of hue, tone, chroma; colors that seem to leap forward or step back in relation to other colors; and color as pigment, the actual physical material with the molecular properties to produce the perception of different colors.

In the first paragraph you can see examples of the associations we bring to different colors. Red: stop, danger, embarassment. Red is associated with the planet Mars, with the worlds of fire, war and demons, with Hell. Red can also be innocent and blushing, young and fresh, a celebration. Green: Peace, tranquility, envy. Black: mystery, evil, elegance, death, despair, darkness. White: coldness, innocence, purity, goodness. Yellow, when it is bright and light can symbolize gold, sunlight, transparency, intelligence, knowledge. When yellow is pale and muted with green it represents decay, sickness, cowardice and fatigue to many people.

Color triggers different emotional responses. Some colors make you feel nervous, unsettled, closed in. Other colors make you feel cheerful, relaxed, maybe even sleepy. Artists over the centuries have recognized this emotional impact or psychology of color. It is fascinating (but beyond the scope of this book) to trace the ways in which painters have used colors symbolically to affect the viewer's emotions. Modern day designers need to be aware of people's reactions to color. It just wouldn't do to paint a restaurant a color that made diners nauseous or to paint a doctor's office a color that made patients nervous and uncomfortable. No sirree.

Natural color is loaded with different sets of meanings. We respond to natural color because of associations with the world around us. We think of trees and grass as green. So strong is the connection to nature, even though trees and grass can be many other colors: brown, yellow, orange, red. Similarly, the sky is blue to us even though it can sometimes be grey, yellow, white, and purple as well. Natural colors come from the "real" world, while the symbolic properties of color spring more from our own emotions, history, and psychology.

The perceptual nature of color is where the human eye meets color. Color doesn't exist in and of itself. Without light, there is no color. Different objects have different molecular properties. An object will absorb and reflect different light waves based on these properties. When we say a rose is red, we're saying that the molecular constitution of that rose is such that it absorbs all light waves *except* those which generate the color red, which are reflected back to the human eye. When night falls the rose is *no longer* red. The absence of light means that no light waves can be reflected and therefore no color is generated. While a rose is a rose is a rose, a red rose is not always a red rose.

As people discovered the scientific principles of color generation, they developed theories about the human's perceptions of those colors. Some colors, they realized, like yellow and red, are "warm," they seem to come forward. Other colors, like green or blue, are "cold" and seem to recede or fade back. To put it another way, a room decorated with yellow, pinks and reds would feel like a warmer room than one decorated in blues and greens and purples.

The position of a color in relation to other colors influences our perception of those colors. A blue square on a black background looks very different from a blue square on a yellow background. The visual world is seen only as colors in relation to other colors; what appears as "lines" are borders between colors.

Color exists as pigment, the actual paint that has molecular properties to reflect or absorb certain light waves, thus producing what humans sense as color. A painting, composed of pigmentation, *reflects* light. There is no light in the painting. The computer, on the other hand, is actually sending electronic signals which generate or create light on the screen. Those light waves create our awareness of color.

Color *is* many things. Our perception of color is a combination of many factors: physical and molecular characteristics of an object that reflect and absorb light waves, the relationships and positions of colors interacting with one another, and the associations and symbols we bring from human experience. You might want to study color some more on your own.

After all, what is the visual world if it's not reflected patterns of color? Now that you know a bit about color, perhaps you'll be better prepared to color your world.

## Drawing

### Line drawing

*Make a CONTINUOUS LINE DRAWING. Every line must start from the end point of the last line. You cannot "pick up the pencil" and move it to a new starting point. The drawing will be finished when you decide to stop the continuous line.*

***Make a CONTINUOUS LINE DRAWING, as above except no line can cross any other line.***

Using ONLY lines,
create an impression
of the following:

a city or
the same city after
an earthquake or
a couple in love or
a campfire or
an amusement park

RULES: LINES CAN BE ANY LENGTH OR COLOR. NO LINE CAN TOUCH ANY OTHER LINE. MAXIMUM OF 15 LINES PER DRAWING.

*Create a drawing of a human face using ONLY diagonal lines.*

*Write your name using the line-drawing mode.*

**Rectangles**

Create a drawing out of rectangles that fit inside each other. No rectangle can touch any other rectangle.

**Create a drawing out of rectangles where they overlap to form new rectangles.**

**Circle**

*Fill the screen with as many concentric circles as you can. (Concentric circles "fit inside" each other. They have the same center point but different radii.)*

*Create a drawing made entirely of overlapping circles.*

***Create a painting entitled HOMAGE TO THE CIRCLE. Use color to fill your circles if you'd like.***

## Erase

***PAINT*** or draw a figure. Choose the background color to "paint over" that figure which will, in effect, erase it since it will disappear into the background. Practice your erasing skills.

Make a number of single pixel dots all over the screen. Now choose the background color. Can you erase each dot on the first try?

*PAINT by erasing.*
*Here's how:*

*Fill the screen with color, pattern, design, whatever you'd like for starters. Use the background color to "scrape away" or erase the paint to create your painting.*

***Fill the entire screen with one solid color. Now take the background color and erase the paint until you have created a recognizable human face out of the background color.***

## Fill

Create two different closed figures of identical area on the screen. (You'll have to use a little math here.) Place the cursor in the exact center of one figure. Time how long it takes to fill 'er up. Now place the cursor in the exact center of the other figure. Time how long it takes the second figure to fill. Do figures of the same area but different shape fill in the same length of time? Place the cursor near the edge of each figure. Does that alter the length of time necessary to fill them?

**Create a *PAINTING* using ONLY filled shapes.**

What's the skinniest shape you can fill?

*Have you ever watched thousands of dominoes lined up, where you push the first and it hits the second which knocks down the third until all the dominoes have fallen over? Make a series of shapes connected to each other by narrow links. Just like dominoes, fill the first and watch it travel to the second and then to the third until all the shapes have been filled. Does the computer fill each shape completely before going on to the next? Does it make any difference where you place the cursor?*

**Make a set of concentric circles. Fill every other circle with a different color.**

**Make a *PAINTING* of filled shapes where each shape is filled with the same color as the outline. Keep your *PAINTING*. Now make the same *PAINTING*, only X-fill each shape in a different color than the outline. Look at the two *PAINTINGS*. How much difference did that one change make?**

I think you've probably had your fill of these.

## KEEPING PICTURES

Being able to keep pictures lets you do all sorts of things. Here are a few ideas to try:

Make a coloring book. Keep the un-colored outlines in the computer memory. Bring them to the screen and let friends color them in.

***Make a "connect the dots" grid. Keep the grid in the computer's memory. Bring the dots to the screen and let a friend connect them according to your instructions. (You may want to number the dots in order.) Your friend may want to use the line-drawing mode for this one.***

*Make a background landscape. Keep it in the computer's memory. Bring it to the screen and ask a friend to inhabit your scene with people. Ask many friends to do the same thing. Keep all the pictures and then see how many different ways your friends populated the same landscape. Could you tell which friend painted which people from knowing about your friend and looking at the paintings?*

You can play lots of games by making a game board and keeping it in the computer's memory. Just bring it to the screen whenever you want to play.

**Try: Checkers (you'll have to figure out how to move your pieces)**
**Tic Tac Toe**
**Hangman**
**Dots (sometimes called squares or boxes)**

**Invent your own games and game boards.**

Create a maze. Keep it in the computer's memory. Bring it to the screen. Place a dot at the entrance to the maze and see if a friend can move through it to get to the exit.

***PAINT* from memory. Create a painting of shapes or designs. Keep it. Now try to re-create the same painting from your memory. Look at the two paintings. How'd you do?**

*Make a doodle or simple object. Keep it in the computer's memory. Bring it to the screen and ask your friends to add to the doodle or object to make it into something else. Keep their work and see how many different objects were made from the same starting doodle.*

Well, I could go on forever with these ideas. And so could you! In fact, that's the whole idea!!! Why not add your own pages to this chapter. Fill them with more games, paintings to make, moods to capture. Then try them out on your family and friends. Go to it.

# CONCLUSION

Guess what? I don't have any brilliant conclusions to offer you. Why? ***PAINT*** is art, ***PAINT*** is imagination. ***PAINT*** is the human spirit, ***PAINT*** is you. ***PAINT*** is a never-ending process, a series of heartbeats in the life of art history. There are no conclusions to an open-ended process like this, only a lot of wonderful experiences leading to...?

.....leading to wherever *YOU* want to go, for *YOU* are the creative force behind ***PAINT***. You are unique and your art will reflect your world, your hopes, your visions, your experiences, your colors. ***PAINT***, the book, is ending, but YOU, the artist, are just beginning. HAPPY ***PAINTING***!

# GLOSSARY

**ALGORITHM** — part of a computer program that solves a specific problem for which it can always find a result. In ***PAINT***, circle and fill are examples of algorithms which are part of the overall program.

**BINARY** — the number system upon which all modern computers are based. All activity takes place inside the computer as manipulations of strings of 1's and 0's, and any number no matter how large can be stored with enough 1's and 0's.

**BIT** — the incredible unit of information which makes up all digital computing. One bit is a single 1 or 0. It can be used to express Yes or No, True or False.

**BUG** — error or problem in the software that prevents it from working as it should. The SuperBoots staff spent many hours tracking down bugs and swatting them.

**BYTE** — a group of 8 bits together, which can stand for an operation like add, or jump, or letters, or any number from 0 to 255.

**CPU** — Central Processing Unit (can be one chip or many chips together) which controls all the activity inside. In the ATARI 800 the CPU is the 6502 single-chip microprocessor.

**CRT** — Cathode Ray Tube, a video monitor like your TV set which is an output device displaying the contents of your computer screen memory.

**CURSOR** — the small cross or box that marks your location on the screen.

**DATA** — codes that represent numbers, letters or words which become meaningful when people interpret them.

**DIGITAL** — nearly all computers these days are digital, which means they use data that is "discrete" or broken up into bits rather than continuous electronic signals like your stereo or TV.

**DISK** — a magnetic storage medium coated with microscopic magnets like audio recording tape. Disks are round and flat like records, and programs such as *PAINT* are read off the disk by the head inside the disk drive.

**DOS** — Disk Operating System. The program which controls all the computer handling of disk activity.

**HARDWARE** — the physical components of a computer system, i.e., the machine and its input and output devices.

**IMAGING** — computer graphics, where images are generated from inside the computer with software as opposed to manual or mechanical means.

**INPUT** — the data given to the computer for processing.

**INTERACTIVE** — a responsive user/computer environment where a dialog exists between the program and the person using it.

**INTERPRETER** — the BASIC cartridge inside the ATARI is the interpreter between BASIC commands which people understand and the machine code which the computer uses to follow instructions.

**JOYSTICK BUTTON** — the button at the base of the joystick which, when pressed, indicates to the computer that you want an "event" to happen.

**JOYSTICK** — the rod that is used to control the movement of the cursor on the screen.

**KEYBOARD** — the set of typewriter-like keys used to give instructions and data to the computer.

**MENU** — a screen display which shows the choices available to the computer's user.

**OUTPUT** — the results of the computer's processing.

**PIXEL** — literally "picture element", the smallest rectangle screen unit. In the ATARI Graphics 7 mode which ***PAINT*** uses there are 80 x 160 pixels (12,800) which have corresponding values in the computer's screen.

**PROGRAM** — a set of instructions which perform tasks inside the computer.

**RAM** — Random Access Memory. The very fast memory inside the computer where the processing takes place. Your computer has somewhere between 16 and 48K (K means 1024) bytes of RAM.

**RASTER** — refers to the horizontal lines scanned across the video monitor which make up the image you see.

**ROM** — Read Only Memory. This specialized variety of memory chip differs from RAM because it is "read only"; you cannot write into it or change it.

The BASIC cartridge for the ATARI 800 has ROM inside.

**SOFTWARE** — a general term for programs—that part of an operating computer system which is not the machine or hardware. Software is what makes hardware do exactly what people want.

# BIBLIOGRAPHY


1. Arnason, H. H. *History of Modern Art.* New York: Prentice-Hall and Harry N. Abrams, 1976.
2. Batterbury, Ariane Ruskin, *The Pantheon Story of Art for Young People.* Canada: Pantheon Books, 1964.
3. Hartt, Frederick. *ART: A History of Painting, Sculpture, Architecture*, Vol. I, II. New York: Prentice-Hall and Harry N. Abrams, 1976.
4. Itten, Johannes. *The Art of Color.* New York: Van Nostrand Reinhold, 1973.
5. Nouri, Guy. *High Tech in the 80's*. Backstage Publications, April 1980.
6. Perlman, Martin, *"The Artist and the Computer." Santa Barbara News and Review*, 9 October 1980. pp. 19–21.
7. Shaw, Donald R. *Your Small Business Computer.* New York: Van Nostrand Reinhold Company, 1981.
8. Taylor, Judy. *"Stan VanDerBeek: Independent Filmmaker, Artist of the Future." University of Maryland Graduate School Chronicle*, September 1977. pp. 2-5.
9. Whitney, John. Digital Harmony: *On the Complementarity of Music and Visual Art*. Peterborough, N.Y.: BYTE Books/McGraw-Hill, 1980.

# THE PEOPLE BEHIND *PAINT*

Late at night. The melodic sounds of a well-played recorder fill the room. Must be Eric "thinking" again. Jimmy is staring at the screen, his concentration so intense he doesn't even hear the music. Mark is pacing back and forth waiting for the coffee to heat up. This is SuperBoots™, the Capital Children's Museum's computer laboratory that created ***PAINT***.

Jimmy continues to stare at the computer screen. The soft blips and bleeps of purring computers provide an accompaniment to Eric's recorder. The music stops. Eric now strides through the offices, around the desk, behind the file cabinet, past the door, through Jimmy's room and back to his own desk. Around the desk behind the file cabinet, past the door, through Jimmy's room, and back to his own desk. This continues for half an hour. Suddenly, Eric pounces on his keyboard, and typing furiously, spews the thoughts of the past half hour into the computer as fast as they can come out. The thinking pays off. A smile fills his tired face. "I got it!" he cries. "I know how we can mix colors! It's in there. I got it!"

And so it went at SuperBoots™. For two months, the programmers, Eric Podietz, Mark Scott, Jimmy Snyder, and Project Director, Guy Nouri, worked to create the ***PAINT*** program.

During the day, SuperBoots™ offices were surrounded, not by secretaries and engineers, but by kids: hundreds of excited, delighted kids visiting the Children's Museum; kids at play, kids at work, kids making crafts, using computers, learning about patterns, shapes, foreign countries, kids feeling the thrill and pride of new discoveries.

In this vibrant, people-filled environment the SuperBoots™ team worked. They wanted to create the best ***PAINT*** program ever.

Have you ever spent a lot of time working together with a group of people? Have you ever gone camping for a few weeks with friends? Or trained and practiced and sweated all season with sports teammates? Or perhaps you rehearsed for months to put on a play? If you've ever done anything like that, you know the type of closeness and spirit that develops. It was just that type of team effort and affection that made the SuperBoots™ spirit so special.

Guy Nouri, the Project Director, praising, coaxing, encouraging, reminding, scolding, hugging, helping. He gave his programmers the respect and trust they needed to do the job. Guy is an artist at heart, a painter. Guy was the one who always saw ***PAINT*** as a new art form. He's a computer graphics consultant dedicated to the creative use of simple computers.

Eric Podietz, chief programmer. Ringlets of frizzy, fly-away blond hair. Why even bother to comb it? Eric was a computernik from his high school days. Worked at age 15 programming for the University of Pennsylvania, fascinated by the infinite possibilities of computers. Studied geology at Tufts, traveled to Nepal and the East. Eric—a wry sense of wit, a mind capable of solving any programming challenge, a teacher of arts and crafts, a lover of ideas and painting.

Mark Scott, programmer. Straight out of Duke. Didn't even touch a computer until college.

Interested in artifical intelligence and the graphic capabilities of computers. Mischievious, warm, full of fun, grew up in "...New Jersey 'burbs." Mark loves the SuperBoots experience: "We're all good friends."

Jimmy Snyder, programmer, ATARI specialist. Quiet, dedicated, Jimmy worked at his computer for hours and hours at a stretch. The pessimist, never thinks he can make the program work. Then goes ahead and does it! A mathematician who went to Rutgers and Temple. Teacher of math, piano player, first got into computers after playing *Star Trek*. The thrill for Jimmy is when the program finally works in the computer just as he envisioned it. Tenacious, methodical, Jimmy is engaged to be married.

Last comes me, the author, I love kids and worked for 8 years as the Director of a warm and wonderful alternative junior high school. Maybe one reason I worked at such an untraditional school is because I went to traditional schools (Exeter, Harvard College and School of Education). I am now living at my farm, Austin's Rock, in the Blue Ridge Mountains. Along with other educators and artists, I am developing Austin's Rock as a summer camp, a workshop retreat; a place devoted to art, theatre, learning, creativity and people.

# INDEX

ATARI®

A Warner Communications Company



PRINTED IN U.S.A.
C016083-48 REV. A