COMPUTER GRAPHICS AND STORY TELLING

by
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Abstract _

The use of computer graphics designed for film and
television is discussed from an aesthetic and systems
point of view. Graphics are used for information
clarification in news and documentary work, digital
video effects are used for style and pizazz, and
special computer effects are used in fictional film.
Freedom in designing all three demands a flexible,
modular system and a responsive user interface.
Business systems are described and current research
into this problem explored.

Development of effects in the specific MIT environment
for the videotape project Key Change is also explained.
Key Change is a 30 minute, 3/4 inch, color, stereo vi-
deotape submitted in partial fulfillment of the degree
requirements. Problems and solutions in interfacing
the time-sharing Visible Language Workshop graphics
workstation to the Film Section one inch equipment are
described. A possible user interface based on current
research and the author's experience is designed.
The videotape is in English.

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"This technology is like fire. It's a great tool but a lousy master. Somebody takes something and flips it just for the sake of flipping it. You say 'Why? Who needs it? That's gimmickry.' We're not going to be doing things for their own sake. I hope not. I sure hope not."

Julius Barnathan
President of Broadcast Operations and Engineering
American Broadcasting Corporation

Acknowledgements _

This page is intended to show my appreciation to
people without whom this effort could not have been
made, and yet who were not credited in the videotape.
A list of those who worked on the videotape is in-
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Like a frozen pizza, computer graphics are not the
real thing. Although graphical effects are in some
ways a closer representation of reality, unlike film
and video, it is not a recording of a real object. As
with any communication or artistic medium, computer
graphics have a distinct quality, which can be ex-
ploited for itself [1]. Story telling feature films
have become more and more naturalistic over time, with
non-representational films split off into that unplea-
sant category "abstract" or "experimental" film. These
divisions would suggest that abstraction does not have
a place in fictional filmmaking. Recently there has
arisen a genre which straddles the line between pure
abstraction and story telling, the music video.
Although music videos are quite new and not very
highly developed, it is important that for the first
time audiences in large numbers are watching a non-
representational style of filmmaking. I have explored
another use of abstraction through computer graphics,
in story telling, by making the videotape Key Change.

As Julius Barnathan [2] suggests, aesthetic consi-
derations are the primary motivation for creating

graphics, not the attraction of technology. The
greatest use of computer graphics in television until
the present has been to enliven and clarify factual
information: sports statistics, logos and news stories.
Because graphics equipment for these purposes is the
most sophisticated in design and utilization, its
technology and possibilities will serve as a central
focus for discussion. In my movie Key Change, however,
computer graphics must be integrated with the formal
and contextual nature of fiction. A brief discussion
of my feelings about effects in movies follows before
continuing with the hardware and software issues.

Among feature films, the most extensive use of
abstraction has occured in science fiction films, most
notably Tron. Some of the effects in the Star Wars
series were computer generated. The New York Institute
of Technology has been producing a space fiction epic,
The Works, since 1978 with their evolving computer
animation system. All of these movies depend on
science fiction to justify the use of graphics.
Without unduly impugning a popular literature, much
science fiction depends for its success on formulaic
plot, heroic rather than complex character, and
oftentimes reinforcement of common prejudice. While
fantasy allows the author (auteur) to ask radical
questions in a radical style, unlike naturalistic

moviemaking, science fiction has often chosen to continue the conservative path. Tron is spectacular for its use of computer graphics, but neanderthal in literary content.

On the other side of the coin, the attempt to use effects in story telling of the non-fantastic variety has had uneven success. The following examples were not computer originated, but the aesthetic choice to include non-representational images is interesting to examine. Spellbound, directed by Alfred Hitchcock, attempts to show the main character's recovery from schizophrenia through Salvador Dali's phantasmagoric effects in an episode halfway through the movie. The animation in no way resembles the naturalistic look of the rest of the film, so that Hitchcock's typical tightly woven editing and shooting is suddenly interrupted with the look of cell animation. Audiences often laugh in surprise at the break in continuity of style, as well as at the shallowness of the Freudian analysis. A more successful film is Robert Altman's Images, starring Susannah York. Also a psychological drama, this one allows the viewer to see the characters who populate both the inner and outer life of the main character without always indicating which is which. It is successful because most of the affect lies in the acting, only at the end do we see both of

Susannah York's personalities in one frame.

This history has challenged me to truly integrate the graphics in Key Change. Movies, due to their youth, draw on several older mediums. Two of metaphorical interest are music and painting. In a sense, combining graphics with film is like stopping a symphony mid-movement, carrying on a large painting, then continuing with the music an appropriate amount of time later. I have chosen to use some iconic, but real time images in the live action and incorporate moving images in the effects. More information about the story itself is found in Appendix A, the script in Appendix D.

Subtle psychological changes want to be depicted abstractly. However, the above two feature film examples show that continuity of style must be maintained for proper affect. Like words, picture elements (pixels) begin as abstractions and can be manipulated in infinite ways. I propose that greater access to these ways be provided and have attempted to achieve an approximation of my goal by writing programs specifically for a videotape on the Visible Language Workshop computer to be recorded on the Film Section videotape machines. This thesis proposes that through both machine and human interface alterations, graphics can become more flexible and personal.

2.1 The Merging of Digital Technology with Analog Video

Analog video is a time dependent phenomenon. Like film
and music, television is experienced in real time by
an audience. Although interactive computer systems
demand attention to speed, computer graphics are more
analogous to painting. Although not universally true
of the computer graphics world, when used for
television, the end result is the object, not the
process. In addition, the television signal must
conform to one of three world standards in order to be
broadcast, whereas computer graphics systems have been
designed without regard for compatibility. An artist
is stuck with the resolution of NTSC, but can work on
a high resolution system when drawing with a computer.

As recently as 1980, television engineers had to be
introduced to the foreign medium of computer graphics
[1], a medium which has been evolving since the
mid-sixties. Graphics machines have come a long ways
towards compatibility with the analog environment in
the intervening years. At the same time television has
become more and more digital [2]. The popularity of
the computer look has actually led to imitation by

more traditional animation methods, so that it is sometimes difficult to tell them apart [3].

Computer graphics hardware for television arose from two separate needs. One from titling, and the other from picture manipulation. Originally character generators were hardware devices that made monochrome letters for keying. Over the past ten years software-intensive font generators such as the Chyron and Dubner series have evolved. Features include multiple fonts, from eight to 500 colors and typesetting niceties such as kerning algorithms. These have become standard on the more expensive models [4]. At the same time ever-flashier movement was sought in the form of digital picture manipulation. Companies like Quantel made it possible to manipulate the picture as if it were a piece of paper: turning it, flipping it, rolling it, or "dve", digital video effects. Later, "real" computer graphics were introduced in such products as the Quantel Paint Box out of a need to clarify statistical and geographical information.

Exactly which boxes qualify as computer graphics generators is open to interpretation, however picture creators as opposed to picture manipulators is a good beginning division. Among the picture generators, frame storage based devices have a raster scan display,

whereas calligraphic displays must be filmed or re-
scanned to become video [5]. Ease of use, greater com-
patibility with video, and lower memory costs have led
to a greater number of frame storage based devices on
the market.

There are three categories of considerations when
merging digital and analog video. They are the system
in which graphics are used, hardware compatibility,
and differing aesthetic demands.

2.1.1 Systems Considerations

Traditional television art departments used paper and
mylar or slides to originate material before recording
with a graphics camera. The art department resided in
its own area of the station and produced about ten or
twelve slides per day [6]. Motion was simulated by
zooming or panning across a still frame. Real time
effects were created in the editing room with an
analog switcher.

As software-based font generators were introduced,
they were kept in the editing room as an adjunct to
the switcher in much the same way an echo box is
attached to an audio mixer. DVE and Quantel motion
effects boxes were seen as a kind of digital switcher,
performing the same task of effects creation.

In order to change an effect new software could
sometimes be bought from the manufacturer, but it was
not necessarily customized. As new features were added
to each product the lines blurred between product
categories. At the same time the cost rose commensu-
rately with the new capabilties. Especially in a house
or station with more than one editing room, it was not
cost effective to buy duplicate graphics equipment for
each room.

The amount of time spent to create a good graphic also
became a factor. Even though the computer titling took
far less time than drawing by hand, it is more
involved than simply typing in the appropriate title
to a character generator. Picture creation was also
much more rapid, nevertheless, it is inappropriate to
sit in an editing suite watching the artist draw with
a digitizing tablet. Computer graphics have to be
integrated into station use. This question is being
resolved a number of different ways to be discussed
throughout this thesis.

2.1.2 Technical Considerations

Video equipment used in a system configuration runs on
"house sync" or a constant synching signal usually
provided by a composite video signal. Computers must
be able to listen for this signal to provide output at

the proper intervals. The "proper interval" is usually the vertical refresh interval every one-thirtieth or one-sixtieth of a second. Computer interrupt signals should occur in this interval. In editing suites and production situations all video signals are phased at the switcher for mixing together.

Timing problems have still not been completely solved in computer graphics [7]. Most informational graphics are still frames: graphs, election returns, maps or faces and titles. Camera type motion across the still frame is simulated by the computer or by a motion effects box. Color map values can be cycled through a still picture. Another way of simulating motion is with computer animation. In animation, one frame of video is created at a time, often from interpolated movements. After this frame is created, it is then recorded onto videotape (usually for two video frames). With this method the length of time to fill the frame buffer has no effect on the resulting videotape. The third method is real time motion creation, used mainly by the Department of Defense to train pilots. A few very specialized companies like Information International, Inc. (triple-I) have real time motion creation. Real time motion creation requires a dedicated main frame computer and is usually shown on a vector display, sometimes in an analog environment.   14

2.1.3 Aesthetic Considerations

For broadcast quality work, the computer graphics
artist is bound by several considerations. One is
SMPTE Safe Area, or the middle 75% of the screen which
SMPTE has determined will be readable on all home
television sets. Another is that colors must be
readable as contrasting intensity values as well as
contrasting hues, otherwise a black & white home
receiver will not be decipherable.

Resolution in NTSC is fixed and may be greater or less
than the computer graphics screen. For instance,
non-serif letters are usually more successful on the
television screen, even if they are perfectly legible
on a 1024 x 1024 bit-mapped display [8]. If resolution
is much greater for the graphics generator, a moire
pattern may appear on the television screen. Some
frame buffers, like the Grinnell at the VLW have a
square aspect ratio, unlike the 1:1.3 aspect ratio of
television. When images generated by the computer are
written back into NTSC the black border on both sides
remains.

Aliasing problems, once a dominant problem in graphics,
have been solved for most systems. In brief, aliasing
is cured through algorithms which apply the Nyquist
sampling rule: that the sampling rate must be at least

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twice the highest image frequency to avoid stairstep-
ping. A pixel, in that case, must not be smaller than
two raster scan lines wide.

Computers are usually capable of generating and dis-
playing greater numbers of colors than NTSC video. In
particular, saturated yellows can not be broadcast or
recorded.

2.2 Current Television Graphics

The wealth and size of the networks makes their use of
graphics the most interesting from both a systems
point of view and from a use point of view.

2.2.1 ABC

Of the three broadcast networks, ABC (American
Broadcasting Corporation) has invested the most
research and money into television graphics, primarily
due to their large sports contracts and election
coverage. Unlike NBC who is tied to RCA engineering
decisions, or CBS who prefers a more conservative
image, ABC has encouraged equipment and engineering
innovations of all kinds. Julius Barnathan, President
for Broadcast Operations and Engineering at ABC is the
single most responsible individual for ABC's ascen-
dancy. Together with Roger Goodman, Director of
Production Development for News and Sports, they have

designed the most sophisticated (and expensive) graphics system in use today.

Electronic graphics for the Olympics were conceptualized in much the same way traditional graphics departments were. In other words graphics were developed alone for four years before the Games began, separately from live coverage. Harry Dubner worked with ABC to create software appropriate for them. Artist/programmer teams were intensively trained on the Quantel Mirage and Paintbox systems. The "look" of the graphics was created and developed.

At the Winter Olympics the graphics machines were still kept in one room with feeds to switchers in twelve three-machine 3/4" editing rooms. This organization is a return to the old Art Departments with their feed from graphics cameras. Graphics machines included 5 Dubner CBG-2s, 2 Chyron IVs, a 4 channel ADO, 1 Mirage, 2 Quantel 6030s (1600 frames each), 1 Quantel Paint Box, 1 control computer and 1 archival computer for the still stores. All of the equipment was kept in the graphics room. In addition, three Dubners were used during live broadcast. Because any editing room could need access to any graphic at any time, and because trained personnel are needed to operate graphics equipment, the graphics output was

used as a switcher feed to the editing room rather than as an adjunct to the switcher. The editor calls the graphics room to request an effect by number and a motion by number with the effect [9].

The graphics produced for the 1984 Winter Olympics were clear and consistent, but not to my taste. I found them somewhat staid and squat. One of the effects, presumably a Mirage creation, of a turning globe, was unreadable. The "Close-up and Personal" series profiling each athlete was more exciting and informative, as it was meant to be. To their credit, the graphics were smooth enough that it's hard to believe so much time went into their creation.

ABC has done far and away the most in-house work with graphics, to the point that it has created the station's "look".

2.2.2 CBS

CBS (Columbia Broadcasting Systems) has had a more sophisticated attitude towards graphics than the other networks, employing a Vice President for Design. Their emphasis has been on style rather than on method, attempting to integrate both traditional and computer methods, both in house and out of house. The most conservative of the broadcast systems has the most conservative graphics style. CBS World News Tonight

uses a spinning globe for its promos, now, in spring 1984. In addition CBS also used a different kind of globe opening briefly last year on Nightwatch. Although this graphic was made out of house, Nightwatch does use an Ampex AVA, an ADDA system and a Dubner font generator to create graphics for news.

2.2.3 NBC

NBC (National Broadcasting Corporation), is owned by RCA and consequently has not been as innovative during the past twenty years while RCA was diversifying into other interests besides television. Even after NBC developed, in 1983, a new spinning globe logo for The Nightly News at a specialty house; they abandoned it for a clean opening straight to the anchor [10]. The Nightly News uses three ADDA still stores (223,000 frames), one Quantel Paint Box, an one Chyron IV.

2.2.4 Specialty Houses and Other Users

"Most of the truly sophisticated computer graphics seen on television are generated at specialized production houses." [11] Although Mr. Stock's information is somewhat outdated, he is substantially correct when it comes to series openings and closings, variety shows, animation and some special effects. The existence of computer graphics houses who cater to

television came about largely for two reasons. One is the necessity of training operators, hopefully giving them enough time with the tool that they become proficient with it. The second is the tremendous cost of the equipment and the need to have it earn its keep through steady use. In addition, when the networks are under pressure, a specialty house can pick up the slack. Increasingly, other uses for computer graphics are being found, such as disc premastering and some industrial tapes.

The Weather Channel, a national cable service, is the most reliant on computer graphics of any single network [12]. The service provides both teletext and video. Weather information is released in 30 minutes segments, each designed and switched by an on-air meteoroloist. Graphics on the national uplink feed are created by an Aurora AU-100 Design System, Quantel Paint Box and a Quantel 6030 still store from constantly incoming National Weather Service and Weather Service International data. A modified Industrial Sciences Incorporated switcher controls everything, including the central computer. There are no moving cameras, no directors, no switcher operator. Two people run and load tape. Computer graphics are the reality; the weather person is keyed in!

Chapter Three
Developing the Proposed System _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

3.1 State of the System in December 1983

In this chapter practical development of the thesis
idea is described, starting with efforts by other
students and ending with the author's efforts.

3.1.1 General State (Computing Environment)

At the outset a general overview of the system will be
helpful. The Perkin-Elmer 3220 is a 32-bit mini-
computer with 512K bytes of core memory. Disk storage
is a 300 megabyte "trident-type" drive with a high I/O
bandwidth. Peripherals include: a Grinnell GMR-270
frame buffer with a capacity of 512 x 512 pixels by 27
bits of color information deep, a Vidicon surveillance
camera which feeds non-composite video signals to the
frame buffer, and a Summagraphics Bit Pad tablet with
a 4-button puck.

The Magic Six operating system, developed by the
Architecture Machine Group at M.I.T., supports an
interactive computing environment. Features include a
tree-structured file system, dynamic linking, and a
process stack. The pl/1 language, a subset of standard
PL/1, was also developed by the Architecture Machine

Group. It supports recursion, pointers, structures, signals, error-handling, and "initiated segments," which allow the user to structure core memory. [1]

Source code is designated with the postscript ".pll" (no quotation marks) and the object code only bears the name. Several programs can be run in the same segment space by binding them in a file called <name>.bind. Again, the bind file is designated by the name only and stores all the object code listed. Menus have the postscript ".menu". Names can be any length, but must not have spaces or begin with nonalphanumeric characters. Menus provide access to different processes at the user's discretion through tree-structured pathways.

The one inch machine room consists of two Ampex VPR-2B with time base correcters, the single board computer and a patch bay with inputs and outputs from the VLW. Other control and audio equipment exists in the room which make it an editing suite when not interfaced.

3.1.2 Peppel, Adams and Thompson efforts

Tyler Peppel, a Visible Language Workshop graduate (January 1984) originated the idea of linking the VLW computer to videotape recording facilities at the Film Section in the fall of 1982. Through his efforts, and under his direction, much work was accomplished.

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The interface to the Film Section begins with 100 feet of a serial computer link, and coaxial cable for both sync and video (send and return). A proc amp and a codec, modified by Mark Abbate, Film Section Engineer, process the RGB computer signal to NTSC composite video at the VLW. A single board computer (SBC) built by M.I.T. graduate John Thompson (B.S.1983) interprets commands to the Ampex VPR-2B kept at Film Section as both a recording machine and a source machine for grabbing frames. When properly patched, playback is available at the VLW through a Panasonic NTSC television monitor. A detailed description of this process was written by Peppel in his thesis, Digital/ Analog Video.

Software was developed in several packages. John Thompson wrote an animation package based on Karl Sim's animation package at the Architecture Machine Group. Thompson restructured the programming to conserve space. Important to this thesis are two aspects of his software. First, the program calls the menu, the menu is not the primary structuring device. Secondly, no video commands are explicit. When the interface is activated, frames are automatically recorded as they are interpolated. Inevitably, his video package is incompatible with Adams video effects menu.

Kate Adams was an undergraduate M.I.T. student who completed her thesis at the VLW in January of 1984. Using Peppel's design she wrote a video effects menu. This menu, entitled "eff" on the system, is the one I built on to explore my thesis. Using Henigan's menu system, the menu is the primary structuring device for the available programs. Adams describes her work as "... a software package... which implements zooms, pans, wipes, fades, and dissolves. A menu-based user interface with on-line documentation make the package easy to use and consistent with other computer graphics facilities at the VLW" [2].

Adams has indeed made an extremely accessible, organized menu for manipulating computer graphics images. Her robust programs cover all the basic manipulations a user could want, in imitation of an analog switcher's processes, but with a surprising twist based on the computer's capabilities. Wipes can be colorized in the overlay plane (eight colors) or made into simulated 3D box shapes using the area define and color functions. Dissolves are not smooth, but rhythmic, as color matrices are loaded. Since her work is extremely well documented both on-line and in her thesis, I will not cover them here.

3.2 Further Development

As an initial effort, many directions are suggested by Adam's initial menu. Options on the menu primarily aid a graphic designer to create output which looks like analog television. Very little emphasis was placed on making video look like graphics. In addition, the video interface commands were not installed in Adam's menu at the time of her graduation. Immediate goals were to 1) allow access to 1" and 2) write programs of specific importance to the author's videotape.

3.2.1 VTR control and menu

Because packages on the VLW system are not compatible in their menu calling protocol, a video control system which could be called from any package is not possible without writing a menu which actually called more than one video control system. Therefore it was decided that desired controls be installed in Adams menu. Available commands are "talk" to examine the one inch interface, "play" to view video, "record" to record from one frame marked by time code to another, and "stop" and "rewind". There is no practical method of controlling speed of effects creation on a time-sharing computer. A kludge was created using the delay capability of Kate's menu and reserving the entire system for use when needed.

3.2.2 Unique effects developed

The idea for Key Change did not appear as a story but as a series of images; not still, but having very little movement, and as a stream of words from different voices. In one sense the live action or naturalistic footage is only there to give the audience a context in which to understand the digitized image.

With these images in mind I set about programming in June 1983. The first series of images were stochastic wipes in an overlay plane. My feeling about Patricia's resolution with herself and her brother is a combination of inevitability of the act and uniqueness of the form. This wipe in its full screen version was incorporated into the effects menu as the soft-edge wipe. I continued playing with it in various forms and came up with a series of window wipes, still randomly generated, in windwipes.pll.

Another series of wipes were based on circle drawing routines. By using a circle drawn with radians, the circumference points became the center points for squares. Instead of writing squares, I could also use the buffer. Another wipe, spike, is just the radian-drawn circle. Polish, half, star, spike, and circle-

wipe are the entry points in circlewipes. pll.

I wanted to show a longer change than a two picture dissolve can afford, so I rewrote Adam's fourbit.pll to dissolve four two bit pictures, hence, twobits.pll. Again, the dissolve is performed on the reconstructed pictures by loading color matrices into the frame buffer. Source code and maintenance information for these programs is listed in Appendix B.

3.2.3 Scripting

Although the menu system is useful for one series of commands, allowing for a separate chain of commands becomes difficult. Because video equipment needs one set of commands and the computer another, two separate operations are being carried on at once. Like being in one train running parallel to another, it's hard to see into or communicate with the other train. However, a plane flying overhead can see quite easily what each train is doing and measure when it does it.

Scripting is the software term for the plane. It saves and lists the commands given from a menu in order. Video commands use the calculation abilities of the built-in microcomputers in controllers to construct an edit list. This list allows for edits to be remade at any point, like a script. More sophisticated controller/ switcher combinations also record analog effects. A

similar system is needed to fully implement the effects menu.

Henigan (S.M.Vis.S. 1983) had written a program which recorded tablet information in the form of a linked list, btest.pll. Since all commands are given from the menu this software could be adapted for use with the menu. The script tracks all cursor commands and saves them to be replayed when "record" is requested. If the file is preserved and the source pictures kept on line, the effect can be replayed at any time.

Another method does not require the computer to recognize button level and area, but remembers calls to programs. Although this script "hardwires" the menu in the sense that changes to the menu must be reflected in the script, it is much easier to implement and more reliable under the circumstances. Scripting is the final touch to the video menu, however it remains a future project.

4.1 Using the Specific System

The way in which computer graphics is understood (sys-
tematized) changes options for the user. I will
consider and criticize use of the current MIT system,
as well as commercial systems and possibilites.

4.1.1 Implementation of the MIT System

In order to maintain consistency of style in my
videotape I chose to manipulate frames of video,
rather than create drawings on the system. Using the
systems paint and graphics capabilities it is quite
possible to "draw" a park bench and a brick wall, but
I wanted my material to look like the video around it.
While editing, appropriate frames were noted for
images in the finished piece. A one inch reel of these
possible choices was then recorded from the 3/4"
original tape. Only sixteen frames can be grabbed from
one inch and stored on magnetic computer tape at a
time. In all, about 20 frames were grabbed and stored.

Grabbing is currently a manual process in which one
person finds frames in the one inch room at the Film
Section and another person digitizes at the VLW. Due

to inefficiencies in the decoder (NTSC -> RGB) contrast and luminence is lost from the picture. To remedy this problem, sys (the VLW paint system) was used to change and resolve the color matrix. A warm color matrix was chosen.

Then a process of experimentation began in order to find the right effects. For instance the opening dissolve is actually one frame of video. "Restore", another sys program allows a user to restore a picture one pixel at a time. By saving the picture in three partially restored states, I was able to then switch to the dve menu and execute a four picture dissolve, resulting in the full picture.

The animals from the African tapestry in the baby scene were quite complex to create, but resulted in seemingly simple images. First the color matrix had to be established and resolved. Grab brush was used to modify the texture. Paint allowed me to highlight the eyes. Restore erased the palette from view.

Effects were recorded onto one inch tape from the VLW in all-night sessions. An additional period of time was needed for titles. Again, two people were needed for this process, one to insure the one inch deck was responding properly and one to employ the dve menu. In the process of doing the fine cut, the special effects

were edited in at the appropriate points in the one inch to one inch editing suite.

4.1.2 Critique of the System

The most glaring criticism is that, as a time-sharing computer, the Perkin-Elmer is the wrong computer to use for a time based procedure. Since this limitation was accepted at the outset, I expected that the process would be made longer and more difficult by the inability of the computer to respond to specific timing requirements. For instance, there is no real possibility for frame accurate transitions under Perkin-Elmer control, which is why the effects were recorded on one tape, then edited into the master.

The user interface at the VLW is that of any experimental laboratory: what you make it. Conditions are never stable, not even the ability to logout and login to the computer! Specifically, Adam's menu-accessible documentation is a great help to the menu user, but no other system has comparable documentation. Since there is no commercial product goal, or potential for stability, actual work on the user interface beyond imitating Adam's and Peppel's structure would not be profitable.

For another student to utilize the system for a

videotape as it stands now, the same method could be employed. Writing and testing programs in their own directory would take place before installation in the dve menu. My additions, listed in xtal.bind, could be removed from the menu rather simply, without removing the programs or the bind file from the directory >u> kma>video_source, to create more room for new effects. The system is flexible from a programmer's point of view.

4.2 The Business Environment

Different purposes require different systems, of course. While ABC's graphics system for the Olympics was very sophisticated and serviceable, it would not do for The Weather Channel. However, there are some system problems and interface problems both share. If computer graphics are to become as flexible and user-accessible as a pencil and paper are for a traditional artist, it is these problems which must be resolved.

4.2.1 Interface Problems

The interface between the designer and the machine now consists of a mouse, puck, or light pen and a keyboard. As physical items, these human-machine communication tools are adequate if traditional. Voice commands are not suited to describing visual design. Finger paint-

ing on a touch sensitive device is usually no more sophisticated than finger painting with paint. With the exception of the Quantel Mirage, the interface design aim has been to exclude end user programming of effects beyond the command level. Proprietary software is the major reason for this. In addition is the general division in society between those who program and those who design. Also, some union contracts define design and programming jobs separately [1].

Keyboards have grown in size up through the Dubner CBG-2. Not only are there as many keys as on a regular terminal, but there are shift and control-like keys, giving three command levels per key [2]. Although the operator need not program, he or she at least develops the logical ability to give commands in sequence. Light pens are the most popular drawing implement because of their range and precision over a digitizing tablet. As anyone who's used a puck knows, the edges of a picture are simply out of reach. Mice tend to be able to give only the crudest commands, such as indicating buttons on a menu or moving a cursor.

One user interface development has been KPL or keyboard programming language. On the CBG 1 and 2 the operator can define keys to address storage space and playback time. If this concept were carried further, user flexibility could be greatly increased, and the

size of the keyboard [3] could be reduced.

Another set of interface problems exist for both the editor and the designer, based on hardware problems. Serial protocol between machines has been standardized by a joint EBU-SMPTE committee, but machine languages have not [4]. Although digital effects can be implemented directly at any time, there is a problem with describing them on the Edit Decision List (or Edit List Management). In the graphics room, machines can not always be conjoined into one system.

4.2.2 Systems Problems

> "Once the remote control system is software
> based the broadcasting industry will have been
> finally able to divorce the question of human
> ergonomics from the question of the needs of
> the processing path. This will enable the
> development of the optimum human interface
> within the broadcast and post-production
> industries to proceed." [5]

This quotation from the EBU-SMPTE Serial Data Committee Report succinctly expresses how hardware interface problems affect the user interface. I will describe a conceivable solution to these hardware problems, a solution garnered from several sources.

The solution is based on a microcomputer node. This node could be networked to a larger system, stand alone, or control other pieces of hardware. In a financially ideal situation, it would do all three.

Starting at the least intelligent level of hardware
are the peripherals: VTRs of different formats, analog
switchers, paint boxes, still stores, digital effects
creators, video disc players and the next new "black
box" on the market. Since the late seventies there has
been an increasing effort to make these boxes less and
less hardware dependent. Grass Valley Group developed
E-MEM in 1979 to "teach" switchers and get away from
electro-mechanical connections to switchers [6]. Edit-
ing systems were improved through individual microcom-
puter board control generically called I-squares or
Intelligent Interfaces [7]. These boards use a micro-
processor chip as their central processing unit. VTRs
are seen as system elements rather than as stand alone
elements in an editing system [8]. Protel in England,
a computer systems design group, began their important
study of a fully computer networked television station
in 1978 [9].

These efforts have produced positive results in the
last year. One is the EBU-SMPTE Serial Protocol
agreement, another is the thoughtful design of post-
production houses such as Teletronics in New York. The
third result is the implementation of Protel's design
on a reduced scale.

After some amount of balking on my part, I realized it

was impossible not to include "black boxes" in any scheme. Proprietary software is not going to go away, nor are styles of effects or the demand for immediate gratification in use. The advantage of modularity is immediately clear upon reaching this conclusion. At this level the EBU-SMPTE agreement (RS232 and RS422 pins) is essential. However, what is sent through these interfaces and in what order - the machine dialects - is not standardized. Protel emphasizes this stumbling block to a more sophisticated system: "The system must, therefore, use a universal language for control of machines which is interpreted by the machine itself or an electronic supervisor to control the machine in question. By adopting this technique, the effects of the introduction of different machines are localized in the software system" [10]. Digital effects are a major category on the EBU-SMPTE list of hardware due for a standardized language.

> "As editing suites become progressively more complex, there is a need for system integration where some method of tying all the equipment together becomes essential. Recording an edit where audio must be dissolved, a title key brought in and out, and a digital frame store the start of the event - becomes very difficult to perform correctly in real time, unless the editor has multiple arms and an internal SMPTE time code reference!" [11]

Because the editing suite is one of the two main destinations for graphics (as opposed to on-air graphics),

the editing system and graphics system must function together smoothly. Graphics can be sent to editing as a video signal, in which case there is not an interface problem, as ABC did for the 1984 Olympics. However, in the case that the editing suite is described as a local network comprised of a microcomputer and its peripherals, a different set of data could be sent. Scripting information could describe the process rather than the end result. While most purely static information would not benefit from this method, other kinds of information would. It will continue to be easier for a news editor to request still store 1462 when she needs a map of Lebanon than it will be for her to worry about how the map was created. However, in the story telling use of graphics the process of creating the picture could often be as important as the picture itself. The ability to store, edit and communicate this list to the edit controller could be very important. Winkler developed what he calls the Very Intelligent Interface as an approach to solving this problem. The V-I squared talks to and coordinates all the peripherals in a room, using SMPTE Recommended Practice 113, "Supervisory Protocol for Digital Control Interface"[12]. Because of machine language inconsistencies it is not generic, but specific to the types of peripherals.

Another problem in Edit List Management is solved by using scripting information. The edit list, although simpler, is equivalent to the picture script. In the days of analog effects, a wipe or dissolve was lettered and numbered as to kind of effect and style, and inserted as a special kind of edit into the list [13]. Digital effects are not describable as a simple number nor would that number be portable from system to system. The Montage, the most sophisticated editing system on the market, has no way to name and pre-plan digital effects [14]. However, scripting is detailed enough that it very well could complete the editing list. Rather than print out the scripting information in the hard copy of the list, the file name of the script and length of edit would appear at the appropriate juncture on the list. Dean Winkler's editing suite design generalizes and modularizes hardware. Although he is not oriented towards graphics per se, the development of the Very Intelligent Interface [15] allows for the kind of software communication necessary for graphics.

In Protel's description of a networked station,the editing room is called a functional system or one microcomputer node and its peripherals. The microcomputer is on a larger network. The same software that interfaces one node to the network interfaces a

functional system to the ring. Cambridge Ring Technology was chosen rather than the more standard and popular Ethernet for its ability to begin information flow at a definitive time. The network integrates the editing system into the station. Any VTR on the network can be accessed. Because graphics equipment can be accessed it is not necessary to edit with time code numbers (except as machine instructions, of course). Program story script and previsualization materials are available from Management Information System files. The Edit Decision List is stored automatically and can be transferred to the fine cut room (actually a virtual room, or node) at any time [16].

Although the physical interface - light pen, tablet and key board - have not changed substantially, access for the graphic designer can now be made software dependent. Graphic designer/programmer teams can access software from any effects box or write their own software. Storyboarding or previsualization techniques can occur interactively with management, as well as finished graphics for programs. In the next chapter a software prototype for this situation will be explained.

> "We are watching with interest and a certain
> degree of skepticism, the ADO derivative-type
> hardware, like the Mirage, which tends to do a
> few things very well but appears to have a
> limited repertoire and requires a great deal of
> programming expertise. . . . It still... does not
> solve the dilemma between the new and routinized
> effects, because as soon as they become
> routinized, they lose all their commercial value."[1]

Again, the answer to the commercial dilemma is a more

flexible tool. A tool which avails itself of the

computer's mathematical capabilities while still

reflecting the artists "touch", the ineluctable

quality of human personality.

5.1 An Interface and Hardware Solution

5.1.1 Issue of categories

The artist's medium falls into categories: pastels,

steel, video, fresco. Each has certain parameters

which define its use, give it its nature, yet each

medium has been explored and stretched by artists at

work. The first important user of pastels, Rosalba

Carriera, combined chemical knowledge with willingness

to experiment and the vision to see the potential of

the medium to make a workable tool. Because the com-

puter requires highly specialized skills and a good
deal of dedicated time to keep up with technological
changes in addition to the time spent in training, it
does not easily lend itself to exploration by an
artist.

The trick with categorizing software is to limit in
"natural" ways. Charcoal is easier to handle in sticks,
but it can still be broken and smeared when appro-
priate. Lines and smudges can be easily combined in
the same picture. "Natural" means that the tool stays
in one piece for use in one way, but "breaks" for use
in another way. Practically this would indicate that
functions be in their smallest units, and be acces-
sible in a variety of structures.

5.1.2 Software Categories

In a comprehensive picture making and picture moving
facility for television there are five categories for
software. A network such as Protel's is assumed.
1. MAKE PICTURE - For drawing a still picture.
Includes paint, color, layout, 3D object design and
what I will describe later as program "activators."
2. PICTURE ELEMENTS - Font storage, Map storage, Icon
storage.
3. PICTURE UTILITIES - Save, Load, Edit, Digitize.
4. MOVE PICTURES - Plane animation (color maps), 3D

animation, simple DVE (expected effects such as dissolves), and complex DVE (designed effects). The ability to sense and change objects on videotape as described in Peppel's thesis is also necessary in a television production studio.

5. PREVISUALIZATION - Frame makers, bitmap construction, listing and data functions.

These five functions are the major "trees" of the system. There is movement between trees by returning to the root and continuing down another tree.

5.1.3 Software Functions

Within MAKE PICTURE the standard tools exist: Paint, Color, Layout, and 3D object creation. However, these programs can be called in different fashions. The "activators" tell the program how it is to be con-trolled. Examples are random calls, "all" or the total picture area, cursor-driven calls, or a defined area of the screen. For example if a color and a brush shape is chosen, the "brush" could be scattered in the picture randomly by using the random function, or placed with the lightpen (cursor-driven). Smear, a way of averaging adjacent color values, could occur over a defined area, or only where the cursor designates. Through activators, the programs are under greater user control. Modular programming makes calls among

programs possible. The artist can "hold" her tool the way she wishes.

PICTURE ELEMENTS are the constantly reused elements of news, weather, sports and commercials, as well as titling and map-making. Examples are fonts, numbers, maps, symbols and logos. This category is necessarily constant and not as flexible as picture making. Picture making could always be used to manipulate the elements or create new ones.

PICTURE UTILITES can be an important creative function in addition to the necessity of storing and loading artwork. The frame buffer can be stored as a script of commands, as static picture information, or as a new picture element. Thus, a script editor is needed. Pictures can be loaded whole, as a pixel, or as an area at a time. External materials such as photographs or videotape frames can be digitized and stored.

MOVE PICTURES includes standard plane and color map animation as well as simple digital video effects which have proved popular enough to be kept permanently on hand. An important addition is a complex digital effects designer. Complex digital video effects should have a visual design tool, one that would respond to specific picture input.

The complex camera moves for the Olympics required

technical personnel not trained in the visual arts. As
Roger Goodman tells it:

> "As far as the programming, it turned out to
> be pretty easy - that is, the programming on
> a day-by-day basis: If you wanted to move a
> box from left to right, that was pretty
> simple. The actual creating of the software
> in new programs was done by two outside
> mathematicians we hired. They both had
> doctorates. Basically their job was 40 hours
> a week. We'd come up with an idea and they'd
> write the software." [2]

From my own experience in trying to communicate design
ideas to designers, let alone to people untrained in
the field, it seems to me that the mathematicians
could be put to better use making a movement design
tool. Using a process not unlike animation a designer
to draw beginning and end moves of picture motion and
request interpolation. The drawings could be done
simply in bitmap fashion, with picture areas drawn in
and identified. Corners are identified as vector
points and smoothness is interpreted by the number of
interpolated frames requested. When the movement is
set, it can be compiled by an interpreter and tried
out on the pictures in question. Movement can be
integrated with a specific picture. Unlike the Mirage,
no math or programming is necessary at the design end.

In the networked station, PREVISUALIZATION is no
longer clearly separated from post-production. The
same artist who finishes the product can help design

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it. Producers and directors can receive feedback for their ideas more quickly through the network. Story-boarding will have access to a variety of different sources: videotape prototypes, polaroids, bit map drawings, digitized traditional drawings, and color computer paintings. An "icon-maker" or program which constructs and fills frames of the correct aspect ratio and desired size begins the process. Other programs would order and reorder frames or keep track of the data structures represented by each frame.

Admittedly this arrangement is somewhat "software happy". Probably quite a bit of speed is lost in continually constructing tools. Hopefully practice will make the user faster. The gain in direct access to the tool will eventually offset any loss in speed.

Just as analog and digital technology have tended to merge, and new communications technologies have merged in use, kinds of data needed in the production houses of the future will merge.

> "Devlin (Sandra) commented, 'I suppose I would have to say the single greatest advance in 1983 is the marriage of the computer with audio/visual devices,which include videodisc, the whole graphics-effects explosion, and interfacing the whole house. There's no real separation anymore between sorting out business information and processing visual information and controlling production systems.'" [3]

Programmers will certainly be needed to continue their work, but with easier information flow, more people

will have more control over their own work and the
opportunity to exercise their own skills.

5.2 Graphics for Key Change

Although there weren't as many or as complex effects
as I could have wished for in the final version, I'm
happy with the ones that are in Key Change. Due pri-
marily to the experimental nature of the tool and
equipment breakdowns, use time was limited by the end
of the semester.

Because the digitizing tablet was broken during the
time I needed it, and a switcher was unavailable, no
wipes were recorded at the time the thesis date
arrived. Hopefully some wipes will be recorded in the
early summer, with the addition of a new switcher. The
plate effect at the end of the kitchen scene needs a
transition. Other points where these wipes could be
used in the videotape are the wedding cake image (now
analog video) and the edit from the airport to the
Christmas party.

I am happiest with the dissolves because of their
subtle, yet definite effect. Rather than occuring
smoothly, the two pictures merge in a series of
definite steps. Since Patricia's story occurs in
stages with no definite change point, these dissolves

seem to be most clearly about her.

The still frames which were digitized and returned to video are interesting to me. There is a kind of live-liness and mystery to the digitized and painted image which does not exist in the original video.

As far as the VLW-Film Section system is concerned, the attempt to interface an uncooperative computer with an uncontrollable one inch machine gradually became a medieval meditation for me. Many of the problems which loomed dramatically over the system have been solved long ago in the commercial world. The inadequate decoder, the inability to time events, lack of permanent switcher hardware or an intelligent video controller made working on the interface seem too problematical to complete the more I understood the difficulties.

On the positive side, utilizing the system without trying to improve on its obvious technical deficien-cies was exciting. I could create effects not seen in the commercial world and play with my results. Having access to all the tools in an open graphics system gave me a tremendous amount of freedom. By going down a generation in the recording it was easy enough to "fit" the effects into the tape.

5.3 Drawing Together

Computer graphics for television has taken off dramatically in the last two or three years. In exploring an underutilized area, graphics for story telling, through a specific project at M.I.T., I discovered a set of user interface problems which seem to rest directly on hardware interface problems. Although most graphics are fairly formulaic in their use, for example, a map of Lebanon for a news story about Lebanon, commercial graphics would benefit greatly from the ability to unleash their designers with a truly flexible tool. The commercial dilemma between inaccessible software and routinized effects has to be solved eventually through a better hardware and user interfaces.

Notes _

|Chapter One
|Introduction

[1] Peppel, T. "Analog/Digital Video", M.S.Vis.S.
Thesis January 1984., p. 88.
[2] Taaffe, W., "You Ain't Seen Nothing Yet", SPORTS
ILLUSTRATED, February 6, 1984, p. 63.

|Chapter Two
|Current Practices and Issues

[1] Stock, R., "Introduction to Digital Computer Graphics
for Video", SMPTE JOURNAL, v.90, n.12, December 1981,
p. 1184.
[2] Davidoff, F., "An Update of Digital Television
Fundamentals", 11th SMPTE WINTER TELEVISION CONFERENCE,
San Francisco, January 19, 1977. p.5.
[3] Stock, op.cit., p.1184.
[4] "Character Generators: Evolution is Delivering More for
Your Money", TELEVISION/BROADCAST COMMUNICATIONS, January
1984, p.88.
[5] Newman, Wm. and Sproull, R. PRINCIPLES OF INTERACTIVE
COMPUTER GRAPHICS, second edition, New York: McGraw-Hill
Book Company, 1979, p. 213.
[6] Madarasz, T., "Television News by the Keyboard", COMPUTER
PICTURES, v.1, n.2., March/April 1983, p. 13.
[7] Briggs, J., "Electronic Graphics in Television -
The Next Step", SMPTE, September 1983, p. 912.
[8] Black, P. "The Responsible Use of Computer Graphics in
Broadcasting", COMPUTER GRAPHICS WORLD, September 1981, p. 26.
[9] "Conversation with Roger Goodman", VIDEOGRAPHY, v.9, n.2,
February 1984, p. 48.
[10] Prince, S., "Projects: Inside 'The Works'", COMPUTER
PICTURES, v.1,n.2, March/April 1983, p.52.
[11] Stock, op.cit. p. 1184.
[12]Burk, P. "Computers are Starring on The Weather Channel",
BROADCAST COMMUNICATIONS, April 1983, p. 59.

|Chapter Three
|Developing the Proposed System

[1]Henigan, Nardy, "Software Tools for the Graphic Designer",
Master's of Science Thesis at the VLW, Massachusetts
Institute of Technology, June, 1983. p. 9-10.
[2] Adams, K., "Software Techniques for Digital Video
Production", Bachelor's of Science Thesis for Electrical
Engineering and Computer Science at M.I.T., January 1984,
p. 3.

|Chapter Four
|Systems

[1] Goldberg, M., NABET representative at WGBH - TV, Phone
interview March 28, 1984.
[2] Noe, D. "Dubner 'Weathers' Heavy Use", TV TECHNOLOGY,
Dubner Company Reprint, November 1983.
[3] "Edit Controllers: The Pushbutton Philosophy", TELEVISION/
BROADCAST COMMUNICATIONS, November 1983, p. 82.
[4] Pensinger, G., "Production Switchers: Meeting the Challenge",
TELEVISION/BROADCAST COMMUNICATIONS, November 1983, p. 65.
[5] McAll, R., Stickler, M., "Progress Report on EBU-SMPTE
Serial Data Control of TV Equipment",Prepared for delivery at
SMPTE Winter Conference February 4-5, 1983, p.1
[6] Rayner, Bruce, "Switcher Intelligent Interfaces", SMPTE
JOURNAL, v.88, n.10, October 1979, p. 715.
[7] Geise, H.D., " Use of Micro-Computers in VTR Control",
SMPTE JOURNAL, v.88, n.12, December 1979, p. 832.
[8] Thornton, D. and G. Simon, "VTR Modifications for Computer-
Assisted Editing Systems", SMPTE JOURNAL, v.92, n.6, June 1983,
p. 649.
[9] Tooms, M.S. and Anderson, J.W., "Evolution of a Comprehensive
Computer Support System for Television Operation",
SMPTE JOURNAL, v.92, n.8, August 1983, p. 824.
[10] ibid., p. 830.
[11] Winkler, D., "Videotape Editing Suite Design", SMPTE
JOURNAL, v.92, n.3, March 1983, p. 280.
[12] ibid., p. 281.
[13] Schneider A., "Edit List Management", SMPTE JOURNAL,
v.88, n.8, August 1979, p. 541
[14] Weynand, D., "Picture Processing: An Editing Alternative,"
VIDEOGRAPHY, April 1984, p. 36.
[15] Winkler, op.cit., p. 280.
[16] Tooms & Anderson, op.cit., p. 830.

| Chapter Five
| Conclusions

[1] Interview with Digital Effects, New York. Mitzner, M., "Post-Production: NY Studios are Banking on Digital Effects", TELEVISION/BROADCAST COMMUNICATIONS, December 1983, p. 62.
[2] "Conversation with Roger Goodman", op.cit., p. 52.

Appendix A
Comments on <u>Key Change</u>

In Margaret Mead's book SEX AND TEMPERAMENT I found an
ideological home for the ideas in my story. The last
chapter, "The Deviant", draws conclusions from her field
studies about the occurence of deviancy in societies with
differing sex role definitions. Patricia is not living in a
rigid society, but one in transition, hopefully towards one
in which both sexes develop freely.

I have included a copy of this chapter because of its succinct
description of traditional societies, and its comparison to
American culture at a time when sex roles were rigidly defined,
and defined quite differently from any of the three Oceanic
cultures she studied. As background it helps to demonstrate
the state of flux in our society.

I have only read anthropological works as a lay person
and make no claim to any real understanding of
anthropology. However, Margaret Mead's point that
cultural-identity confusion becomes gender-identity
confusion in a society that defines tasks according to
sex has definite applications to Patricia's story.

Patricia's inability to function successfully as a male-
identified person means that she will change, by doing it,

what the traditional role "audio engineer" implies. This

story arises, of course, from stories other women have told

me and incidences in my own life. From such blatant

examples as a television producer nursing her child while

calling shots, to more subtle examples of personal warmth

valued over outright competition, women are changing the

way we work as they enter the salaried population. Patricia's

story is an attempt to show one woman working through

these difficulties on a personal level.

THE DEVIANT

WHAT are the implications for an understanding of the social deviant of the point of view outlined in the last chapter? Under the term "deviant" I include any individual who because of innate disposition or accident of early training, or through the contradictory influences of a heterogeneous cultural situation, has been culturally disenfranchised, the individual to whom the major emphases of his society seem nonsensical, unreal, untenable, or downright wrong. The average man in any society looks into his heart and finds there a reflection of the world about him. The delicate educational process that has made him into an adult has assured him this spiritual membership in his own society. But this is not true of the individual for whose temperamental gifts his society has no use, nor even tolerance. The most cursory survey of our history is enough to demonstrate that gifts honoured in one century are disallowed in the next. Men who would have been saints in the Middle Ages are without vocation in modern England and America. When we take into account primitive societies that have selected far more extreme and contrasting attitudes than did our own ancestral cultures, the matter becomes even clearer. To the extent that a culture is integrated and definite in its goals, uncompromising in its moral and spiritual preferences, to that very extent it condemns some of its members—members by birth only—to live alien to it, in perplexity at the best, at the worst in a rebellion that may turn to madness.

It has become the fashion to group together all of those by

whom the cultural norm is not accepted as neurotics, individuals who have turned from "reality" (that is, the present-day solutions of their own society) to the comfort or inspiration of fantasy situations, taking refuge in some transcendental philosophy, in art, in political radicalism, or merely in sexual inversion or some other elaborated idiosyncrasy of behaviour—vegetarianism or the wearing of a hair shirt. The neurotic is furthermore regarded as immature; he has not grown up sufficiently to understand the obviously realistic and commendable motivations of his own society.

In this blanket definition two quite different concepts have become blurred and confused, each one rendering the other nugatory. Among the deviants in any society, it is possible to distinguish those who are physiologically inadequate. They may have weak intellects or defective glands; any one of a number of possible organic weaknesses may predetermine them to failure in any but the simplest tasks. They may—very, very rarely such an individual is found—have practically all of the physiological equipment of the opposite sex. None of these individuals are suffering from any discrepancy between a purely temperamental bent and social emphasis; they are merely the weak and the defective, or they are abnormal in the sense that they are in a group which deviates too far from human cultural standards—not particular cultural standards—for effective functioning. For such individuals any society must provide a softer, a more limited, or a more special environment than that which it provides for the majority of its members.

But there is another type of neurotic that is continually being confused with these physiologically handicapped individuals, and this is the cultural deviant, the individual who is at variance with the values of his society. Modern psychiatric thought tends to attribute all of his maladjustment to early conditioning and so places him in the invidious category of the

psychically maimed. A study of primitive conditions does not bear out such a simple explanation. It does not account for the fact that it is always those individuals who show marked temperamental proclivities in opposition to the cultural emphases who are in each society the maladjusted persons; or for the fact that it is a different type of individual which is maladjusted among the Mundugumor from the type which is maladjusted among the Arapesh. It does not explain why materialistic, bustling America and a materialistic, bustling tribe in the Admiralty Islands both produce hoboes, or why it is the individual endowed with a capacity to feel strongly who is maladjusted in Zuñi and Samoa. Such material suggests that there is another type of unadjusted person, whose failure to adjust should be referred not to his own weakness and defect, not to accident or to disease, but to a fundamental discrepancy between his innate disposition and his society's standards.

When society is unstratified and the social personalities of both sexes are fundamentally alike, these deviants are drawn indiscriminately from both sexes. Among the Arapesh the violent man and the violent woman, among the Mundugumor the trustful, co-operative man and the trustful, co-operative woman, are the deviants. Too much positive self-feeling predetermines one to maladjustment among the Arapesh, too much negative self-feeling is an equal liability among the Mundugumor. In earlier chapters we have discussed the personalities of some of these deviating individuals, and shown how the very gifts that Mundugumor society would have honoured were disallowed among the Arapesh, how Wabe and Temos and Amitoa would have found Mundugumor life intelligible, and Ombléan and Kwenda would have been well placed among the Arapesh. But the alienness of both these groups in their own cultures, although it impaired their social functioning, reducing the uses to which

their gifts might have been put, nevertheless left their psycho-sexual functioning unimpaired. Amitoa's positive drive made her behave not like a man, but like a woman of the Plains. Ombléan's love for children and willingness to work strenuously in order to care for a number of dependents did not make him suspect that he was like a woman, nor did it provoke in his associates an accusation of effeminacy. In loving children and peace and order, he might be behaving like some white men or some tribe they had never seen, but certainly no more like a Mundugumor woman than like a Mundugumor man. There was no homosexuality among either the Arapesh or the Mundugumor.

But any society that specializes its personality types by sex, which insists that any trait—love for children, interest in art, bravery in the face of danger, garrulity, lack of interest in personal relations, passiveness in sex-relations; there are hundreds of traits of very different kinds that have been so specialized—is inalienably bound up with sex, paves the way for a kind of maladjustment of a worse order. Where there is no such dichotomy, a man may stare sadly at his world and find it essentially meaningless but still marry and rear children, finding perhaps a definite mitigation of his misery in this one whole-hearted participation in a recognized social form. A woman may day-dream all her life of a world where there is dignity and pride instead of the mean shop-keeping morality that she finds all about her, and yet greet her husband with an easy smile and nurse her children through the croup. The deviant may translate his sense of remoteness into painting or music or revolutionary activity and yet remain in his personal life, in his relations to members of his own and the opposite sex, essentially unconfused. Not so, however, in a society which, like that of the Tchambuli or that of historical Europe and America, defines some temperamental traits as masculine, some as feminine. In

addition to, or aside from, the pain of being born into a culture whose acknowledged ends he can never make his own, many a man has now the added misery of being disturbed in his psycho-sexual life. He not only has the wrong feelings but, far worse and more confusing, he has the feelings of a woman. The significant point is not whether this malorientation, which makes the defined goals of women in his society intelligible to him and the goals of the man alien and distasteful, results in inversion or not. In extreme cases in which a man's temperament conforms very closely to the approved feminine personality, and if there is in existence a social form behind which he can shelter himself, a man may turn to avowed inversion and transvesticism. Among the Plains Indians, the individual who preferred the placid activities of the women to the dangerous, nerve-racking activities of the men could phrase his preference in sex terms; he could assume women's dress and occupations, and proclaim that he really was more a woman than a man. In Mundugumor, where there is no such pattern, a man may engage in feminine activities, such as fishing, without its occurring to him to symbolize his behaviour in female attire. Without any contrast between the sexes and without any tradition of transvesticism, a variation in temperamental preference does not result in either homosexuality or transvesticism. As it is unevenly distributed over the world, it seems clear that transvesticism is not only a variation that occurs when there are different personalities decreed for men and women, but that it need not occur even there. It is in fact a social invention that has become stabilized among the American Indians and in Siberia, but not in Oceania.

I observed in some detail the behaviour of an American Indian youth who was in all probability a congenital invert, during the period when he was just making his transvesticism explicit. This man had, as a small boy, showed such marked

feminine physical traits that a group of women had once captured him and undressed him to discover whether he was really a boy at all. As he grew older he began to specialize in women's occupations and to wear female underclothing, although he still affected the outer costume of a male. He carried in his pockets, however, a variety of rings and bangles such as were worn only by women. At dances in which the sexes danced separately, he would begin the evening dressed as a man and dancing with the men, and then, as if acting under some irresistible compulsion, he would begin to move closer and closer to the women, as he did so putting on one piece of jewelry after another. Finally a shawl would appear, and at the end of the evening he would be dressed as a *berdache*, a transvestite. The people were just beginning to speak of him as "she." I have cited his case in this connexion to make clear that this is the type of maladjusted individual with which this discussion is not concerned. His aberrancy appeared to have a specific physiological origin; it was not a mere temperamental variation that his society had decided to define as feminine.

This discussion is concerned neither with the congenital invert nor with overt behaviour of the practising homosexual. There are, it is true, ways in which the different types of maladjustment intersect and reinforce each other, and the congenital invert may be found among those who have found shelter in transvesticism. But the deviants with whom we are concerned here are those individuals whose adjustment to life is conditioned by their temperamental affinity for a type of behaviour that is regarded as unnatural for their own sex and natural for the opposite sex. To produce this type of maladjustment, not only is it necessary to have a definite approved social personality, but also this personality must be rigidly limited to one of the two sexes. The coercion to behave like a member of one's own sex becomes one of the

strongest implements with which the society attempts to mould the growing child into accepted forms. A society without a rigid sex-dichotomy merely says to the child who shows aberrant behaviour traits: "Don't behave like that." "People don't do that." "If you behave like that, people won't like you." "If you behave like that you will never get married." "If you behave like that, people will sorcerize you"—and so on. It invokes—as against the child's natural inclination to laugh or cry or sulk in the wrong places, to see insult where there is none, or fail to see insult that is intended—considerations of human conduct as socially defined, not of sex-determined conduct. The burden of the disciplinary song is: "You will not be a real human being unless you suppress these tendencies which are incompatible with our definition of humanity." But it does not occur to either the Arapesh or the Mundugumor to add: "You aren't behaving like a boy at all. You are behaving like a girl"—even when actually this may be the case. It will be remembered that among the Arapesh, boys, owing to their slightly different parental care, do cry more than girls and have temper tantrums until a later age. Yet because the idea of sex-difference in emotional behaviour is lacking, this real difference was never invoked. In societies without a sex-dichotomy of temperament, one aspect, one very basic aspect, of the child's sense of its position in the universe is left unchallenged—the genuineness of its membership in its own sex. It can continue to watch the mating behaviour of its elders and pattern its hopes and expectations upon it. It is not forced to identify with a parent of opposite sex by being told that its own sex is very much in question. Some slight imitation of a father by a daughter, or of a mother by a son, is not seized upon and converted into a reproach, or a prophecy that the girl will grow up to be a tomboy or the boy a sissy. The

Arapesh and Mundugumor children are spared this form of confusion.

Consider in contrast the way in which children in our culture are pressed into conformity: "Don't act like a girl." "Little girls don't do that." The threat of failing to behave like a member of one's own sex is used to enforce a thousand details of nursery routine and cleanliness, ways of sitting or relaxing, ideas of sportsmanship and fair play, patterns of expressing emotions, and a multitude of other points in which we recognize socially defined sex-differences, such as limits of personal vanity, interest in clothes, or interest in current events. Back and forth weaves the shuttle of comment: "Girls don't do that." "Don't you want to grow up to be a real man like Daddy?"—tangling the child's emotions in a confusion that, if the child is unfortunate enough to possess even in some slight degree the temperament approved for the opposite sex, may well prevent the establishment of any adequate adjustment to its world. Every time the point of sex-conformity is made, every time the child's sex is invoked as the reason why it should prefer trousers to petticoats, baseball-bats to dolls, fisticuffs to tears, there is planted in the child's mind a fear that indeed, in spite of anatomical evidence to the contrary, it may not really belong to its own sex at all.

How little weight the anatomical evidence of own sex has, as over against the social conditioning, was vividly dramatized recently in a case in a Middle Western city, where a boy was found who had lived twelve years as a girl, under the name of Maggie, doing a girl's tasks and wearing a girl's clothes. He had discovered several years before that his anatomy was that of a boy, but that did not suggest to him the possibility of being classified as a boy socially. Yet when social workers discovered the case and effected the change of his classification, he did not show any traits of inversion; he was merely

a boy who had been mistakenly classified as a girl, and whose parents, for some reasons that were not discovered, refused to recognize and rectify their error. This bizarre case reveals the strength of social classification as over against merely anatomical membership in a sex, and it is this social classification which makes it possible for society to plant in children's minds doubts and confusions about their sex-position.

Such social pressure exerts itself in a number of ways. There is first the threat of sex-disenfranchisement against the child who shows aberrant tendencies, the boy who dislikes rough-and-tumble play or weeps when he is rebuked, the girl who is only interested in adventures, or prefers battering her playmates to dissolving in tears. Second, there is the attribution of the emotions defined as feminine to the boy who shows the mildest preference for one of the superficial sex-limited occupations or avocations. A small boy's interest in knitting may arise from a delight in his own ability to manipulate a needle; his interest in cooking may derive from a type of interest that might later make him a first-class chemist; his interest in dolls may spring from no tender cherishing feelings but from a desire to dramatize some incident. Similarly, a girl's overwhelming interest in horse-back-riding may come from a delight in her own physical co-ordination on horseback, her interest in her brother's wireless set may come from pride in her proficiency in handling the Morse code. Some physical or intellectual or artistic potentiality may accidentally express itself in an activity deemed appropriate to the opposite sex. This has two results: The child is reproached for his choice and accused of having the emotions of the opposite sex, and also, because the occupational choice or hobby throws him more with the opposite sex, he may come in time to take on much of the socially sex-limited behaviour of that opposite sex.

A third way in which our dichotomy of social personality by sex affects the growing child is the basis it provides for a cross-sex identification with the parents. The invocation of a boy's identification with his mother to explain his subsequent assumption of a passive rôle towards members of his own sex is familiar enough in modern psychiatric theory. It is assumed that through a distortion of the normal course of personality development the boy fails to identify with his father and so loses the clue to normal "masculine" behaviour. Now there is no doubt that the developing child searching for clues to his social rôle in life usually finds his most important models in those who stand in a parental relationship to him during his early years. But I would suggest that we have still to explain why these identifications occur, and that the cause lies not in any basic femininity in the small boy's temperament, but in the existence of a dichotomy between the standardized behaviour of the sexes. We have to discover why a given child identifies with a parent of opposite sex rather than with the parent of its own sex. The most conspicuous social categories in our society—in most societies—are the two sexes. Clothes, occupation, vocabulary, all serve to concentrate the child's attention upon its similarity with the parent of the same sex. Nevertheless some children, in defiance of all this pressure, choose the parents of opposite sex, not to love best, but as the persons with whose motives and purposes they feel most at one, whose choices they feel they can make their own when they are grown.

Before considering this question further, let me restate my hypothesis. I have suggested that certain human traits have been socially specialized as the appropriate attitudes and behaviour of only one sex, while other human traits have been specialized for the opposite sex. This social specialization is then rationalized into a theory that the socially de-

creed behaviour is natural for one sex and unnatural for the other, and that the deviant is a deviant because of glandular defect, or developmental accident. Let us take a hypothetical case. Attitudes towards physical intimacy vary enormously among individuals and have been very differently standardized in different societies. We find primitive societies, such as those of the Dobu and the Manus, where casual physical contact is so interdicted for both sexes, so hedged about with rules and categories, that only the insane will touch another person lightly and casually. Other societies, such as that of the Arapesh, permit a great deal of easy physical intimacy between individuals of different ages and both sexes. Now let us consider a society that has specialized to one sex this particular temperamental trait. To men has been assigned the behaviour characteristic of the individual who finds casual physical contact intolerable, to women, as their "natural" behaviour, that of individuals who accept it easily. To men, the hand on the arm or across the shoulder, sleeping in the same room with another man, having to hold another man on the lap in a crowded automobile—every contact of this kind would be, by definition, repellent, possibly even, if the social conditioning were strong enough, disgusting or frightening. To women in this given society, however, physical contact that was easy and unstylized would be, by definition, welcome. They would embrace each other, caress each other's hair, arrange each other's clothes, sleep in the same bed, comfortably and without embarrassment. Now let us take a marriage between a well-brought-up man in this society, who would be intolerant of any physical casualness, and a well-brought-up woman, who would consider it as natural when displayed by women and never expect it among boys or men. To this couple is born a girl who displays from birth a *noli me tangere* attitude that nothing her mother can do will dispel. The little girl slips off her

mother's lap, wriggles away when her mother tries to kiss her. She turns with relief to her father, who will not embarrass her with demonstrations of affection, who does not even insist upon holding her hand when he takes her for a walk. From such a simple clue as this, a preference that in the child is temperamental, in the father is socially stabilized male behaviour, the little girl may build up an identification with her father, and a theory that she is more like a boy than like a girl. She may come in time to be actually better adjusted in many other ways to the behaviour of the opposite sex. The psychiatrist who finds her later in life wearing mannish attire, following a male occupation, and unable to find happiness in marriage may say that identification with the opposite sex was the cause of her failure to adjust as a woman. But this explanation does not reveal the fact that the identification would not have occurred in these terms if there had been no dichotomy of sex-attitudes in the society. The Arapesh child who is more like a reserved father than like a demonstrative mother may feel that it resembles its father more than its mother, but this has no further effects on its personality in a society in which it is not possible to "feel like a man" or "feel like a woman." The accident of a differentiation of sex-attitudes makes these chance identifications dynamic in the adjustment of the child.

This example is admittedly hypothetical and simple. The actual conditions in a modern society are infinitely more complicated. To list merely some of the kinds of confusions that occur should be sufficient to focus attention upon the problem. One of the child's parents may be aberrant, and therefore be a false guide to the child in its attempt to find its rôle. Both the children's parents may deviate from the norm in opposite ways, the mother showing more pronounced temperamental traits usually specialized as male, the father showing the opposite traits. This condition is very likely

to occur in modern society, in which, because it is believed marriage must be based upon contrasting personalities, deviant men often choose deviant women. So the child, groping for clues, may make a false identification because its own temperament is like that decreed for the opposite sex, or a false identification because, while it is itself fitted for easy adjustment, the parent of its own sex is maladjusted.

I have discussed first identification along temperamental lines, but the identification may also be made in other terms. The original identification may be through intelligence or specific artistic gifts, the gifted child identifying with the more gifted parent, regardless of sex. Then, if the double standard of personality exists, this simple identification on the basis of ability or interest will be translated into sex terms, and the mother will lament: "Mary is always working with Will's drafting instruments. She hasn't any more normal girl's interests at all. Will says it's a pity she wasn't born a boy." From this comment, it is very easy for Mary to come to the same conclusion.

Worth mentioning here is the way in which the boy's plight differs from the girl's in almost every known society. Whatever the arrangements in regard to descent or ownership of property, and even if these formal outward arrangements are reflected in the temperamental relationships between the two sexes, the prestige values always attach to the occupations of men, if not entirely at the expense of the women's occupations, at least to a great extent. It almost always follows, therefore, that the girl "who should have been a boy" has at least the possibility of a partial participation in activities that are surrounded by the aura of masculine prestige. For the boy "who should have been a girl" there is no such possibility open. His participation in women's activities is almost always a matter for double reproach: he has shown himself unworthy to be categorized as a man, and

has thereby condemned himself to activities with a low prestige value.

Furthermore, it is seldom that the particular attitudes and interests which have been classified as feminine in any society have been given any very rich expression in art or in literature. The girl who finds the defined masculine interests closer to her own can find for herself forms of vicarious expression; the boy who might have found similar outlets if there were a comparable feminine art and literature is denied such satisfactory escape. Kenneth Grahame has immortalized the perplexity of all small boys before the special and limited interests of girls in his famous chapter, "What They Talked About":

"She's off with those Vicarage girls again," said Edward, regarding Selina's long black legs twinkling down the path. "She goes out with them every day now; and as soon as ever they start, all their heads go together and they chatter, chatter, chatter, the whole blessed time! I can't make out what they find to talk about. . . ."

"P'raps they talk about birds'-eggs," I suggested sleepily . . . "and about ships, and buffaloes, and desert islands; and why rabbits have white tails; and whether they'd sooner have a schooner or a cutter; and what they'll be when they're men—at least, I mean there's lots of things to talk about, if you *want* to talk."

"Yes; but they don't talk about those sort of things at all," Edward persisted. "How *can* they? They don't *know* anything; they can't *do* anything—except play the piano, and nobody would want to talk about *that*; and they don't care about anything—anything sensible, I mean. So what *do* they talk about? . . . But it's these girls I can't make out. If they've anything really sensible to talk about, how is it nobody knows what it is? And if they haven't—and we know they *can't* have, naturally—why don't they shut up their jaw? This old rabbit here—*he* doesn't want to talk. . . ."

"O but rabbits *do* talk!" interposed Harold. "I've watched them often in their hutch. They put their heads together and their noses go up and down, just like Selina's and the Vicarage girls'!" . . .

"Well, if they do," said Edward unwillingly, "I'll bet they don't talk such rot as those girls do!" Which was ungenerous, as well as unfair; for it has not yet transpired—nor has it to this day—*what* Selina and her friends talked about.[1]

This perplexity is likely to remain throughout life. The woman who either by temperament or accident of training has become more identified with the interests of men, if she cannot adjust to the current sex-standards, loses out in her essentially feminine rôle of child-bearing. The man who has been disenfranchised from his own sex's interests suffers a subtler disenfranchisement, since a great part of the artistic symbolism of his society is rendered unavailable and there is no substitute to which he can turn. He remains a confused and bewildered person, unable to feel as men "naturally" feel in his society, and equally unable to find any satisfaction in rôles that have been defined by women, although their social personality is more akin to his temperament.

And so, in a thousand ways, the fact that it is necessary to feel not only like a member of a given society in a given period, but like a member of one sex and not like a member of the other, conditions the development of the child, and produces individuals who are unplaced in their society. Many students of personality lay these multiple, imponderable maladjustments to "latent homosexuality." But such a judgment is fathered by our two-sex standard; it is *post hoc* diagnosis of a result, not diagnosis of a cause. It is a

[1] From *The Golden Age*, by Kenneth Grahame. Copyright 1895, 1922, by Dodd, Mead and Company, Inc.

judgment that is applied not only to the invert but to the infinitely more numerous individuals who deviate from the social definition of appropriate behaviour for their sex.

If these contradictory traits of temperament which different societies have regarded as sex-linked are not sex-linked, but are merely human potentialities specialized as the behaviour of one sex, the presence of the deviant, who need no longer be branded as a latent homosexual, is inevitable in every society that insists upon artificial connexions between sex and bravery, or between sex and positive self-feeling, or between sex and a preference for personal relations. Furthermore, the lack of correspondence between the actual temperamental constitution of members of each sex and the rôle that a culture has assigned to them has its reverberations in the lives of those individuals who were born with the expected and correct temperament. It is often assumed that in a society which designates men as aggressive and dominating, women as responsive and submissive, the maladjusted individuals will be the dominant, aggressive woman and the responsive, submissive man. Theirs is, indubitably, the most difficult position. Human contacts of all sorts, and especially courtship and marriage, may present insoluble problems to them. But consider also the position of the boy naturally endowed with an aggressive, dominating temperament and reared to believe that it is his masculine rôle to dominate submissive females. He is trained to respond to responsive and submissive behaviour in others by a display of his self-conscious aggressiveness. And then he encounters not only submissive females, but also submissive males. The stimulus to dominating behaviour, to an insistence upon unquestioning loyalty and reiterated statements of his importance, is presented to him in one-sex groups, and a "latent homosexual" situation is created. Similarly, such a man has been taught that his ability to dominate is the

measure of his manhood, so that submissiveness in his asso-
ciates continually reassures him. When he encounters a
woman who is as naturally dominating as he is himself, or
even a woman who, although not dominating tempera-
mentally, is able to outdistance him in some special skill or
type of work, a doubt of his own manhood is set up in his
mind. This is one of the reasons why men who conform
most closely to the accepted temperament for males in their
society are most suspicious and hostile towards deviating
women who, in spite of a contrary training, show the same
temperamental traits. Their hold upon their conviction of
their own sex-membership rests upon the non-occurrence of
similar personalities in the opposite sex.

And the submissive, responsive woman may find herself
in an equally anomalous position, even though her culture
has defined her temperament as the proper one for women.
Trained from childhood to yield to the authority of a dom-
inant voice, to bend all of her energies to please the more
vulnerable egotism of dominant persons, she may often en-
counter the same authoritative note in a feminine voice and
thus she, who is by temperament the ideal woman in her
society, may find women so engrossing that marriage ad-
justments never enter the picture. Her involvement in de-
votion to members of her own sex may in turn set up in her
doubts and questions as to her essential femininity.

Thus the existence in a given society of a dichotomy of so-
cial personality, of a sex-determined, sex-limited personality,
penalizes in greater or less degree every individual born
within it. Those whose temperaments are indubitably
aberrant fail to adjust to the accepted standards, and by their
very presence, by the anomalousness of their responses, con-
fuse those whose temperaments are the expected ones for their
sex. So in practically every mind a seed of doubt, of anxiety,
is planted, which interferes with the normal course of life.

But the tale of confusions is not ended here. The Tcham-
buli, and in a milder degree parts of modern America, rep-
resent a further difficulty that a culture which defines per-
sonality in terms of sex can invent for its members. It will
be remembered that while Tchambuli theory is patrilineal,
Tchambuli practice gives the dominant position to women,
so that the position of the man with aberrant—that is, dom-
inating—temperament is rendered doubly difficult by the
cultural forms. The cultural formulation that a man has
paid for his wife and can therefore control her continually
misleads these aberrant individuals into fresh attempts at
such control, and brings them into conflict with all their
childhood training to obey and respect women, and their
wives' training to expect such respect. Tchambuli institutions
and the emphases of their society are, to a certain extent, at
odds with one another. Native history attributes a high de-
velopment of dominating temperaments to various neigh-
bouring tribes, whose women have for many generations run
away and married the Tchambuli. In explanation of its own
inconsistencies, it invokes the situation that was just fre-
quent enough among the Arapesh to confuse the adjustments
of men and women there. These inconsistencies in Tcham-
buli culture were probably increased by a diminished interest
in war and head-hunting and a greater interest in the delicate
arts of peace. The importance of the women's economic
activities may also have increased without any corresponding
enhancement of the men's economic rôle. Whatever the
historical causes, and they are undoubtedly multiple and com-
plex, Tchambuli today presents a striking confusion between
institutions and cultural emphases. And it also contains a
larger number of neurotic males than I have seen in any
other primitive culture. To have one's aberrancy, one's
temperamental inability to conform to the prescribed rôle of
responsive dancing attendance upon women, apparently con-

firmed by institutions—this is too much, even for members of a primitive society living under conditions far simpler than our own.

Modern cultures that are in the throes of adjusting to women's changing economic position present comparable difficulties. Men find that one of the props of their dominance, a prop which they have often come to think of as synonymous with that dominance itself—the ability to be the sole support of their families—has been pulled from beneath them. Women trained to believe that the possession of earned income gave the right to dictate, a doctrine which worked well enough as long as women had no incomes, find themselves more and more often in a confused state between their real position in the household and the one to which they have been trained. Men who have been trained to believe that their sex is always a little in question and who believe that their earning power is a proof of their manhood are plunged into a double uncertainty by unemployment; and this is further complicated by the fact that their wives have been able to secure employment.

All such conditions are aggravated in America also by the large number of different patterns of decreed behaviour for each sex that obtain in different national and regional groups, and by the supreme importance of the pattern of intersex behaviour that children encounter within the closed four walls of their homes. Each small part of our complex and stratified culture has its own set of rules by which the power and complementary balance between the sexes is maintained. But these rules differ, and are sometimes even contradictory, as between different national groups or economic classes. So, because there is no tradition which insists that individuals should marry in the group within which they were reared, men and women are continually marrying whose pictures of the interrelationships between the sexes are

entirely different. Their confusions are in turn transmitted to their children. The result is a society in which hardly anyone doubts the existence of a different "natural" behaviour for the sexes, but no one is very sure what that "natural" behaviour is. Within the conflicting definitions of appropriate behaviour for each sex, almost every type of individual is left room to doubt the completeness of his or her possession of a really masculine or a really feminine nature. We have kept the emphasis, the sense of the importance of the adjustment, and at the same time we have lost the ability to enforce the adjustment.

Appendix B
Source Code and Explanation

How to Use the System

To activate the interface to video a few simple steps
are taken. Fox terminal 1Ø is deactivated and its port
connected to the serial cable. The remote cable to the
1" record machine (named Art) is unattached and the
control cable from the single board computer SBC is
attached to the remote port. The SBC is powered up and
connected to the serial cable coming from the VLW.
There is a reset button in the middle of the SBC which
can be pressed if confusion exists.

Begin working with the menu. Request "talk" to find
out the status of the interface. A menu user manual is
in Adam's thesis and the effects are documented on
line.

Maintenance Information

Source code and object code is installed in >u>kma>
video_source, alternately named demo. New effects are
bound under xtal.bind along with support programs.

```
xtal.bind
xtal
windwipes
circlewipe
twobit
dizzy2
```

```
gen_cm2
um
umm
select
kbat
lp
ndelayslide
selsend
>sll>io_util
```

New programs are:

```
source name          type        entry points in menu

windwipes.pll        wipe        HOLES, PICKET, CLOSER, EXGRAD, BRICKWIN
circlewipes.pll      wipe        CIRCLE, SOFTEDGE
twobits.pll          dissolve    LO-COLOR, TWOBIT, DIZZY2
```

gen_cm2.pll is the only new support program, and is based on
gen_cm.pll. array_1 is the only necessary new data file.

The following changes were made to eff menu trees. (Again

see Adam's thesis for complete tree documentation.)

Capitals indicate existing pathways; small letters,

additions.

```
WIPE
  |_____
   |          |                              |      |
 OVERLAY   GRADIENT                      SOFTEDGE  MISC
    |_____        |___|_____
    |       |         |       |         |     |      |       |       |
 OVERLAY windwipes  circle  spike     HORZ   VERT   half   polish  star
 (kma)   ____|_____
         |    |         |       |     |
      brickwin      closer picket exgrad
```

Both windwipes.pll and circlewipes.pll are installed

in this tree. Windwipes has entrypoints xtal$brickwin,

xtal$closer, xtal$picket and xtal$exgrad. These

programs work by filling buffers with random number

routines. The differences are based on zooming into different levels and writing the buffers in different ways.

Circlewipes.pll has entrypoints xtal$circlewipe, xtal$polish, xtal$half, xtal$spike and xtal$star. Circlewipe and spike are solid circlewipe routines based on a radian drawn circle algorithm. Polish, half and star write buffers in different ways using the radian endpoints as location points for the buffer.

```
DISSOLVE
   |_____
   |            |                                    |
       lo-color                                    lo-res
        |_____                    _____|_____
   |    |    |     |      |                   |       |        |
 4-BIT DIZZY 2-bit dizzy2                    STRIP         FLIPBOOK
```
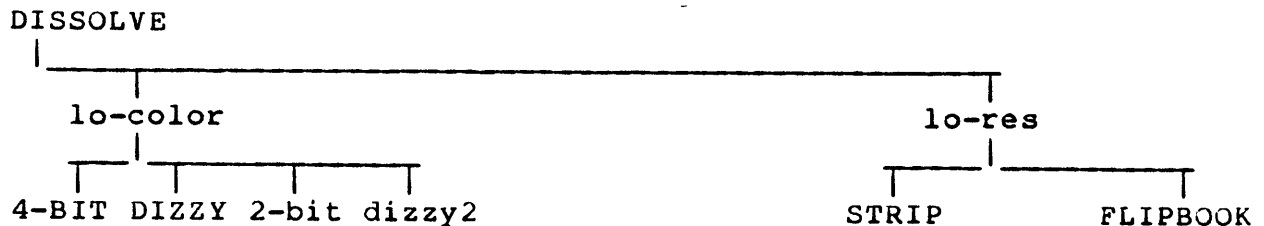
Like fourbit.pll, twobit.pll constructs the frame buffer in such a way that it does not have to be loaded during the dissolve. By choosing the first two significant bits of each picture's red, green and blue information and storing this information in the buffer, a low-color resolution version of each of four pictures can be stored. As can be seen in the program printout, this is done through string manipulation.

Dizzy2 (no capital at the beginning) loads the color matrices generated by gen_cm2.pll one at a time. This has the effect of "exposing" one picture at a time, by highlighting its red, green and blue portions of the

string.

proposed scripting structure:

```
script
   |<---------------------------------------
   |                                        |
  DVE                                       |
   |                                        |
   |-------T-------T-------T---------        |
   |       |       |       |        |        |
  EFF  PICTURES  VIDEO  OUTSIDE  WHATIS      |
                   |                         |
     talk  play  rec  rew  stop             |
                   |_____|
```
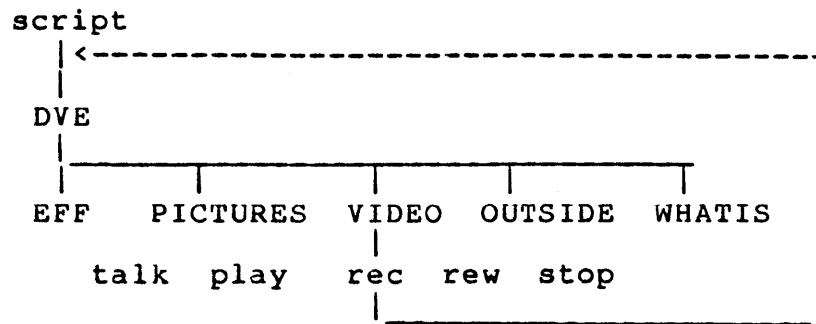
Source code is printed on the following pages.

```
/*-------------------------------------------------------------*
 | progname: windwipes.pll                                     |
 | procname: windwipes                                         |
 | bindfile: xtal.bind                                         |
 | includes: generic.incl.pll                                  |
 | entrypts: xtal$windwipes                                    |
 |           xtal$closer                                       |
 |           xtal$picket                                       |
 |           xtal$brickwindows                                 |
 | author  : sarah griffith                                    |
 | descript: closeup incomplete overlay plane wipes            |
 *-------------------------------------------------------------*/
windwipes: proc;

%include generic;
dcl $restore_cm entry;
dcl grin$gwrop entry(fix,fix,fix,fix,fix,bit(1));
dcl grin$defcm entry (bit(24),fix,fix);
dcl cm[0:511] bit(24);
dcl $get_ocolor entry (fix);
dcl delay fix init(999);
dcl hcs$truncate_ptr entry (ptr, fixed bin(31),fixed bin(31));
dcl (col,plane,z) fix;
declare
    /* indices into array m      */
    (x,y)           fix(15),
    /* lower array x index       */
    xmin            fix(15) init ( 0),
    /* lower array y index       */
    ymin            fix(15) init ( 0),
    /* upper array x index       */
    xmax            fix(15) init (63),
    /* upper array y index       */
    ymax            fix(15) init (63),
    syscode         fix(31);

declare
    /* part of x index range     */
    part            float,
    /* whole x index range       */
    whole           float,
    /* varies 0.0 --> 1.0        */
    threshold       float;

declare
    array1          pointer;

/***********************************************************/
common: proc;
call hcs$initiate (">u>xtal>vidwipes", "array_1", array1, syscode);
call $get_ocolor(col);
end;
```

```
/* ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::*/
picket: entry;
/* [xmin:xmax, ymin:ymax]      */
dcl  m [0:63, 0:63] bit(1) based;

on break begin; goto done; end;
call common;
/* create the bit array with the gradient pattern */
xmin = 0; xmax = 63; ymin = 0; ymax = 63;
whole = xmax - xmin;      /* fix->float conversion */
call $erase;
call $big_msg ("PLEASE WAIT...",300);
do x = xmin to xmax;
     part  = x - xmin;    /* fix->float conversion */
     threshold = part / whole;
     do y = ymin to ymax;
          if math$random () > threshold then
          array1->m [y, x] = '1'b;
          else array1->m [y, x] = '0'b;
          end;
    end; /* x */

/* write the bit array into the frame buffer */
call grin$vis("0000"b4);
call grin$ocolor(col-1,col-1, 0);
call grin$rectv(0,0,511,511,ate,0);
call $erase;
do x = 0 to 511; cm[x] = "000000"b4; end;
call grin$defcm(cm,512,1023);
call grin$rectv(0,0,511,511,ate&nine,0);
call $big_msg("PRESS Z BUTTON TO START",250);
call grin$nwzoom (255,255,2);
z = -1; do while (z^=0); call $invis(x,y,z); end;
do while (z^=1); call $invis(x,y,z); end;
     call $erase;
     plane = 8;
     call grin$gtext("PRESS BREAK KEY TO ABORT",180,250,ten,0);
     do x = 191 to 319 by 3;
     call grin$gwrop (x, 191, x + 63, 319, plane, array1->m);
     end;
goto done;

/*::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::*/
closer: entry;
/* [xmin:xmax, ymin:ymax]      */
dcl  n [0:63, 0:63] bit(1) based;

on break begin; goto done; end;
call ioa("entered closer");
call common;
/* create the bit array with the gradient pattern */
xmin = 0; xmax = 63; ymin = 0; ymax = 63;
```

```
whole = xmax - xmin;        /* fix->float conversion */
call $erase;
call $big_msg ("PLEASE WAIT...",300);
do x = xmin to xmax;
     part  = x - xmin;     /* fix->float conversion */
     threshold = part / whole;
     do y = ymin to ymax;
          if math$random () > threshold
            then array1->n [y, x] = '1'b;
            else array1->n [y, x] = '0'b;
            end;
     end; /* x */


/* write the bit array into the frame buffer */
call grin$vis("0000"b4);
call grin$ocolor(col-1,col-1, 0);
call grin$rectv(0,0,511,511,ate,0);
call $erase;
do x = 0 to 511; cm[x] = "000000"b4; end;
call grin$defcm(cm,512,1023);
call grin$rectv(0,0,511,511,ate&nine,0);
call $big_msg("PRESS Z BUTTON TO START",300);
call grin$nwzoom (255,255,3);
z = -1; do while (z^=0); call $invis(x,y,z); end;
do while (z^=1); call $invis(x,y,z); end;
     call $erase;
     plane = 8;
     call grin$gtext("PRESS BREAK KEY TO ABORT",180,250,ten,0);
     do x = 123 to 378 by 3;
     call grin$gwrop (x, 223, x + 63, 287, plane, array1->n);
     end;
goto done;


/*::::::::::::::::::::::::::::::::::::::::::::::::::::::::*/
exgrad: entry;
/* [xmin:xmax, ymin:ymax]      */
dcl  o [0:511, 0:63] bit(1) based;

on break begin; goto done; end;
call common;
/* create the bit array with the gradient pattern */
xmin = 0; xmax = 63; ymin = 0; ymax = 63;
whole = xmax - xmin;        /* fix->float conversion */
call $erase;
call $big_msg ("PLEASE WAIT...",300);
do x = xmin to xmax;
     part  = x - xmin;     /* fix->float conversion */
     threshold = part / whole;
     do y = ymin to ymax;
          if math$random () > threshold
          then array1->o [y, x] = '1'b;
          else array1->o [y, x] = '0'b;
          end;
```

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```
            end; /* x */

/* write the bit array into the frame buffer */
call grin$vis("0000"b4);
call grin$ocolor(col-1,col-1, 0);
call grin$rectv(0,0,511,511,ate,0);
call $erase;
do x = 0 to 511; cm[x] = "000000"b4; end;
call grin$defcm(cm,512,1023);
call grin$rectv(0,0,511,511,ate&nine,0);
call $big_msg("PRESS Z BUTTON TO START",250);
z = -1; do while (z^=0); call $invis(x,y,z); end;
do while (z^=1); call $invis(x,y,z); end;
      call $erase;
      plane = 8;
      call $big_msg("PRESS BREAK KEY TO ABORT",300);
      call grin$nwzoom (128,64,3);
      do x = 0 to 511 by 3;
      if x > 448 then plane = 9;
      call grin$gwrop (x, 0, x + 63, 63, plane, array1->o);
      end;
goto done;

/*:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::*/
brickwindows: entry;
/* [xmin:xmax, ymin:ymax]     */
dcl  p [0:511, 0:63] bit(1) based;

on break begin; goto done; end;
call common;
/* create the bit array with the gradient pattern */
xmin = 0; xmax = 63; ymin = 0; ymax = 511;
whole = xmax - xmin;      /* fix->float conversion */
call $erase;
call $big_msg ("PLEASE WAIT...",300);
do x = xmin to xmax;
      part  = x - xmin;   /* fix->float conversion */
      threshold = part / whole;
      do y = ymin to ymax;
            if math$random () > threshold then
            array1->p [y, x] = '1'b;
            else array1->p [y, x] = '0'b;
            end;
    end; /* x */

/* write the bit array into the frame buffer */
call grin$vis("0000"b4);
call grin$ocolor(col-1,col-1, 0);
call grin$rectv(0,0,511,511,ate,0);
call $erase;
do x = 0 to 511; cm[x] = "000000"b4; end;
call grin$defcm(cm,512,1023);
call grin$rectv(0,0,511,511,ate&nine,0);
```

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```
call $big_msg("PRESS Z BUTTON TO START",300);
z = -1; do while (z^=0); call $invis(x,y,z); end;
do while (z^=1); call $invis(x,y,z); end;
     call $erase;
     plane = 8;
     call $big_msg("PRESS BREAK KEY TO ABORT",300);
     call grin$nwzoom(255,255,2);
     do x = 191 to 319 by 3;
     call grin$gwrop (x, 191, x + 31, 319, 9, array1->p);
     end;
go to done;

/*::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::*/
done:
call hcs$truncate_ptr(array1,0,syscode);
call hcs$terminate (array1);
call $erase;
call grin$gtext("PRESS Z BUTTON TO CLEAR",180,255,ten,0);
call grin$gtext("OVERLAY PLANE AND RETURN",180,225,ten,0);
do while (z^=0); call $invis(x,y,z); end; /* let settle */
do while (z^=1); call $invis(x,y,z); end; /* wait for z */
call grin$zoom_off;
call grin$erase(ate,ate);
call grin$erase(nine,nine);
call grin$vis("0008"b4);
call $restore_cm;
end;
```

```
/*-----------------------------------------------------*
 | progname: circlewipes.pll                           |
 | procname: circlewipes                               |
 | bindfile: xtal.bind                                 |
 | includes: generic.incl.pll                          |
 | entrypts: xtal$circlewipe                           |
 |           xtal$starr                                |
 |           xtal$half                                 |
 |           xtal$polish                               |
 |           xtal$spike                                |
 | author  : sarah griffith                            |
 | descript: overlay circular wipes, solid and airbrushed |
 *-----------------------------------------------------*/
circlewipes: proc;

%include generic;
dcl $restore_cm entry;
dcl $black_cm2 entry;
dcl $get_ocolor entry (fix);
dcl delay fix init(999);
dcl plane bit(16);
dcl grin$gwrop entry (fix, fix, fix, fix, fix, bit(1));
dcl grin$defcm entry (bit(24), fix, fix);
dcl cm[0:511]  bit(24);
dcl hcs$truncate_ptr entry(ptr, fix bin(31), fix bin(31));
declare
     /* indices into array m        */
     (a, b)          fix(15),
     /* lower array x index         */
     amin            fix(15) init (0),
     /* lower array y index         */
     bmin            fix(15) init (0),
     /* upper array x index         */
     amax            fix(15) init (63),
     /* upper array y index         */
     bmax            fix(15) init (63),
     syscode         fix(31);
declare
     /* part of x index range       */
     part            float,
     /* whole x index range         */
     whole           float,
     /* varies 0.0 --> 1.0          */
     threshold       float;
declare
     array1          pointer,
     m [0:63, 0:63] bit(1) based;
declare
     (cenx,ceny,side)          fix init (0),
     (rx,ry)                   fix(31),
     (theta,radius)            fix,
     (x,y,z,i,col)             fix(15),
     (dx,dy)                   flt,
```
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```
/* . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . */
common: proc;

call hcs$initiate (">u>xtal>star", "array_1", array1, syscode);
call $get_ocolor(col);
call $delayslide(delay);
amin = 63-delay/16;          /* scale 0-999 to 0-63 */
do a = 0 to amin-1;
     do b = bmin to bmax;
          array1->m[b,a] = '1'b;
          end;
     end;
call $erase;
call $big_msg("CHOOSE CENTER POINT",300);
call $big_msg("WITH Z BUTTON AND",270);
call $big_msg("FIRST RADIUS POINT WITH BUTTON 2.", 230);
do z = -1 while (z<1); call $bat(x,y,z); end;
if z  = 1 then do; cenx = x; ceny = y; end;
do z = -1 while (z < 4); call $bat(x,y,z); end;
if z  = 4 then do;
     rx = x;
     ry = y;
     dx = rx-cenx; dy = ry-ceny;
     radius = math$sqrt((dx*dx)+(dy*dy));
     call $erase;
     end;
end; /* common */


/* write pixel values into buffer . . . . . . . . . . . . .*/
fill: proc;

call $big_msg("PLEASE WAIT",300);
whole = amax - amin;     /* fix->float conversion */
do a = amin to amax;
     part  = a - amin;   /* fix->float conversion */
     threshold = part / whole;
     do b = bmin to bmax;
          if math$random () > threshold then
               array1->m[b,a] = '1'b;
          else array1->m[a,b] = '0'b;
          end;
end;
end; /* fill */


/* init all entrypoints . . . . . . . . . . . . . . . . . . . .*/
setup:proc;
call grin$vis("0000"b4);
call grin$ocolor(col-1,col-1,0);
call grin$rectv(0,0,511,511,ate,0);
call $erase;
```
                                                                    74

```
do x = 0 to 511; cm[x] = "000000"b4; end;
call grin$defcm(cm,512,1023);
call grin$rectv(0,0,511,511,ate&nine,0);
end;

/* . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . */
circlewipe:entry;
      on break begin; goto done; end;

call common;
call setup;
z = -1;
call $big_msg("PRESS Z BUTTON TO START",300);
do while (z^=0); call $invis(x,y,z); end;
do while (z^=1); call $invis(x,y,z); end;
      call $erase;
            if radius > 100 then side = radius/4;
            else side = 12;
      plane = ate;
      call $big_msg("PRESS BREAK KEY TO ABORT", 300);
      do i = radius to 511 by amin;
        do theta = 1 to 180;
            rx = (math$cos(theta) * i) + cenx;
            if rx > 511-side/2 then rx = 511-side/2;
            if rx <   0+side/2 then rx =   0+side/2;
            ry = (math$sin(theta) * i) + ceny;
            if ry > 511-side/2 then ry = 511-side/2;
            if ry <   0+side/2 then ry =   0+side/2;
            call grin$rectv(rx-side/2,ry-side/2,
                  rx+side/2,ry+side/2,plane,on);
        end; /* theta */
      end; /* i */
goto done;

/* . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . */
starr:entry;
      on break begin; goto done; end;

call common;
call fill;
call setup;
z = -1;
call $big_msg("PRESS Z BUTTON TO START",300);
do while (z^=0); call $invis(x,y,z); end;
do while (z^=1); call $invis(x,y,z); end;
      call $erase;
      call $big_msg("PRESS BREAK KEY TO ABORT",300);
      do i = radius to 511 by 32;
        do theta = 1 to 180 by 12;
            rx = (math$cos(theta) * i) + cenx;
            if rx > 511 then rx = 511-amin;
            if rx <   0 then rx =   0+amin;                75
```

```
            ry = (math$sin(theta) * i) + ceny;
            if ry > 511 then ry = 511-amin;
            if ry <    0 then ry =    0+amin;
            call grin$gwrop (rx-amin, ry-amin,
                rx+amin, ry+amin, 8, array1->m);
            end; /* theta */
        end; /* i */
goto done;

/* . . . . . . . . . . . . . . . . . . . . . . . . . . . */
half:entry;
      on break begin; goto done; end;

call common;
call fill;
call setup;
z = -1;
call $big_msg("PRESS Z BUTTON TO START",300);
do while (z^=0); call $invis(x,y,z); end;
do while (z^=1); call $invis(x,y,z); end;
      call $erase;
      call $big_msg("PRESS BREAK KEY TO ABORT",300);
      do i = radius to 511 by amin;
        do theta = 1 to 180 by 12;
            rx = (math$cos(theta) * i) + cenx;
            if rx > 511 then rx = 511;
            if rx <    0 then rx =    0;
            ry = (math$sin(theta) * i) + ceny;
            if ry > 511 then ry = 511;
            if ry <    0 then ry =    0;
            if rx>cenx | ry>ceny then
            call grin$gwrop (cenx, ceny, rx, ry, 8, array1->m);
            if rx<cenx | ry<ceny then
            call grin$gwrop (rx, ry, cenx, ceny, 8, array1->m);
        end; /* theta */
      end; /* i */
goto done;

/* . . . . . . . . . . . . . . . . . . . . . . . . . . . */
polish:entry;
      on break begin; goto done; end;

call common;
call fill;
call setup;
z = -1;
call $big_msg("PRESS Z BUTTON TO START",300);
do while (z^=0); call $invis(x,y,z); end;
do while (z^=1); call $invis(x,y,z); end;
      call $erase;
      side = amin;
      call $big_msg("PRESS BREAK KEY TO ABORT",300);
```

```
      do i = radius to 511 by amin;
        do theta = 1 to 180 by 12;
            rx = (math$cos(theta) * i) + cenx;
            if rx > 511-side then rx = 511-side;
            if rx <    0+side then rx =    0+side;
            ry = (math$sin(theta) * i) + ceny;
            if ry > 511-side then ry = 511-side;
            if ry <    0+side then ry =    0+side;
        call grin$gwrop (rx-side, ry-side,
            rx+side, ry+side, 8, array1->m);
            end; /* theta */
          side = side + 4;
          end; /* i */
goto done;

/* . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . */
spike:entry;
      on break begin; goto done; end;

call common;
call setup;
z = -1;
call $big_msg("PRESS Z BUTTON TO START",300);
do while (z^=0); call $invis(x,y,z); end;
do while (z^=1); call $invis(x,y,z); end;
      call $invis(x,y,z);
      plane = ate;
      call $erase;
      do radius = radius to 511 by amin;
        do theta = 0 to 359;
            rx = (math$cos(theta) * radius) + cenx;
            if rx > 511 then rx = 511;
            if rx <    0 then rx =    0;
            ry = (math$sin(theta) * radius) + ceny;
            if ry > 511 then ry = 511;
            if ry <    0 then ry =    0;
            call grin$linev(cenx,ceny,rx,ry,plane,on);
            end; /* theta */
      end; /* radius */
goto done;

/* . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . . */
done:
call hcs$truncate_ptr(array1,0,syscode);
call hcs$terminate (array1);
call $erase;
call $big_msg("PRESS Z BUTTON TO CLEAR",300);
call $big_msg("OVERLAY PLANE AND RETURN",270);
do while (z^=0); call $invis(x,y,z); end; /* let settle */
do while (z^=1); call $invis(x,y,z); end; /* wait for z */
call grin$erase(ate,ate);
call grin$erase(nine,nine);
```

```
call grin$vis("0008"b4);
call $restore_cm;
end;
```

```
/*------------------------------------------------------------*
 | progname: twobits.pll                                      |
 | procname: twobit                                           |
 | bindfile: xtal.bind                                        |
 | includes: generic.incl.pll                                 |
 | entrypts: xtal$twobit                                      |
 |           xtal$dizzy2                                      |
 | author  : kate adams                                       |
 | modified: sarah griffith                                   |
 | descript: two-bit dissolve - twobit generates the         |
 |           composite image, and dizzy2 does the dissolve.  |
 *------------------------------------------------------------*/

twobit:proc;
/* see fourbit.pll for further explanantion                 */

%include generic;
dcl  $sel_pic entry (char(32)vary, char(32)vary),
     bufl bit(32) based (tpl),
     buf2 bit(32) based (tp2),
     buf3 bit(32) based (tp3),
     buf4 bit(32) based (tp4),
     ibuf [0:511] bit(32),
     (steps,strip,i,j,r,g,b) fix,
     O fix bin(31),
     (bpl,bp2,bp3,bp4,tpl,tp2,tp3,tp4) ptr,
     /* down name, pic name, ptr name */
     (dnl,dn2,dn3,dn4,pnl,pn2,pn3,pn4,namel,name2,name3,
          name4) char(32) vary,
     cnum char(64) init ("00010203040506070809101112131415l
          617181920212223242526272829303l");


dcl  (loadcm,grin$icm) entry options (variable),
     ints char(33) init ("0123456789ABCDEFGHIJKLMNOPQRSTUVW"),
     (x,y,z) fix;

/*. . . . . . . . . . . . . . . . . . . . . . . . . . . . .*/

on break begin; goto done; end;
call grin$ocolor(0,0,0);

getpl:
call hcs$terminate(bpl);
call $sel_pic(namel,"START");
dnl = ">pix>"||namel;
call hcs$initiate (dnl,namel||".little",bpl,O);
if O ^= 0 then goto getpl;
call hcs$terminate(bpl);

getp2:
call hcs$terminate(bp2);
call $sel_pic(name2,"SECOND");
```
                                                         79

```
dn2 = ">pix>"||name2;
call hcs$initiate (dn2,name2||".little",bp2,O);
if O ^= 0 then goto getp2;
call hcs$terminate(bp2);

getp3:
call hcs$terminate(bp3);
call $sel_pic(name3,"THIRD");
dn3 = ">pix>"||name3;
call hcs$initiate (dn3,name3||".little",bp3,O);
if O ^= 0 then goto getp3;
call hcs$terminate(bp3);

getp4:
call hcs$terminate(bp4);
call $sel_pic(name4,"FINAL");
dn4 = ">pix>"||name4;
call hcs$initiate (dn4,name4||".little",bp4,O);
if O ^= 0 then goto getp4;
call hcs$terminate(bp4);

do strip = 0 to 31;
    pn1 = name1||".pic"||substr(cnum,strip*2+1,2);
    /* eg ben.pic00 */
    pn2 = name2||".pic"||substr(cnum,strip*2+1,2);
     /* eg ten.pic00 */
    pn3 = name3||".pic"||substr(cnum,strip*2+1,2);
     /* eg hen.pic00 */
    pn4 = name4||".pic"||substr(cnum,strip*2+1,2);
     /* eg den.pic00 */
    call hcs$initiate (dn1,pn1,bp1,O);
    call hcs$initiate (dn2,pn2,bp2,O);
    call hcs$initiate (dn3,pn3,bp3,O);
    call hcs$initiate (dn4,pn4,bp4,O);
    tp1 = bp1;      tp2 = bp2;      tp3 = bp3;      tp4 = bp4;
    do i = 0 to 15;
      do j = 0 to 511;
          /* red group */
          substr(ibuf[j],1,2)  = substr(buf1,1,2);
          substr(ibuf[j],3,2)  = substr(buf2,1,2);
          substr(ibuf[j],5,2)  = substr(buf3,1,2);
          substr(ibuf[j],7,2)  = substr(buf4,1,2);
           /* green group */
          substr(ibuf[j],9,2)  = substr(buf1,9,2);
          substr(ibuf[j],11,2) = substr(buf2,9,2);
          substr(ibuf[j],13,2) = substr(buf3,9,2);
          substr(ibuf[j],15,2) = substr(buf4,9,2);
           /* blue group */
          substr(ibuf[j],17,2) = substr(buf1,17,2);
          substr(ibuf[j],19,2) = substr(buf2,17,2);
          substr(ibuf[j],21,2) = substr(buf3,17,2);
          substr(ibuf[j],23,2) = substr(buf4,17,2);
          substr(ibuf[j],25,8) = "00000000"b;
```

```
              tpl = addrel(tpl,6);
              tp2 = addrel(tp2,6);
              tp3 = addrel(tp3,6);
              tp4 = addrel(tp4,6);
              end;
          call grin$write (16*strip+i,0,16*strip+i,511,ibuf);
          end;
      call hcs$terminate(bp1);
      call hcs$terminate(bp2);
      call hcs$terminate(bp3);
      call hcs$terminate(bp4);
end;

done:
      call hcs$terminate(bp1);
      call hcs$terminate(bp2);
      call hcs$terminate(bp3);
      call hcs$terminate(bp4);
      return;


/*--------------------- dizzy2-----------------------------*/

/*    dizzy2:  Once a composite image has been generated,
      this procdedure simulates a "dissolve" from the image
      stored in the top two bits of each r,g, and b pixel
      value to the image stored in the next two bits.  This
      effect is achieved by loading a sequence of previously-
      generated color matrices (see gen_cm2.pll), one after
      another.  Each color matrix "weights" the upper and
      lower two bits slightly differently than the previous
      one.
*/

dizzy2: entry;
      on break begin; goto fin; end;

/* erase cursor and load beginning cm */
call grin$vis ("0000"b4);
call loadcm(">u>cm>2_bit_0.cm");

call $big_msg("COMPOSITE DISSOLVE",400);
call $big_msg("Z BUTTON = 16 STEPS, ONCE  ",340);
call $big_msg("BUTTON 1 = 16 STEPS, REPEAT",310);
call $big_msg("BUTTON 2 = 32 STEPS, ONCE  ",280);
call $big_msg("BUTTON 3 = 32 STEPS, REPEAT",250);
call $big_msg("LIFT PUCK TO EXIT",160);

      /* wait for button, then clear prompt and begin */
z = -1; do while (z ^= 0); call $invis(x,y,z); end;
do while (z = 0); call $invis(x,y,z); end;
call $erase;

      /* 16 steps, once through */
```

```
if z = 1 then do i = 0 to 16;  /* from cm 1 to 33 */
call loadcm(">u>cm>2_bit_"||substr(ints,2*i+1,1)||".cm");
end;


     /* 16 steps, ad nauseum */
if z = 2 then do while ("1"b);
     do i = 0 to 16;        /* from cm 1 to 33 */
          call loadcm(">u>cm>2_bit_"
               ||substr(ints,2*i+1,1)||".cm");
          end;
     do i = 1 to 16;        /* from cm 32 to cm 2 */
          call loadcm(">u>cm>2_bit_"
               ||substr(ints,34-2*i,1)||".cm");
          end;
     end;


     /* 32 steps, once through */
if z = 4 then do i = 1 to 33;
     call loadcm(">u>cm>2_bit_"
          ||substr(ints,i,1)||".cm");
     end;


     /* 32 steps, ad nauseum */
if z = 8 then do while ("1"b);
     do i = 1 to 33;        /* from cm 1 to 33 */
          call loadcm(">u>cm>2_bit_"
               ||substr(ints,i,1)||".cm");
          end;
     do i = 1 to 31;        /* from cm 32 to cm 2 */
          call loadcm(">u>cm>2_bit_"
               ||substr(ints,33-i,1)||".cm");
          end;
     end;

fin:  /* fall through if puck lifted (z = -1) or BREAK */
     call $big_msg ("PRESS Z BUTTON TO RESTORE",300);
     call $big_msg ("INITIAL COLOR MATRIX AND",270);
     call $big_msg ("RETURN TO MENU",240);
     call $big_msg ("LIFT PUCK TO EXIT WITHOUT",160);
     call $big_msg ("CHANGING THE COLOR MATRIX",130);

     /* wait for button, then exit as directed */
     z = -1; do while (z ^= 0); call $invis (x,y,z); end;
     do while ((z ^= -1) & (z ^= 1)); call $invis(x,y,z); end;
     if z = 1 then call grin$icm;
     call grin$vis("0008"b4);
end;
```

```
/*-----------------------------------------------------------*
 |  progname: gen_cm2.pll                                     |
 |  procname: gen_cm2                                         |
 |  entrypts: gen_cm2$gen_cm2                                 |
 |  author  : kate adams                                      |
 |  modified: sarah griffith                                  |
 |  descript: generate intermediate color matrices for       |
 |            two-bit dissolves in >u>cm.                     |
 *-----------------------------------------------------------*/

gen_cm2: proc;
%include generic;
declare
     scs$expand_path entry
          (char(168)vary,char(168)vary,char(32)vary,fix(31)),
     err fix(31),

     (name,dname) char(168) vary,
     tcm_ptr ptr,
     icm [0:255] bit(24),
     tcm [0:255] bit(24) based (tcm_ptr),
     ints char(33) init("0123456789ABCDEFGHIJKLMNOPQRSTUVW"),
     (f1,f2,f3,f4) flt,
     (r1,r2,r3,r4,g1,g2,g3,g4,b1,b2,b3,b4,ent,i,r,g,b) fix;

/* . . . . . . . . . . . . . . . . . . . . . . . . . . . . . */
do i = 0 to 255;                     /* generate identity c.m. */
   icm[i] = grin$color(i,i,i);
   end;

dname = ">u>cm";                     /* color matrix directory  */
name = "2_bit_ .cm";                 /* filename = 2_bit_n.cm    */

/* generate intermediate matrices */
do i = 0 to 32;
   call ioa("generating cm2_ ^i",i);
   /* figure percentage of picture */
   if (i>=0 & i<=8) then
       f2 = i / 8.0; f1 = 1.0 - f2;        f3=0; f4=0;
   if (i>=9 & i<=16) then
      f3 = (i- 8.0)/8.0; f2 = 1.0 - f3; f1=0; f4=0;
   if (i>=17 & i<=24) then
      f4 = (i-16.0)/8.0; f3 = 1.0 - f4; f1=0; f2=0;
   if (i>=25 & i<=32) then
      f1 = (i-24.0)/8.0; f4 = 1.0 - f1; f2=0; f3=0;

      /* set n = ("0","1", etc) */
   substr(name,7,1) = substr(ints,i+1,1);
      /* create new segment */
   call hcs$append_seg(dname,name,err);
      /* open new segment */
   call hcs$initiate(dname,name,tcm_ptr,err);            83
```

```
do ent = 0 to 255;
   r1 = substr(icm[ent],1,2);
   r2 = substr(icm[ent],3,2);
   r3 = substr(icm[ent],5,2);
   r4 = substr(icm[ent],7,2);
   g1 = substr(icm[ent],9,2);
   g2 = substr(icm[ent],11,2);
   g3 = substr(icm[ent],13,2);
   g4 = substr(icm[ent],15,2);
   b1 = substr(icm[ent],17,2);
   b2 = substr(icm[ent],19,2);
   b3 = substr(icm[ent],21,2);
   b4 = substr(icm[ent],23,2);
   r = fix(16.0*(float(r1)*f1+float(r2)*f2)+
            (float(r3)*f3)+(float(r4)*f4));
   g = fix(16.0*(float(g1)*f1+float(g2)*f2)+
            (float(g3)*f3)+(float(g4)*f4));
   b = fix(16.0*(float(b1)*f1+float(b2)*f2)+
            (float(b3)*f3)+(float(b4)*f4));
   tcm[ent] = grin$color(r,g,b);
   end; /* ent = 0 to 255 */

   call hcs$terminate(tcm_ptr);
   end; /* i = 0 to 15 */

end; /*gencm2*/
```

Patricia Linden
URSULA DRABIK

Peter Linden
DAVID ERSKINE

Nancy Compton
JULIE ROCHLIN

Cheryl Walker
GLORIANA DAVENPORT

Ted Walker
TED ZALEWSKI

John
JOHN WALKER

Steve
STEVE RUGGERE

Caterer
BONNIE SYMANSKY

Woman on Street
CHRISTINE PALAMIDESSI

also starring
KATYA CHELLI
SASCHA CHELLI
FRITZ THE CAT
DAVE HEALEY
STEVE KUETTEL
ANDREW NEUMANN

Young Professionals
LUC COURCHENE
JANE JACOBS
JACK LYONS
ANN MCINTOSH
KATE PURDIE
DOROTHY SHAMONSKY
DIANE SOKOL
JAMIE TILGHMAN

```
/* . . . . . . . . . . . . . . . . . . . . . .*/
```

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Production Manager
VANESSA BORIS

Engineer-in-Charge
MARK ABBATE

Technician
STEVE KUETTEL

Sound Recording and Video
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CHARLES MUDGE (MYRTLE)
LEWIS DALVEN (FRITZ)
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VOUROS CAFE

STEVE COLBY
WGBH EDUCATIONAL FOUNDATION

Made at the MIT
Film/Video Section

A Videotape by
SARAH GRIFFITH

A Spyder Media Production

Appendix D
Script for Key Change

The following pages are the script as originally
conceived in September 1983. I am including it for
those who want to understand how the information in
the script changed during shooting. Rewriting
continued all during the shooting process, but many of
these pages got lost in the shuffle. I hope that those
(of you in Rotch, planning your own thesis!) who read
the script also watch the videotape, as I have my
doubts about considering the script a finished piece
in any way.

OUTLINE

Verses	Refrains
Water	
	Shopping and Eating Alone
Calls Brother	
	Sitting Alone
First Date	
	Construction Workers
Conversation with Nancy	
	Holding the baby
P.A. Set-up	
	Hands touching
Pick up Peter at Logan	
	Walking with Peter
Christmas party	
After party conversation	
	Playing with cat
Alone in the Studio	
	Working happily with others in studio
Possible 2nd conversation with girlfriend	
Ice skating with boyfriend	

VERSE

Swimming

I have already shot this in super-8 for transfer.

The camera swirls through the water, sometimes surfacing

for a look around. Because of the iron color of the

water and the transfer technique, and the lack of main

characters, this could well end up a refrain.

VERSE

Location: my kitchen

Costume: sweatpants and t-shirt, same as for eating alone

Patricia is standing and stirring something on the stove.

Some kind of one-pot meal or eggs. She leaves and returns

with the phone, places it next to the stove, and dials a

long distance number. She gets a busy signal and hangs up.

A few seconds later she dials again.

  "Hi. It's me. "It's your adoring little sister."

  "How's it going? Good... So what else are you up to?"

  "No. I'm still working for Barr. Lota concerts this

month."

  "Yeah, I'm trying."

  "Well, how am I supposed to do that? You always expect

so much of me..."

  Yeah, yeah. okay."

  "You still seeing that groupie, what's her name?"

  "Okay, take care of yourself. See you at Christmas...

Do you know when you're coming in yet? I'll pick you up."

(Grabs shopping list and pen and writes it down.)

  "So, good."

  "Bye."

  "Okay, bye."

VERSE

First Date

Location: car and gas station, then Vouros Cafe

Costume: Patricia wears pants and sweater,
          boyfriend wears jeans and sweater

John and Pat pull into a gas station. They are discussing

the merits of various film possibilities for the evening;

John is driving. He decides to check the oil. He can't

get the hood open, and steps out of the car to press on it.

Pat reaches over and pulls the latch and the hood springs

open. He looks up surprised. Pat feels too self-conscious

to make a joke out of it. When he gets back in the car she

agrees to go see what he wants to see, War Games.

Coming into the middle of a conversation. They have just

seen War Games and are getting something at the counter.

J: So what did you think?

P: Well it really bothers me that everything's so completely

resolved in the end. I mean you could walk out of War Games

thinking that nuclear war is no longer a danger.

J: Nah, nobody's going to think that. Besides, it's just

a movie. Maybe the director thinks artificial intelligence

is the way out.

(by now they're sitting down)

P: No, that's stupid. Did you see any of the Star Wars

movies? They all reinforce American militarism; they don't

do anything to stop it. They're expressions of our national

culture and I think they're horrifying, not cute. (very

excited and serious)   92

J: (laughing) Don't you think you're taking all this a

little too seriously?

P: (she's thinking no) Yeah, I guess. (Plays with her

serakopita) Well... (but he's already talking over her)

J: Well, you got to admit they have all these MIT nerds

nailed. That guy was perfect.

P: (Laughs with him. Pause)

J: Did you go down to New York last year? For the peace

day demonstration? (He wants to show he has some liberal

credentials, too)

(they go on discussing nuclear war or some related topic)

VERSE

Breakfast with Nancy

Location: street corner, then F&T Diner
Costume: Nancy wears a skirt
           Pat wears pants and a shirt

Nancy and Patricia meet outside on the street. They have breakfast
together once a week. Nancy sees Pat first because Pat's so
preoccupied.

N: Pat, hey Pat.

P: Hi! How ya doing?

N: I'm fine, how are you?

P: Good.

N: Yeah? So let's go get some breakfast.

They're sitting down and ordering. Pat orders something
tiny, Nancy orders a real breakfast.

P: So you were going to tell me about your rehearsals?

N: Yeah. They're difficult. Everyone knows the movements
now, so it's a matter of getting them to move with it.
(Nancy looks closely at Patricia.)
So did you decide what you're doing Christmas? Are your parents
still going away?

P: Yeah, I talked to my brother Monday night.
(Pat looks away for a second.)

N: So how was that? Same old shit?

P: Yeah, He can always make me feel like a complete failure,
you know?

N: What is his problem? You're just fine the way you
are.

P: Well, he's sort of right, you know. I would make more
money and have more control producing. But I don't want to
do that kind of work. (Looks up at Nancy, she's almost in
tears.)

N: Well, you don't have to.

P: No. I know. (holding it in)

N: Can't you tell him that?

(They've said the following to each other before.)
P: He'd just say he's proud of me. I feel like we're
really a lot alike, you know? Only he can't see it, he
doesn't understand we're both doing the same thing.

N: Except you're not, Pat. Look, all your brother does
is put together business deals. You're a musician, you're
making music.

P: (Nods, she really is fighting tears, but feels some-
what relieved at the admonition.)
Well, it will be good to see him and try to sort some
of this stuff out.

N: You can always come home with me.

P: So how's Tom?

N: Okay. He's still in need of retraining camp (laugh).

P: Yeah?

N: Yeah, he was emptying the drainer the other night and
broke some dishes, and decided it was all my fault since
I put them there.

P: Well, of course dear, you didn't stack them correctly...

N: So we had to have a little talk.

P: That's good at least you can talk about that kind of
stuff.

N: Yeah, it's okay.

P: So I went out with that guy John the other night.

N: How was that?

P: I don't think he really knew what to make of me. He
couldn't get his car hood open, so I just openend it, and
then he was really surprised.

N: Why, doesn't he think you can open a car hood?

P: I guess not. I just felt really . . . you know
sometimes I think I'm not very feminine.

N: It's a problem. It's hard to be competent and be feminine
at the same time. But you don't want some guy who's scared
of you either.

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P: Yeah. (quietly) I guess I do want some guy though.

VERSE

Setting up P.A. System

Location: probably Berklee auditorium

Costume: Patricia is dressed sloppily, almost punk or like
a student.

Patricia is a member of a crew setting up the audio for a
live performance. They are carrying heavy equipment. The
talk is perfunctory and to the point; they have done this
before. One of the guys is in charge.

Later in the same day of setting up equipment, Pat is standing
in the booth (or by a mixer) doing audio checks. Everyone
looks tired and somewhat tense. Eileen Shackleton arrives
with one less sandwich than worker, and hands them out.
Patricia notices that she has been left out and flushes a
little. "Got another one of those?" her voice is showing the
tenseness she feels. Eileen clearly doesn't like Pat. "We
don't serve the groupies," she states, turning to walk out.
"What do you mean? I've been working here for ten hours..."
Pat explodes, more than the situation warrants. Not that
she shouldn't be angry, but that she should be bigger than
this mean-minded person. "setting up this P.A. and you're
calling me a groupie? What have you done today, make some
sandwiches?" Pat is exhausted and knows she can't cry, so
doesn't say more. Eileen finally apologizes and leaves.
One of the guys shares his food with Patricia - the show
must go on. The men were quiet during the episode. Now
they tell Patricia not to take it so personally, that she was
over-reacting.   96

VERSE

Picking up Peter at the Airport

Location: Logan Airport

Costume: Patricia looks more chic than we have seen her before,
          but is still probably wearing pants.
          Peter wears a sport jacket and no tie.

Patricia is waiting for Peter, trying not to look anxious,

trying to look nonchalant. Peter is, naturally close to

one of the last people off the plane. This conversation

is adlib, he's describing his current deals, difficulties

and glories to Patricia who responds attentively and

energetically, almost obediently. At times it should be

obvious that Patricia is thinking about something else,

like his baggage, but responding automatically, like a

good girl. Another part of their conversation could be

his remembering getting her her first job in Boston, a time

when the relationship was working better for both of them.

The conversation could go on down the hall and while they

wait for their baggage.

Either Peter mentions the party near the end or perhaps

he runs into Ted Walker who tells him about it.

VERSE

Christmas Party

Location: Carolyn Oliver's apartment

Costume: Patricia wears something tuxlike - black pants
          and a formal white shirt if tuxes for women seem
          too passe. The rest of the party is dressed in
          young professionals cocktail stuff.

Peter has asked Pat to come along with him to a Christmas
part he's going to in Brookline. He might have a date,
but probably not. It is a "grown-up" party with cocktails,
drinks and cookies appropriate to the season. People are
dressed very nicely - the age-range tends to be mid-thirties,
not particularly couply because everyone is divorced by now.
Peter introduces her to some nerdy guy and leaves her to
her own devices. She sits and watches, talks to some people,
she's having an okay time. Near the end of the party, Peter
is still talking animately to his friends, one of who is Mr.
Walker. Pat walks over and stands ready to sit near Mrs.
Walker, who is very drunk. She is very upset. As soon as
she sees Patricia she hopes for a sympathetic ear.
"Hi," Patricia says, "I'm Patricia Linden, I think I met you
once before." Cheryl looks up at her sadly.

        "What's your career, honey?" she says.

        "Well, I work with sound."

        "He hates me." Cheryl moans a few seconds later.

        "What?"

        "I'm losing him. He's bored with me."

        "No, he's not. It's just a...

        "What do you know? ...You're not really..."

Pat, who has been sitting next to Cheryl moves away a little.

Cheryl obviously needs help, but Pat is in the line of fire.
Cheryl senses she's losing her audience and starts a different tack. "See my dress?" coy now.

"Yes, its beautiful," Pat obliges.

"It's from Bonwit's. Do you shop there?"

"No, I don't." Pat doesn't quite see where this is leading.

"Yes, I have lots of clothes from Bonwits. My children are grown, you know. We send them off to school now. So that's what I do. I go to Bonwit's. What do you do?"

Pat told her again. This was kind of interesting.
What do women do with children and no job in the 1980s?

"So you can't really afford clothes from Bonwit's, can you? I can, and I don't work. He buys them all. (Pause) You know the more I sit here and look at you, the more I think you're not really a woman. You're not really a woman are you?"

Pat is pretty taken aback by this one.

"Oh, I hate myself." Cheryl seems to have forgotten what she just said so vehemently in her current matter-of-fact sigh. "I don't do anything, I'm not like you."

"Sure you are " Pat decides to be encouraging. You could be anything you wanted to. You don't have to worry about tuition."

"Oh you. You're very hard, just like a man. What do people do? Are you sure you're not a man? Come on, how do I know you're not a man?" Cheryl's voice is rising. Pat
is pissed.

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"What do you want, do you want to see my tits? Oh,
Jesus." Pat turns embarrassed at herself for falling into
the trap laid by this drunk, and runs into Mr. Walker.

"Hey, what's going on here. You settle down now."
Ne sasy, putting his drink down in order to pick up Mrs.
Walker.

She's staring at him, changing into a stare through him.
By this time Peter is in the picture, signaling to Patricia
to get out of there. They say their goodbyes and split
before the Walkers.

VERSE

After Party Conversation

Location: car

Costume: Same as party with coats

"So she was pretty wild, huh?" Peter is laughing.

"Yeah." Pat is quiet, thinking about what took place.

"Do you think I'm feminine?" she finally asks. "What
does that mean, really," knowing as she says it how her
brother will react.

Peter laughs a little and says, "Well, I never thought
there was any doubt about it. You're not silly or anything.
You just need to toughen up some. Why do you care what
other people think?"

Patricia looks at him. She's had it. "Yeah, that's
your answer - toughen up. What's that going to do? Don't
you see that I am what you made me? I'm not married, I don't
have kids, I am the way that woman described me..."

She's crying a little, but sniffs it back. Peter thinks
this is all pretty absurd.

"You infuriate me," she finally gets it out.

"Why for crying out loud? Tell me what I'm doing
and I'll quit doing it."

"You just expect so much of me I feel like a little
trained dog bringing home prizes for you. I don't always
have prizes, Peter."

"Pat, look it, I'm really proud of you. I don't know
anything about audio mastering and you can do it all. How

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many girls are there who can do that kind of stuff? You're

special."

"Yeah, look what you just said. You said I'm special

because I'm an audio engineer. And now you want more, you

want me to produce, too. Well, I don't want to. I don't

want to do any of it any more," she adds childishly.

"No, I just want you to be the best you can be. You

could earn a lot more mo y, have a lot more control,

producing. Shit man, I don't care, you don't have to do

anything."

There's a pause, and Patricia begins to try to make

sense of this. "I guess I'm just lonely. I'm tired of

working all the time. I go out with these guys and they're

all wimps. I don't know what's wrong with me." A long

pause, and Peter puts out his hand.

"There's nothing wrong with you. Now cheer up. Look,

I'll take you to Bonwit's tomorrow."

Pat appeases him by smiling. But her brain is working

fast and furiously, she's on to something. "Look. I know

you really taught me a lot. But you're not always right.

I'm not completely like you. I'm not like you.

Peter touches her reassuringly but also because he

doesn't know what to say, starts the car and drives off.

VERSE

Alone in the Studio

Location:

Costume: Patricia is much more put together than we have
           seen her before when working

Patricia has come to work very early in the morning. She

turns on the lights. Runs her fingers over the mixer and

stares out into the studio for a second. She gets up and

orders, sorts and cleans with the skill and touch of some-

one who cares for the equipment because they live with it,

they're the tools of the trade, but they're magical friends,

too. She puts a new ¼" tape on the reel-to-reel. Time

to check the mics or monitor speakers. She picks up the

first one. "Test one two." (pause) Awkward, and listening

to her own voice she says, "It's me. I'm me." The next

mic. "I don't care what he thinks." Impulsively she hugs

herself and stands looking down for a second. Breathes in

deeply and replaces the microphone. "I'm good at this.

I like sounds (now she's playing with her voice a little)

but I don't have to do it." (maybe a bronx cheer) She

puts the mic down andstrides back to the booth. She puts

on a rhythm track or a song or the radio, something she

likes and feels comfortable with. Now she's dancing a

little to the sound. The door opens and one of the guys comes

in carrying coffee and some doughnuts. "You're early.

How ya doing?" "I'm fine" . . .

VERSE

Ice Skating

Location:

Costume: ice skates!

Nancy and Pat go ice skating; Nancy brings along her friend

Greg. They're not such good ice skaters, but who cares?

The camera plays with them, the way it did in the water

at the beginning, and gradually it becomes clear that

Greg likes Patricia's roughhousing and confidence.

REFRAIN

Shopping & Eating

Patricia is in a supermarket aisle with her cart, the camera angle is wide and centered. There is a high angle shot of a grocery bag on the counter at home. Quick shot of her standing over the stove, dialing a number and getting a busy signal. Pushing her empty plate away. These shots are very clean, crisp and quiet. Minute sounds, like the plate scraping seem very loud. Even the grocery store seems quiet, although that will require different treatment than the apartment. The message is that she lives quite alone.

REFRAIN

Sitting Alone

Patricia, in different clothes, seated legs wide apart, back
to an urban brick wall. She is relaxed and her hands rest on
her legs. It's Audrey Flack's brick wall behind David if the
light is right. She does not look particularly masculine or
feminine

Sitting in front of the brick wall, still. In response to
a thought, she brings her legs together and crosses her arms
across her chest, ducks her head. It's a beautiful, directed
movement, like a dance movement, but also like a flower
suddenly wilting.

REFRAIN

Construction Workers

Patricia is walking away, down the street. In front of her

is a beautiful woman, stylishly dressed. Construction workers

whistle and yell at this woman, who subtly squares her shoulders

and walks faster. Patricia digs her hands into her pockets

and walks by with her head won. The workers don't react,

of course.

REFRAIN

Walking with Peter

The two of them walking down city streets together. She looks
to him to see what kind of mood he's in.

REFRAIN

Baby

Patricia sits on a couch in a somewhat dark room, holding a

baby. She is crooning and looking into its eyes, seemingly

alone.

Then two hands enter the frame, the baby's mother and take

the baby up and away. Her hands fall back empty.

REFRAIN

Hands

Close shots, brick reds, of hands touching. Hands close but

not touching. Boyfriend and Patricia seated where she

sits alone, hands on thighs, not touching. Holding hands.

Thighs touching.

These shots are framed tightly and expressively. The move-

ments are slow and abstracted. It's a little unclear exactly

who who the guy is.

REFRAIN

Cat

Patricia lays on the floor playing with her cat.

The sun is shining brightly and warmly on the floor. It

is a sensual warm moment.

REFRAIN

Working in the Studio

Patricia is at work, mixing. There's the producer and maybe
one other person in the booth. She's at ease and competent,
it would be nice if they break out laughing together.

Bibliography _

Adams, K., "Software Techniques for Digital Video
     Production", Bachelor's of Science Thesis for Electrical
     Engineering and Computer Science at M.I.T., January 1984.

Black, Peter, The Responsible Use of Computer Graphics in
     Broadcasting" COMPUTER GRAPHICS WORLD, September 1981, p.
     25.

Boyle, B., "Problems in the Interface Age", TELEVISION/
     BROADCAST COMMUNICATIONS, February 1984, p. 29.

Briggs, J., "Electronic Graphics in Television - The Next
     Step", SMPTE, September 1983, p. 912.

Burk, P. "Computers are Starring on The Weather Channel",
     BROADCAST COMMUNICATIONS, April 1983, p. 59.

"Character Generators: Evolution is Delivering More for
     Your Money", TELEVISION/BROADCAST COMMUNICATIONS, January
     1984, p. 88.

Cooke, S. L., Martin, Wm. R., "Micro-Computer Generated
     Videotapes", Proceedings of NECC, 1979, Nat'l Educ.
     Computer Conference, Univ. of Iowa, Iowa City. Weeg
     Computer Center: Iowa City 1979, p. 347.

Conrac Corporation, RASTER GRAPHICS HANDBOOK, Conrac
     Corporation 1980.

"Conversation with Roger Goodman", VIDEOGRAPHY, v.9, n.2,
     February 1984, p. 45.

Davidoff, F., "An Update of Digital Television
     Fundamentals", 11th SMPTE WINTER TELEVISION CONFERENCE, San
     Francisco, January 19, 1977. p.5.

Dertouzos, Michael L. and Joel Moses, THE COMPUTER AGE: A
     TWENTY-YEAR VIEW, Cambridge: MIT Press, 1979.

"Edit Controllers: The Pushbutton Philosophy", TELEVISION/
     BROADCAST COMMUNICATIONS, November 1983, p. 80.

Fraikorn, B. "Video Animation: The Process and the
     Equipment", AUDIO/VISUAL DIRECTIONS, v.5, n.10, October
     1983, p. 14.

Foley, J.D., and Van Dam, A., FUNDAMENTALS OF INTERACTIVE
     COMPUTER GRAPHICS, Reading, Massachusetts: Addison- Wesley
     Publishing Company, 1982.

Geise, H.D., " Use of Micro-Computers in VTR Control",
     SMPTE JOURNAL, v.88, n.12, December 1979, p. 831.

Goldberg, M., NABET representative at WGBH - TV, Phone
     interview March 28, 1984.

"Guide to Character Generators", VIDEOGRAPHY, v.9, n.2,
     February 1984, p. 40.

Halas, J., VISUAL SCRIPTING, New York, Hastings House
     Publishers, 1976.

Hennigan, Nardy, "Software Tools for the Graphic Designer",
     Master's of Science Thesis at the VLW, Massachusetts
     Institute of Technology, June, 1983.

Katz, C., "Fashioning Animation on Seventh Avenue",
     VIDEOGRAPHY, v.9, n.2, February 1984, p. 36.

Kawaguchi, S., Nagata, N., and Ikegami, H., "Automatic
     Editing-Control Data-Collecting System", SMPTE JOURNAL, v.
     92, n.5, pt.1, May 1983, p. 548.

Madarasz, T., "Television News by the Keyboard", COMPUTER
     PICTURES, v.1, n.2., March/April 1983, p. 7.

Mausler, R., "From Graphic Artist to Composite Scene - The
     Digital Way", RCA ENGINEERING NOTES, v.24, n.6, April- May
     1979, p. 64.

McAll, R., Stickler, M., "Progress Report on EBU-SMPTE
     Serial Data Control of TV Equipment",Prepared for delivery
     at SMPTE Winter Conference February 4-5, 1983.

Mead, Margaret, "The Deviant", SEX AND TEMPERAMENT, New
     York: Wm. Morrow and Company, 1963. p. 290.

Mitzner, M., "Post-Production: NY Studios are Banking on
     Digital Effects", TELEVISION/BROADCAST COMMUNICATIONS,
     December 1983, p. 56.

Newmann, Wm. and Sproull, R. PRINCIPLES OF INTERACTIVE
     COMPUTER GRAPHICS, second edition, New York: McGraw-Hill
     Book Company, 1979.

Noe, D. "Dubner 'Weathers' Heavy Use", TV TECHNOLOGY,
    Dubner Company Reprint, November 1983.

Pensinger, G., "Production Switchers: Meeting the
    Challenge", TELEVISION/BROADCAST COMMUNICATIONS, November
    1983, p. 62.

Peppel, T., "Digital/Analog Video", Thesis for M.S.Vis.S.
    degree, M.I.T., January 1984.

Peppel, T., "Film/Video Proposal", May 17, 1983.

Peppel, T., "VLW_video", help file, January 4, 1984.

Prince, S., "Projects: Inside 'The Works'", COMPUTER
    PICTURES, v.1, n.2, March/April 1983, p. 16.

Rayner, Bruce, "Switcher Intelligent Interfaces", SMPTE
    JOURNAL, v.88, n.10, October 1979, p. 715.

Reynolds, C.W., "Computer Animation with Scripts and
    Actors", COMPUTER GRAPHICS - ACM (SIGGRAPH 1982) v.16,
    n.3, July 1982, p. 289.

Schneider A., "Edit List Management", SMPTE JOURNAL, v.88,
    n.8, August 1979, p. 538.

Smith, A.A., A. Rahman, and R.H. McMann, "New Dimensions in
    Broadcast Graphics", SMPTE JOURNAL, v.91, n.9, September
    1982, p. 774. (Thomson-CSF)

Snow, R.L., "Graphics Go Electronic - The CBS Experience",
    SMPTE JOURNAL, v.91, n.12, December 1982, p. 1186.

Stock, R., "Introduction to Digital Computer Graphics for
    Video", SMPTE JOURNAL, v.90, n.12, December 1981, p. 1184.

Taaffe, W. "You Ain't Seen Nothing Yet", SPORTS ILLUSTRATED,
    v.60, n.5, February 6, 1984, p. 62.

Thornton, D. and G. Simon, "VTR Modifications for Computer-
    Assisted Editing Systems", SMPTE JOURNAL, v.92, n.6, June
    1983, p. 646.

Tolnay, T., "Weathering the Computer Graphics Storm",
    COMPUTER PICTURES, v.1, n.2, March/April 1983, p. 22.

Tooms, M.S. and Anderson, J.W., "Evolution of a
    Comprehensive Computer Support System for Television
    Operation", SMPTE JOURNAL, v.92, n.8, August 1983, p. 824.

Traub, J. "The Wizard of ABC", CHANNELS OF COMMUNICATION, v.2, n.3, September-October 1982, p. 46.

Weynand, D., "Picture Processing: An Editing Alternative," VIDEOGRAPHY, April 1984, p. 33.

Winkler, D., "Videotape Editing Suite Design", SMPTE JOURNAL, v.92, n.3, March 1983, p. 276.