Film Production of *Wavelines II*

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This is my favorite critique of *Wavelines I.* The 1979 Baltimore International Film Festival returned some comment sheets, including one by judge Michael Spanel, with my film print:

COMMENTS (Continue on other side if needed): I THOUGHT THE FAD OF GETTING HIGH, PUTTING ON STOCKHAUSEN AND PLAYING WITH AN "ETCH-O-SKETCH" WENT OUT A FEW YEARS AGO. HAVEN'T WE ALL HAD ENOUGH OF PSUEDO-ART GRAPHICS LIKE THIS.

Sending written feedback from judges and audience members to filmmakers was common in those days. Entrants would thus receive something of value in return for their entry fee. My judge, no fan of abstract kinetic film, was presumably more into film's Real Purpose: character development and dramatic conflict of sympathetic individuals navigating through their problems in a complicated world.

Several opposing comments from other festivals:

> "The judges were deeply impressed by the excellence of the work in *Wavelines II* and by the control and near perfection reached." [Hunter Frost, Fountain Valley Film Festival, 1980]
>
> "Electronics, when both seen and heard, create a film of spectacular beauty. A fascinating visual experience. Different and effective in its images, but even more interesting for the effort put forth in editing, music composition, etc. Almost seemed like 3-D." [Compilation of judges' comments, Movies on a Shoestring Festival, 1980.]

It can be a smile a minute when judges are fed up with rating what they are not interested in.

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My thinking about this film began in 1976, when we acquired an oscilloscope at the electronic music studios of the Cleveland Institute of Music, where I taught. It was a classic Heathkit. My colleague David Peelle assembled the device and kept it running. Possessing such an exotic piece of test equipment (for a music conservatory) gave us a cool high-priest aura among students and faculty alike. We set it atop the mixing console and ran it continuously as a VU/phase meter. Unfortunately students did not perform faculty evaluations in those days, so there exists no documentary evidence of their general esteem.

As an electronic-music composer exploring visual ideas, I started to think about making a piece with these oscilloscope patterns. I was unaware that

there was already an entire genre of "silly-scope" films. Known as Lissajous figures, these patterns are comparative displays resulting from differences in the phase, frequency, and amplitude of two input signals. Closely related signals result in simple patterns, like a circle or an ellipse. Complex signals, like a stereo orchestral track, result in rapidly moving jumbled lines. Between these two extremes, slowly varying static signals can create decorative patterns, many with three-dimensional perspective.

There is an enticing commonly-pursued ideal in working with synthesized music and images: the conceit that the two should emanate from the same source signal. Pursuit of this Holy Grail by artists has been in my opinion an utter wasteland. Some artists and theorists posit direct relationships between musical and visual elements (e-minor triad = purple rectangle) which has resulted in little if any interesting art. Music and images, even when abstract, work too differently to straitjacket them together in this way. There are software packages today that provide a visual output to music, but the artistic interest is slender.

I initially took the path of others before me, determined to create a same-signal musical-visual work. After about a year, I was bound to admit that the most promising patterns were generated by boringly static drones that only LaMonte Young would care to listen to. I did produce one effective but brief same-signal segment, which became the section *Pulse* in the film. Originally this was intended as graphic background for the titles, but I came to see this application as distracting. I decided to postpone the music and concentrate on producing good visuals and learning the mysteries of 16mm film.

A large modular Moog synthesizer, model 55, generated the sounds for the visuals. Patches were simple—two audio oscillators, oscillator control signals and filtering, all manually controlled by keyboard and by knob-twisting. It was a matter of trial and error to create attractive patterns that I could alter progressively and still keep interesting. How interesting was in the eye of the beholder. Judging from people's reactions as I played them my electronic sketches, I reckoned that 10 minutes would be the maximum tolerance for an abstract-waveform film. With 20 minutes of material, naturally I would have to produce two films.

Around this time I met Cleveland's only documentary filmmaker, Joseph Horning, and we agreed to exchange my expertise in sound recording for his in filming. Shortly thereafter I found myself taping sounds at a hockey game in Beachwood, Ohio, for his sports documentary.

I returned from the game to learn that film production was expensive. It was essential to be prepared for a shoot; doing things over was costly. I gave up the idea of performing the synthesizer live for the filming. Any mistakes and we would need to re-shoot. The process could go on for hours and cost hundreds. Furthermore, to shoot live would have required two oscilloscopes: one in a lighted studio that I could watch, the second to be filmed in a darkened room.

Next I learned that we could shoot the same visual segment more than once to advantage. Joe suggested that each section be filmed two or three times, at slightly different sizes, so that the images could later be individually colorized and overlaid in the lab. Each take (A-roll, B-roll, etc.) could have a different size, shape, or color.

Soon I also learned that film production was cumbersome and tedious and would take a great deal of time and tenacity.

Around the end of 1977 I began to record visual progressions onto magnetic tape (Ampex ½-inch tape, model 300 4-track deck, model 351 tube-type electronics), which would then be played back for the filming. The frequency response of our oscilloscope was flat from DC to channel 5, but analogue tape was not. The tape reduced the frequency response: sharp angles became rounded, corners became soft. I compensated where I could by changing the signal parameters. Boosting the regeneration on the lowpass filter restored some edge. I started taping while working so I could monitor off the playback head and see the end result.

A 4-track tape recorder provided an interesting new resource for increasing the density and complexity of the image. I recorded the X (vertical) and Y (horizontal) signals onto two tracks each, and in playback switched one X track and one Y track to the "sel-sync" position ("selective synchronization" was Ampex's term for using the record head as a playback head). When so employed, the frequency response of the record head was poor, which was a good thing because it altered the waveform—not dramatically but it was noticeable. The record and playback heads were 3 inches apart, creating a .2 second time delay at 15 ips. Combining the two X and two Y tracks through an audio mixer into one X and one Y signal produced a more complex image, with more inner lines, shapes, and movement.

I also worked with setting the individual playback levels of the four tracks, so as to enhance the design and also to optimize the aspect ratio of the image for the 16mm film 4:3 standard.

The first section, *Pulse,* begins with separate clicks. It is very easy to hear the pairs of closely-spaced clicks, the first from the record head, the other from the playback head. The second of each pair is crisper, as that is the one with the better frequency response. A second filming with a phase change in one track would provide a different shape and the overlaid images would have different colors.

For the second section, *Cadenza,* I edited the ½-inch tape to delete the more static parts of the image. It became a series of spliced segments. The Y track was played off two heads, the X track was not. This would be filmed twice, with a size change.

For section three, *Close Harmony,* only the playback head was used for filming the A-roll. The B-roll was shot by playing one of the tracks in sel-sync. I kept detailed notes about how this section was created on the Moog synthesizer:

VERTICAL INPUT:

A 921B oscillator sine wave (not pure), a few cycles sharp of Eb below middle C, patched to an older 904A low pass filter (LPF). No regeneration.

HORIZONTAL INPUT:

A 921B rectangular wave, 1 octave below the sine wave. An octave, slightly off, was tuned by patching attenuated keyboard control voltage (CV) into the 921A oscillator driver of the 921B. Non-perfect tuning results in rotation of the image. A 921 low-frequency oscillator (LFO) sine wave, 1 cycle in 13 sec, .7 v, was then patched to the 921A. This caused the rotation of the image to reverse every 13 sec. The speed of rotation was controlled by adjusting the amplitude. The rectangular wave was tuned slightly off in order to create a slight rotation independent of the external LFO. This bias created a slightly longer rotation in one direction than the other.

The rectangular wave was initialized as a square wave, creating a symmetrical image at the outset. Adjustment of the pulse width produces an asymmetrical image, and also causes the vertical rotation on each side of the vertical axis to start and stop at slightly different times—if this change is made continuously in real time. This was accomplished by patching a 921 sine to the width-control input of the 921A rectangular wave. The asymmetry actually varied symmetrically over time, introducing a horizontal motion as well as the split vertical rotation.

The rectangular signal was patched to a new 904A LPF, regeneration 74%, frequency range 3 (slight oscillation in regeneration circuit), fixed CV -4.

PERFORMANCE:

1. Sine LPF up from -1 to +1/3 (increases height of image).

2. Rectangular LPF up in steps (slowly changes shape of image: increases harmonic content, increases angularity, curves change from rounded to jagged).

3. Rectangular LPF regeneration up to 100% (changes shape of image, adds ripples to some portions of image that formerly were straight lines).

4. Sine LPF down (decreases height of image).

5. Rectangular LPF regeneration back to 74% (reduces ripples, simplifies image prior to fadeout).

Joe instructed me on the basics of how this was going to work. The visuals would be shot on B&W reversal film, giving a white figure on a black background. The first take of a section, the A-roll, and color negative stock would be run together through a color contact printer, thus printing the image from the A-roll onto the negative. The A-roll and the color negative would be brought into contact, one frame at a time, and light would shine through the A-roll onto the negative. Then the color negative would be rewound and the second take of that section, the B-roll, would be printed onto the same color negative. This process could be repeated, and many experimental films have been created by a dozen or more runs through the printer.

The color printer has a feature called "color timing," a misleading term. It refers to color adjustment. The light in the printer head is split into three beams which are filtered into red, green, and blue ("RGB light"). The operator can control the level of each on a 0-to-50 scale, after which the 3 beams are recom-

bined. The primary purpose of this is to alter the overall color balance to correct differences in flesh tones, to which our eyes are very sensitive. Film shot under varying light conditions will exhibit unacceptable differences in flesh tones. The term "timing" originates from the beginning of film-printing technology, when changes in light levels were attained by altering the duration of exposure of each frame.

Joe shot a 100-foot roll of Plus-X Reversal film in late March 1978 to test a range of exposures. The 2¾-minute roll of film cost $10 to purchase and $15 to process. It was developed by Ungar Motion Pictures of Parma, Ohio, a small 16mm production company and processing lab. Ungar's specialty was fast cheap turnaround shoots of high-school basketball. No color, no negatives, no prints, just shoot and process the camera-original reversal film. In the days before video, this was how coaches helped players study their moves in final practice sessions before the Big Game.

We did the full shoot, 1,000 feet of film, in April. We also recorded soundtrack audio from the generating signals onto a Nagra recorder for possible transfer to 16mm magnetic fullcoat stock (film coated with magnetic oxide for sound recording). Even though most of it wasn't planned to be used, that decision could thereby be revisited.

The film was processed and sent to FilmLab Service, Inc., Cleveland's one-and-only full-range film processing lab, which returned the first workprint. This was an inexpensive B&W print for reference and editing. In a low-end setting (Joe's), the workprint was wound onto a reel that was mounted on a horizontal spindle on the left side of a table. The spindle was operated by a hand crank. This apparatus was called a "rewind" and fed out the film across the table to the right. There was another rewind on the right-hand side of the table, to take up the film. In between the two rewinds, the film was threaded into one gear of a four-gang synchronizer, which had four toothed gears (for working with any combination of four picture or sound film elements, as desired) and a footage readout. The workprint then ran through a nearby viewer, with a 5-inch screen. A magnetic sound head was attached to one of the gears on the synchronizer, connected to a "squawk box" (amplifier-speaker). It could swing down to rest in contact with the magnetic-fullcoat sound film mounted on that gear. Thus the sound, also mounted on the pair of rewinds, and the picture could be played and locked together. With this arrangement it was not possible to hear the sound in sync. The editor would have to find a visual cue on the viewer, mark the frame, rewind it back to the synchronizer, lock it, and then move the audio to that frame and cut it. Or the editor could find and mark a sound cue, then locate a corresponding visual cue, mark it, and cut it to line up with the audio. Splices in the magnetic fullcoat were made with a sound splicer, which had an angled cutting blade to prevent a bias-frequency pop. The splicing tape was made by 3M, with a translucent white color just like their audio splicing tape, but in 16mm width with perforations to match those in the film. Workprint splices were made with a different tape splicer using clear tape

that covered two frames of film. These would later have to be matched by cutting the negative in the exact same places (always an occasion for high tension) and making cement splices between the frames.

For titles and credits I hired an artist who worked for a local TV station, Ronald Stipes. In May he typeset 22 cards and photographed them with a still camera onto high-contrast Kodalith stock, creating a white image on a black background. The Kodalith large-format negatives were placed on a light box on an animation stand at FilmLab Services, where they were shot onto 16mm film.

I began to learn about film color. Joe sketched a color wheel for me with RGB color-timing values (Fig. 1), sets of three numbers representing various hues. I would give such numbers to the operator of the color printer in the lab for executing the color timing. The values appeared deceptively simple and later proved to be not always precise. "Less reddish orange" 15-5-0, for example, was actually orange.

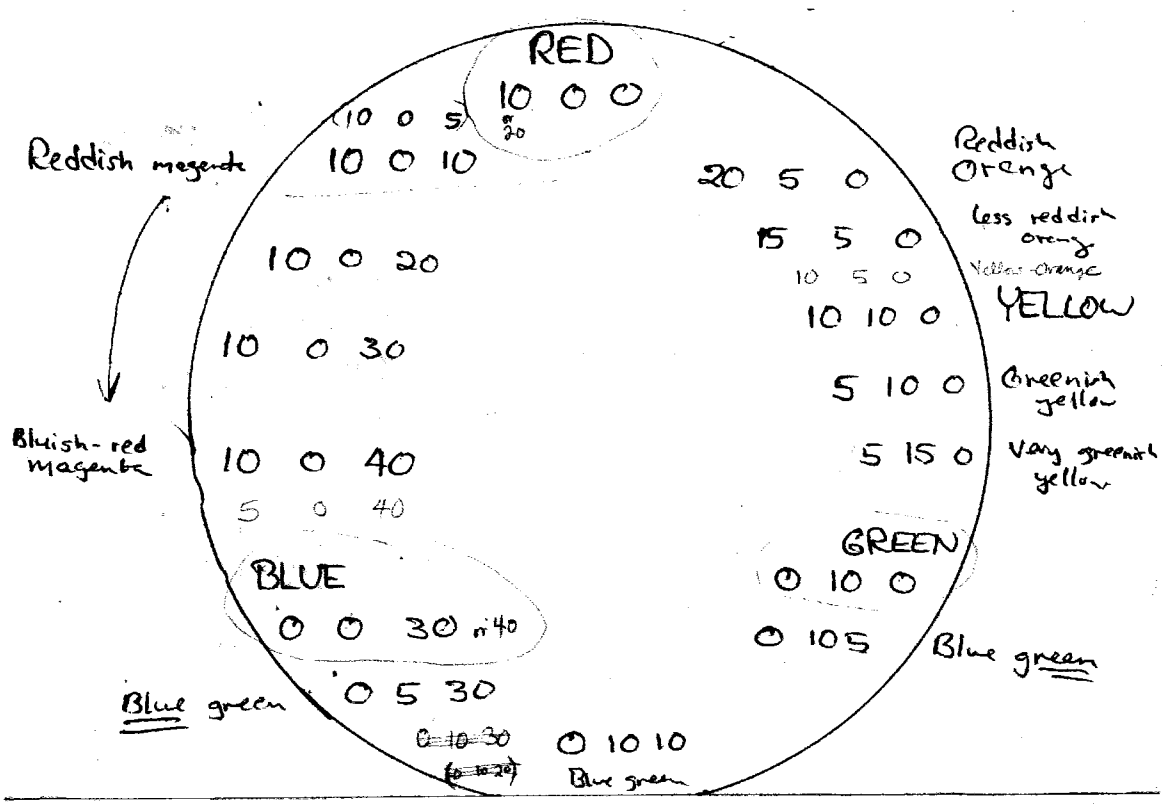


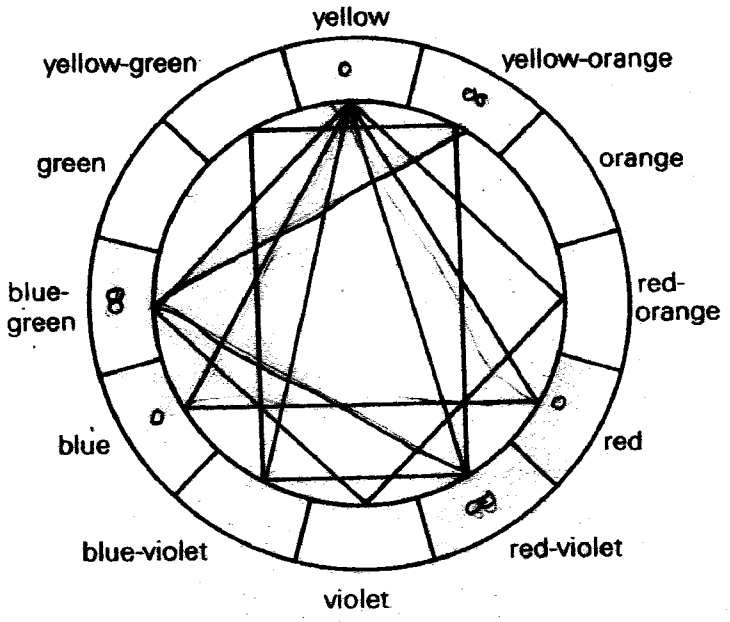
Fig. 1. Joseph Horning's RGB Color Circle.

The three primary colors of generated light are red, green, and blue. When added in equal intensities they create white light. The painter's primary colors, which are light-absorptive pigments, are yellow, red, and blue. When mixed, the effect is subtractive, and they create black.

I read The Elements of Color by Johannes Itten (translated by Ernst Van Hagen, Van Nostrand Reinhold Co., 1970, ISBN 0-442-24038-4). Even though the book was oriented towards painting and subtractive colors, it provided much information on color aesthetics and effects. Itten had interesting comments about colors on black:

> On black, yellow acquires extreme brilliance and a cold, aggressive quality of expression. On black,...red radiates luminous warmth. On black, the blue takes on a brilliant character, with deep luminescence of hue [all p. 17].

Itten's color circle (Fig. 2) was set up so that diametrically opposed colors were complementary. When their paint pigments were mixed, they would yield gray. Itten used the color circle to display relationships of color harmony. He conceded that people vary in their judgments of attractive and unattractive color combinations, but advocated the establishment of objective principles of color harmony. In his color circle, all complementary (opposite) pairs, all triads of equilateral or isosceles triangles, and all tetrads of squares or rectangles, were considered harmonious.



2 Constructions for color chords

Fig. 2. Johannes Itten's YRB Color Circle (p. 21).

I found Itten's color circle helpful, in that it featured a greater number of distinct hues. Note that the RGB circle provides only one hue, blue-green, along an entire 120° of the circle. In the YRB circle, blue and green are closer to-

gether (60°). And the YRB circle provides more distinct warm hues, five to be exact, between red and green, which are 180° apart (120° apart in the RGB circle). The challenge would be to establish the exact RGB levels that could generate the hues displayed in the YRB circle.

Itten cited examples of various kinds of color contrast, such as light-dark, cold-warm, and contrast of hue, this last being the clearest and simplest. For triads the strongest was yellow/red/blue, his three primary colors. The secondary colors, orange/violet/green, formed a weaker triad. The tertiary colors, such as red-orange/blue-violet/yellow-green, created a vaguer impression.

The use of cold-warm contrast seemed simple and obvious, and eventually I ruled out its use. Red-orange vs. blue-green were the polar opposites.

Thus armed, I began the most interesting and challenging part of the production, devising color progressions. I would return to and revise these several times, as I composed music which would seem to work better if colors were changed, re-ordered, or brought in and out at different times. The program notes for *Wavelines II* describe fully the final colors and the thinking behind them. The relevant excerpts:

> *Pulse* moves from single spikes (clicks) to multiple spikes (buzzes) to rectangular patterns (tones). The opening red + blue is held until the patterns re-form, and subsequent colors change one by one in succession. There is violet-magenta, then five strong colors—red, orange, yellow, green, blue—are followed by three weak colors—red-orange, gold, and lime; red + blue concludes. *Cadenza* has cyclical up-and-down movement matched to music segments created from an earlier piece for clarinet, trumpet, and string quartet, with added rapid, filigree electronic voices. The motion is repetitive and serves virtually as a still frame for a color progression centering about the color blue—two colors moving around and across the color wheel in various intervals, always including a form of blue as a pedal point. The color progression is: yellow + light blue, ice blue + yellow, red magenta + blue green, light blue + violet magenta, pale gold + ice blue, blue green + cool yellow, yellow + light blue, ice blue + yellow, white + white, white+ yellow, yellow + ice blue, white + white. The first half of *Close Harmony* is in black-and-white, with repeated cycles of fades at slow, then medium, then fast rates. At the second half, color is established, and the music begins a progression of thin, ascending tones. The color progression centers on sun colors, first changing one by one, later together: yellow, red, orange, lime, gold, red, blackout, gold + red, blackout, gold + green, blackout, red + green, red, red + yellow. The image becomes more symmetrical, with split rotation of its left and right halves. The images fade alternately, then together. There is a floating, ethereal quality that is best enhanced by viewing the film on a large screen in total darkness.

In choosing colors, I honored two crucial considerations: every person has a favorite set of colors, and the commonest favorite color is blue. If I could shamelessly pander to a wide audience by providing a wide variety of combinations, including those I personally hated, so that as many viewers as possible would get to see "their" special colors, and if I could pay particular attention to the blueheads, then everyone would feel an absolute minimum of 10 to 20 seconds of love somewhere along the line. Which mostly did happen.

Joe warned me that areas on the frame where my patterns overlapped would yield pastel colors or pure white. Since these areas would be struck by light two or three times, the increased exposure would highlight them and wash out the chrominance.

In June I took the 16mm magnetic sound recording (no real music yet, just drone tones from the shoot) to Motion Picture Sound, Inc., in Cleveland for transfer to 16mm optical negative stock. I worked out a test color scheme using A-, B-, and C-rolls for *Wavelines I.* I sent this to the lab and awaited my first "answer print," the lab's response to my printing instructions.

Wavelines II originally started with *Cadenza,* which then ran almost 4 minutes. Unfortunately it displayed an unexpected filmic interpretation of my patterns. There was an annoying visual glitch every time the oscillating pattern came to a motion null point. The pattern's stillness created a "burn" effect of brightening one frame of the film. I found this distracting, and logged each "flash frame" so it could be blacked out with India ink at the lab. Unless I wanted to re-design the waveform and re-shoot it from scratch, seeing one totally black frame (1/24 sec) every 5 seconds would have to be acceptable.

Trials and errors ensued. I would prepare a printing list of fades and color timings, send it to the lab, receive an answer print, see what worked and what didn't, make my best new guesses on color values where needed, and send that back to the lab. Naturally they refused to let me sit with the operator of the color timer in the lab to learn how to obtain the colors I needed. Just to project simple blues and greens took four tries to attain the correct color at an acceptable intensity. It was profitable for the lab to make me buy answer print after answer print. A few years later, FilmLab Service, Inc., went out of business. I was glad.

I had even tried writing Bell & Howell for literature or information on the operation of their Model C Continuous Contact Printer. Naturally there was no reply.

I moved to New York in August 1978 and in September received *Wavelines I* answer print no. 5, which I screened and approved, becoming release print no. 1. I felt the film was musically weak and the color changes were not always successful. Some parts felt too long, others too short. Lessons learned here would help make *Wavelines II* a better film.

Working through the first half of 1979, I logged maximum-rotation and movement points in the images, and "bump" points where images pulled apart,

crossed, or collided. Some of these would be places where color changes could occur. I worked with progressions of warm and cool colors. I created music for *Cadenza* from a recording of a sextet for clarinet, trumpet, and string quartet, with added electronic sounds. I did the music for *Close Harmony* largely at the Rutgers University electronic music studio in Camden, N.J. I made a music log, just a few points in the music where I wanted to do something visually. It was crucial to avoid cartoonish cueing between music and image.

In the summer of 1979 I took New York University's world-class beginner film-making course, The Language of Sight and Sound. For 6 weeks we worked every day in permanent crews of four, which became like families. We shot a new film every morning (on 100 feet of B&W reversal), went to class in the afternoon, and edited on upright Moviolas in the evening. Towards the end of the course I screened *Wavelines II* for the class, some 60 students, whose feedback and encouragement were very helpful. They told me to shorten *Cadenza* and put *Pulse* at the beginning. They also told me that the dedication "for Paulette" was not important enough to be the only thing in the frame. I said that I did it so that it would be easier to cut out if necessary. That was all Susie Litwack needed to hear. "How about dinner and a movie tonight?" she announced.

The film went through twelve answer prints and in October 1979 was finished. I had 25 release prints made and started hitting the festival circuit. I then learned about a new low-distortion optical soundtrack process offered at Alpha Cine Labs in Seattle. I struck six more prints in February 1980 using their system. The smoothness and clarity of the new sound was dramatic. Interestingly the success rate of these six prints was noticeably higher than the earlier batch.

I looked forward to using my newly-acquired skills to make more 16mm films, but it was not to be. I had already begun to work a little with video (using open-reel B&W portapaks). The image quality of film was superior (and vastly more prestigious). New York was ruled by a gang of esteemed independent filmmakers who competed aggressively for grants for low-cost access to equipment. Video was much more accessible and available. It was derided as low-end, low-tech, and imprecise. The best video recording equipment then available to artists was the ¾-inch U-matic format without timecode editing. But the potential of image-processing at studios like the Experimental Television Center in Owego, N.Y., was enticing, particularly since much of the technology was similar to audio synthesizers. And so in 1980 I started traveling to Owego for 5-day production residencies at ETC, made miles of video, and left film behind.

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Stanley Kubrick remarked that producing a film is like being a general who is fighting a war. True enough for me. I was a total film novice and started as an outsider in a city with limited processing facilities. It would have been easier if I'd had a film job with access to my employer's equipment. Or, had I started producing my film in New York, I could have worked with a contact printer my-