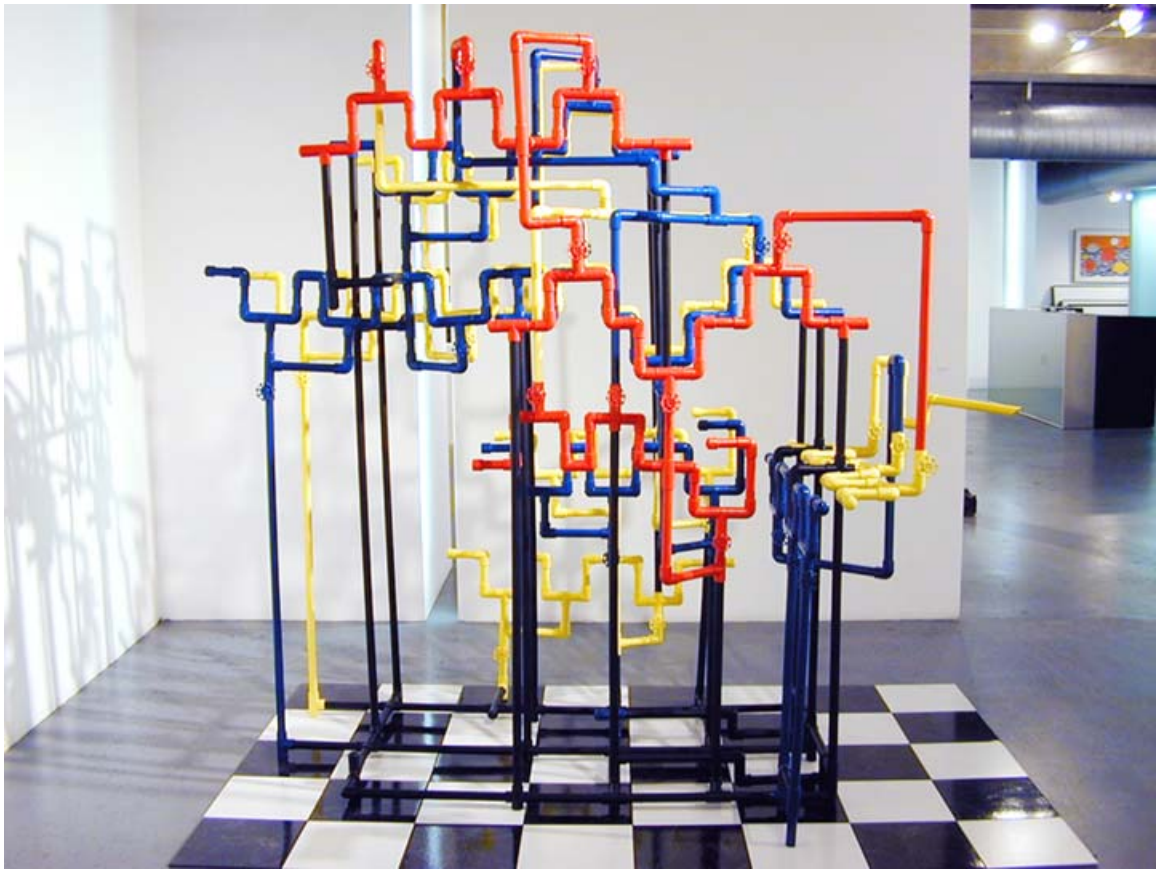
The Art of Analog Engine

by Fred Truck



A Badge of Quality Production
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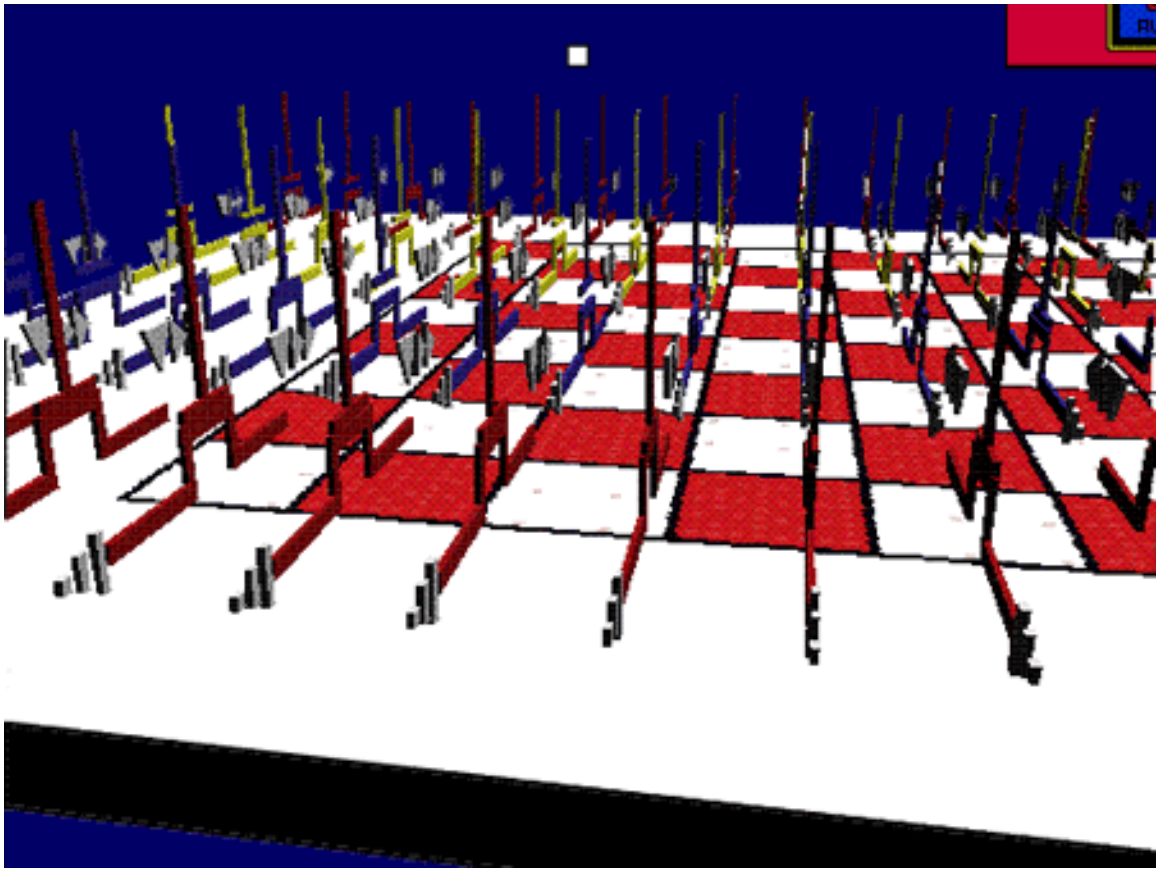
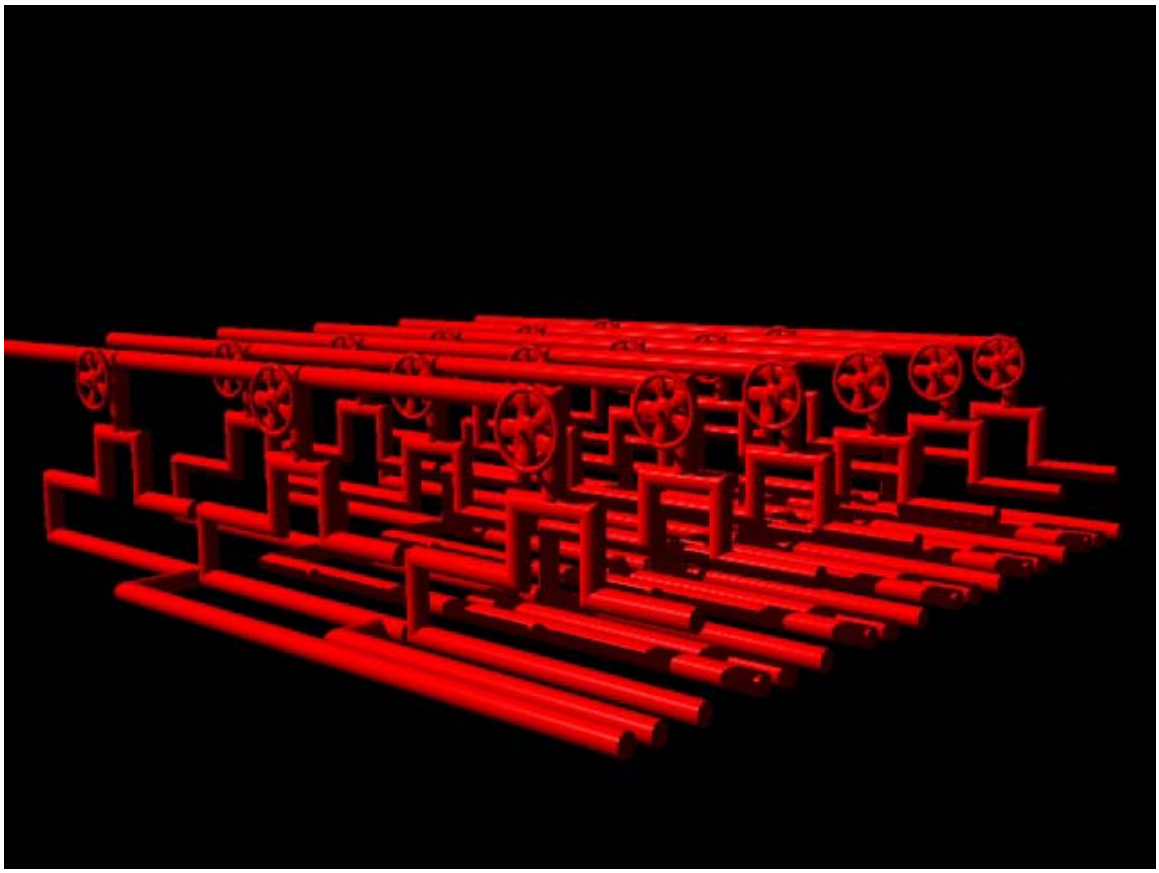
Classic machines are made up of an array of six elemental machines: lever, screw, inclined plane, wheel, pulley, and gears. All other machines can be constructed from these basic parts. When the constructed machine is no longer needed, it is disassembled and its parts returned to bins so that new machines can be constructed from the same parts. Thus, the parts of machines are more important than the constructed whole of a given machine. A good analogy for this practice would be metonymy—the poetic substitution of the part for the whole.

An artist's computer is one built by an artist for the purpose, potentially, of artistic production. Taking machine practice (of the classic machine elements being more important than a larger machine constructed from them) and use of metonymy as my cue, here are two parts of my artist's computer—The Memory Device and Analog Engine.

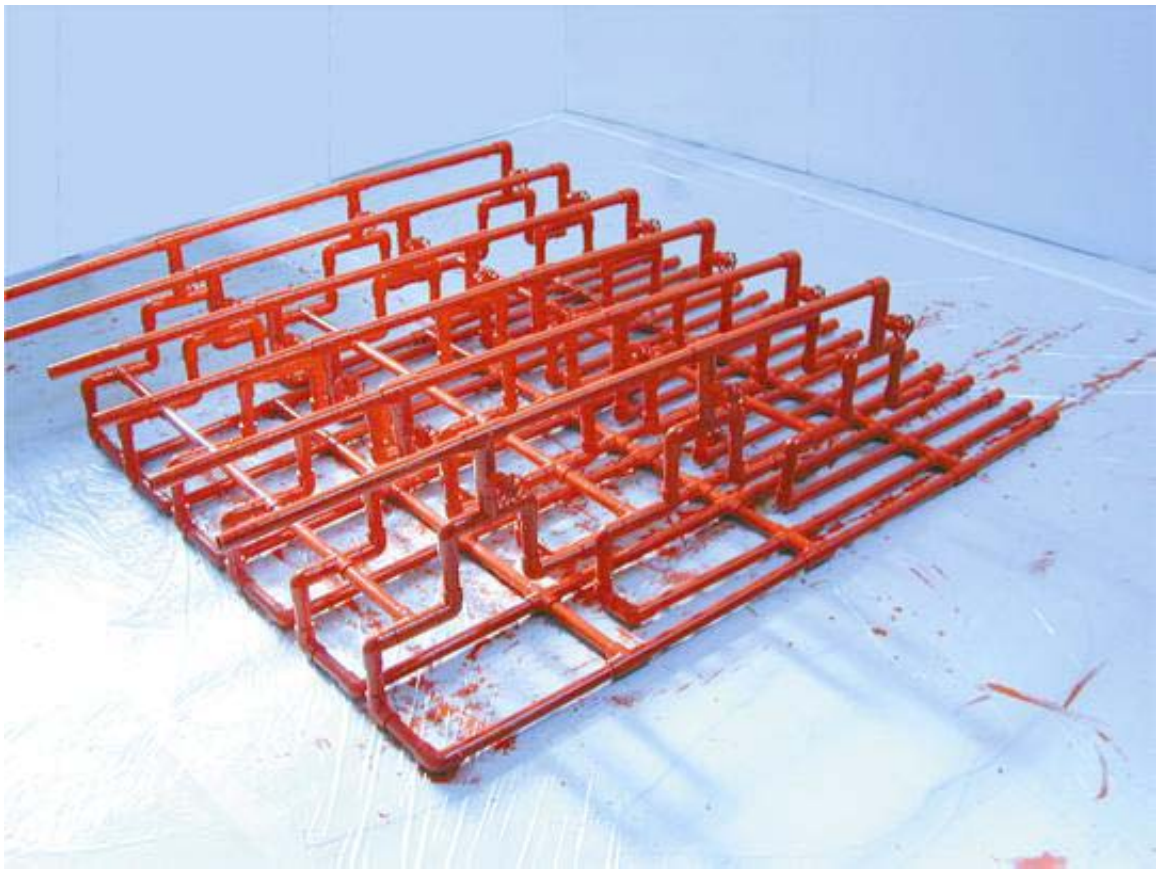
The Memory Device



This image shows the Memory Device in its very early stages of development. It consists of 72 switches. Another design stage followed:

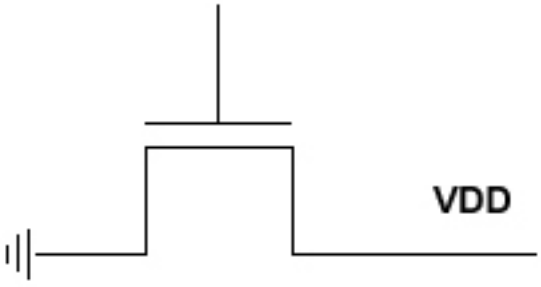


In this stage, the Memory Device consisted of 18 switches. Here, for the first time, hand wheels to set the switches appear, and input and output are differentiated. Six inputs (coming from the rear of the device) result in 18 different outputs.



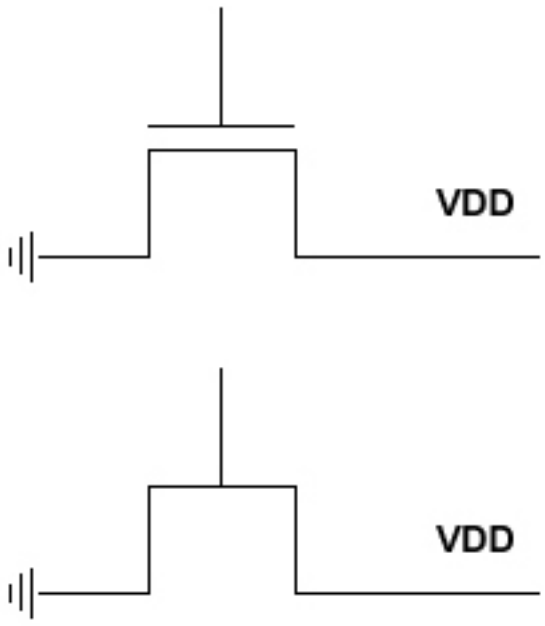
This is the final form of the Memory Device. My sculpture is approximately 6 feet square and 18 inches high. It is made of PVC and painted in gloss latex. It differs primarily from the preceding design in the manner in which the outputs are routed.

All three stages of design are composed of an array of on/off switches or transistors, represented by this type of diagram, often used in electronic engineering:



This on/off switch is a transistor. What interests me here is not how transistors actually work, but what they look like in this picture, and what kind of associations their appearance may lead me to. Having said that, it is still important to understand that this switch has an ON state and an OFF state and that, in actual transistors though no part actually moves, the language USED to describe transistors implies movement. That is, the switch is referred to as a gate and when in the ON state, the gate is said to be OPEN, and when in the OFF state, the gate is CLOSED.

The “open” and “closed” language used in describing gates led me to imagine pistons:



I imagined these gates to be powered by steam, with an actual piston making its on and off states. My early designs for the Memory Device used just such steam-powered pistons.

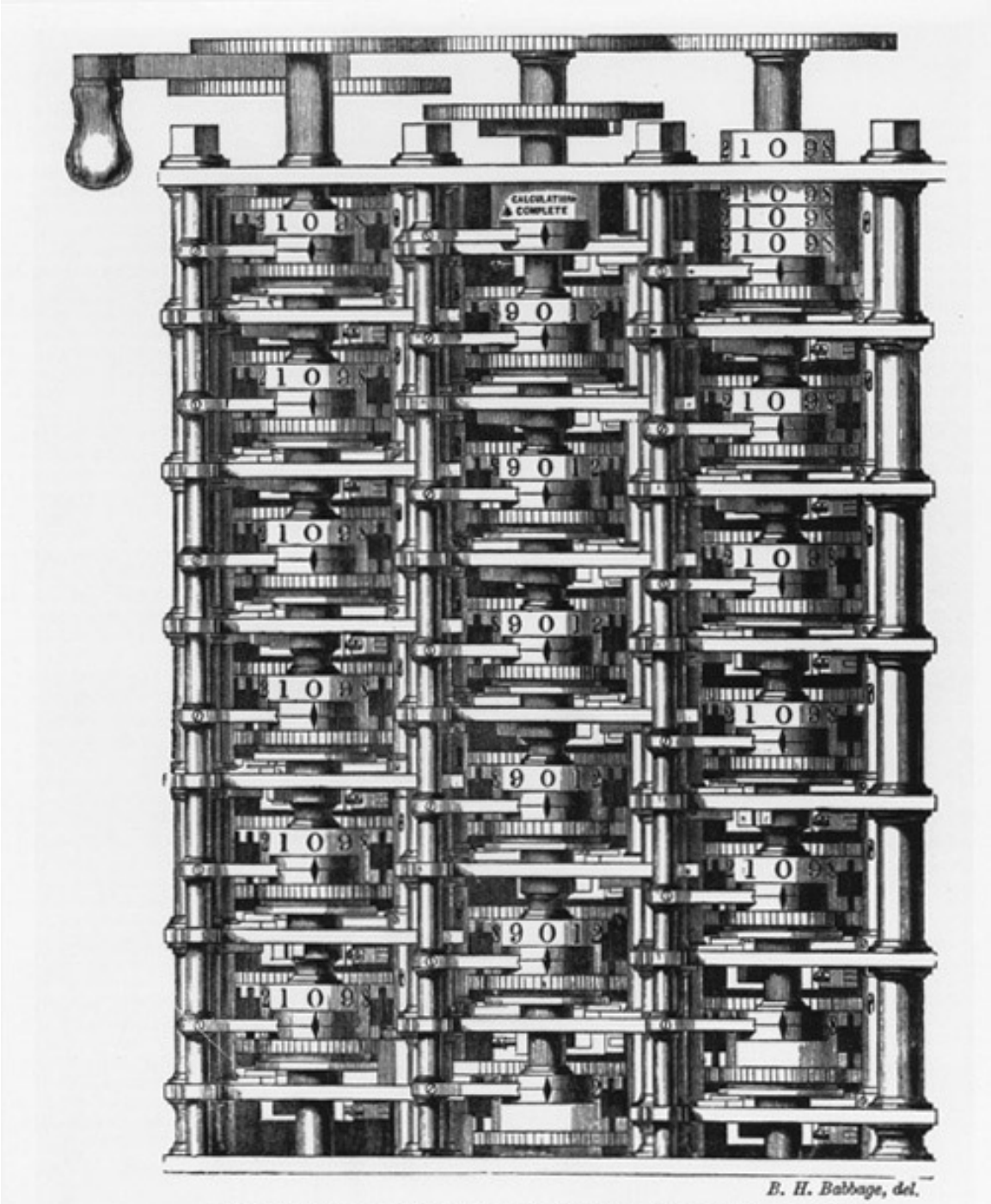
Why steam? Why not electricity or at least gasoline?

Well, there is history to consider. There is a historical precedent for steam-powered computers.

Charles Babbage

Charles Babbage, an English mathematician and inventor, was born in 1798. He invented the Difference Engine, a steam-driven calculator, in 1821. He later developed the Analytical Engine, an improvement on the Difference Engine, which was designed to solve any kind of mathematical problem. The Analytical Engine received instructions on punched cards, performed its calculations, and printed them out. This description sounds much like a description of early mainframe computers. Due to his frequent changes in design and the lack of precision machining necessary to build the machines he designed, and the lack of support of the British government, Babbage was never able to complete his Analytical Engine. However, using Babbage’s designs for the Difference Engine, George Scheutz, a printer from Sweden, built practical versions of that machine in 1854, which were used by both the British and American governments.

Charles Babbage appeals to me not only because he was far ahead of his time, but because he was able to order a number of available technologies of his time—steam, mechanical technology and design—towards the solution of a vexing problem. The specific problem that irritated Babbage so was that human computers made too many errors in figuring logarithmic tables. He reasoned that a steam-powered mechanical calculator would not only eliminate human error, it would be faster. He was also a visionary who foresaw that it might be possible for a mechanical calculator to work in the realms of symbolic logic.



B. H. Babbage, del.

Impression from a woodcut of a small portion of Mr. Babbage's Difference Engine No. 1, the property of Government, at present deposited in the Museum at South Kensington.

It was commenced 1823.
This portion put together 1833.
The construction abandoned 1842.
This plate was printed June, 1853.
This portion was in the Exhibition 1862.

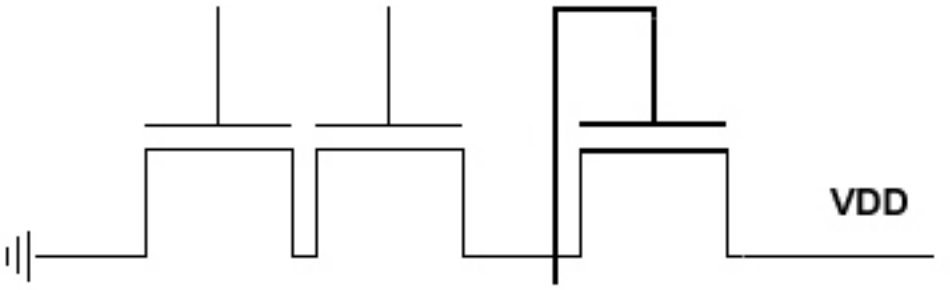
As an artist, using steam as a power source enabled me to solve the problem of scale. Contemporary digital computers are marvels of nanotechnology, but working on a microscopic

scale is not the most direct way to create a powerful visual impression. Translating the visual patterns of the designs for electronic circuitry from electron power to steam power enabled me to build the circuits as large as I wanted.

Analog Engine

In 1986, I began ArtEngine, a piece of software for the Macintosh computer. The user submitted two previously edited images to the Engine and from them, it generated a new, third image. I wrote this software, which incorporated some artificial intelligence techniques, in MacScheme, a compact rendering of the Scheme dialect of LISP, the staple language of articificial intelligence programming.

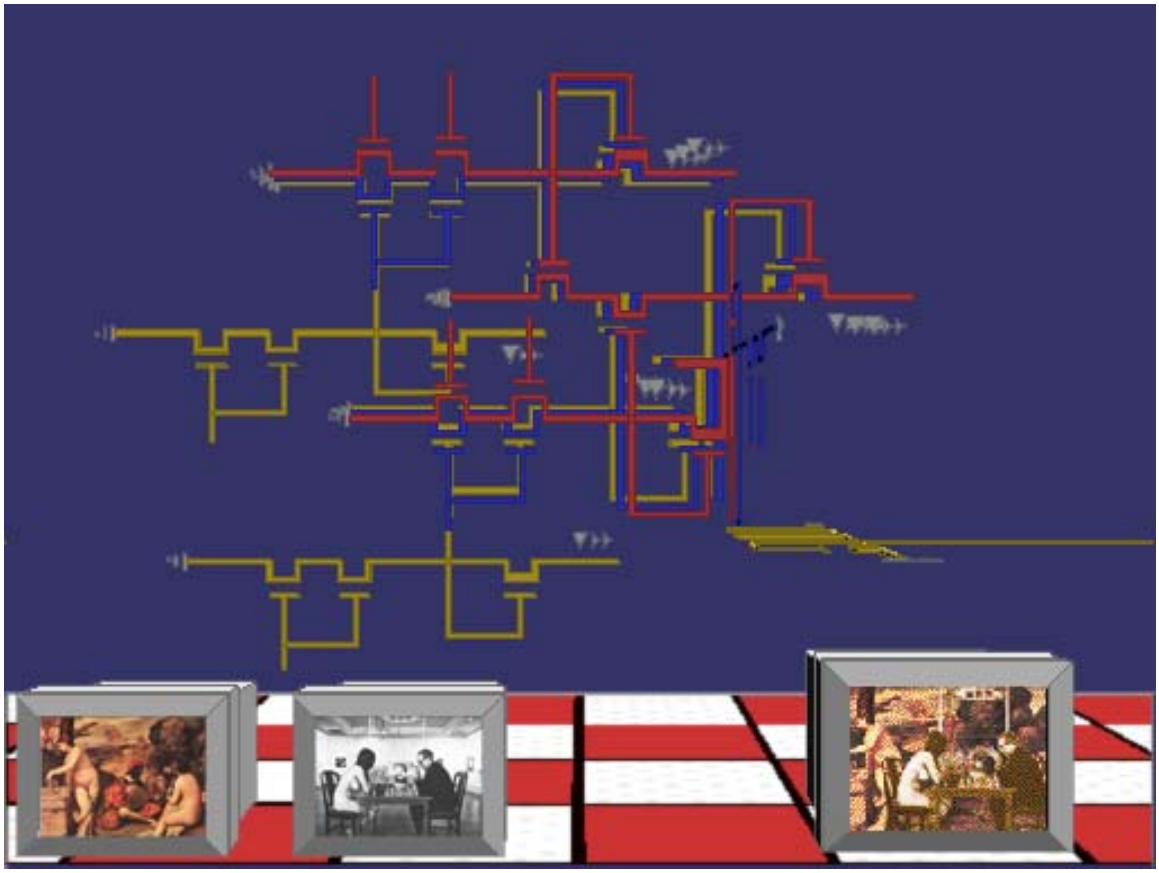
In 1991, the Macintosh no longer supported some of the conventions and techniques Macscheme used, and ArtEngine found itself without a platform. I was reluctant to walk away from five years of work with an idea I found intriguing. As I thought over possible directions to go in, I remembered an interesting fact about LISP. LISP is rich in symbolic logic functions. A symbolic logic function, or BOOLEAN function is any of these logical functions: AND, OR, NAND (Not AND), NOR (Not OR). Because it encourages the programmer to define new functions by combinations of the given ones, LISP is particularly useful for simulating logic chips, before they are committed to silicon. I also learned that all the logical functions can be generated by various combinations of the NAND gate. At the same time I remembered this, I ran across a diagram for a NAND gate, which is very similar to the on/off switch shown above:



The NAND gate is made up of 3 transistors, two input transistors and one output transistor. In the diagram above, the heavier line is the output transistor. I was excited with by the wave-like appearance of the NAND gate. I wondered what the central routine of ArtEngine would look like if I visualized its logic.

The central logic routine of ArtEngine determines that two things have been put to it, and that one input is symbolically true and one is symbolically false. That is, the two inputs are different. After difference is determined, the Engine approves the generation of a synthetic third image from them using other software or hardware following the Engine module in the information flow.

My first realization of Analog Engine, the visualization of my ArtEngine software, was done in CAD/CAM software. This usage proved to be very important and troublesome later on. It used the steam pistons described previously. Because I viewed these images as maps or diagrams of circuitry, I even duplicated the 3 vertical lines of the ground symbol and the VDD at the other end of the diagram in my 3-dimensional renderings of the gate.

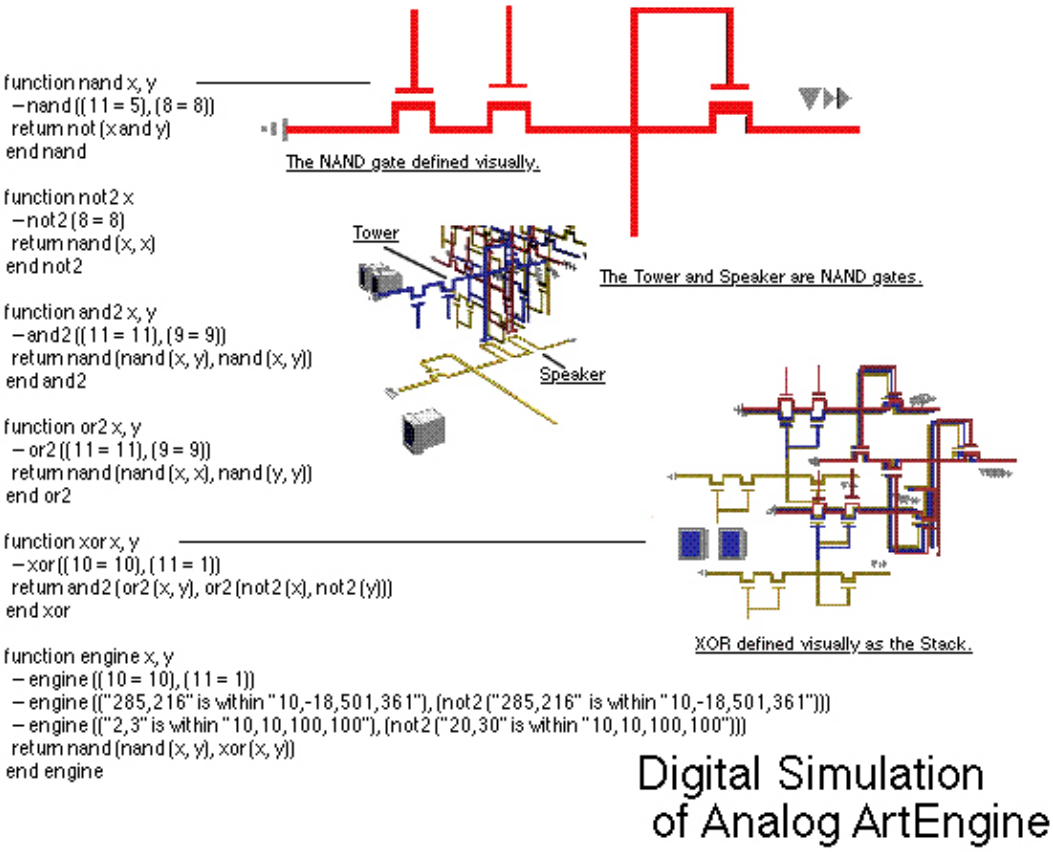


A. B. C.

As you can see here, Analog Engine floats in CAD/CAM space, without gravity. In the foreground are three monitors revealing the Engine's process.

A. Concert Champetre by Titian or Giorgione
B. Photograph of Marcel Duchamp and Eve Babitz by Julian Wasser
C. Synthesized image

In addition to the shape of the NAND gate, the Engine's format was determined by the programming conventions shown in the following image. For this picture, I used the HyperCard scripting language, rather than Scheme, because at the time, that language was accessible to more people, and its conventions were very similar to Scheme. Notice that there are layers that are color coded, and that everything is generated from the NAND gate. Note that in the following programming, lines preceded by "—" are comments, and are not evaluated by the interpreter.



From approximately 1995 until 2000, I did very little work on the Engine. I used it as a motif in a number of prints, so it was never very far out of mind. I realized at some point during this time that the Engine had the potential to be a sculpture, but two conceptual problems needed to be solved in order for a sculpture to be built, in addition to finding a material suitable for executing the work. The problems were:

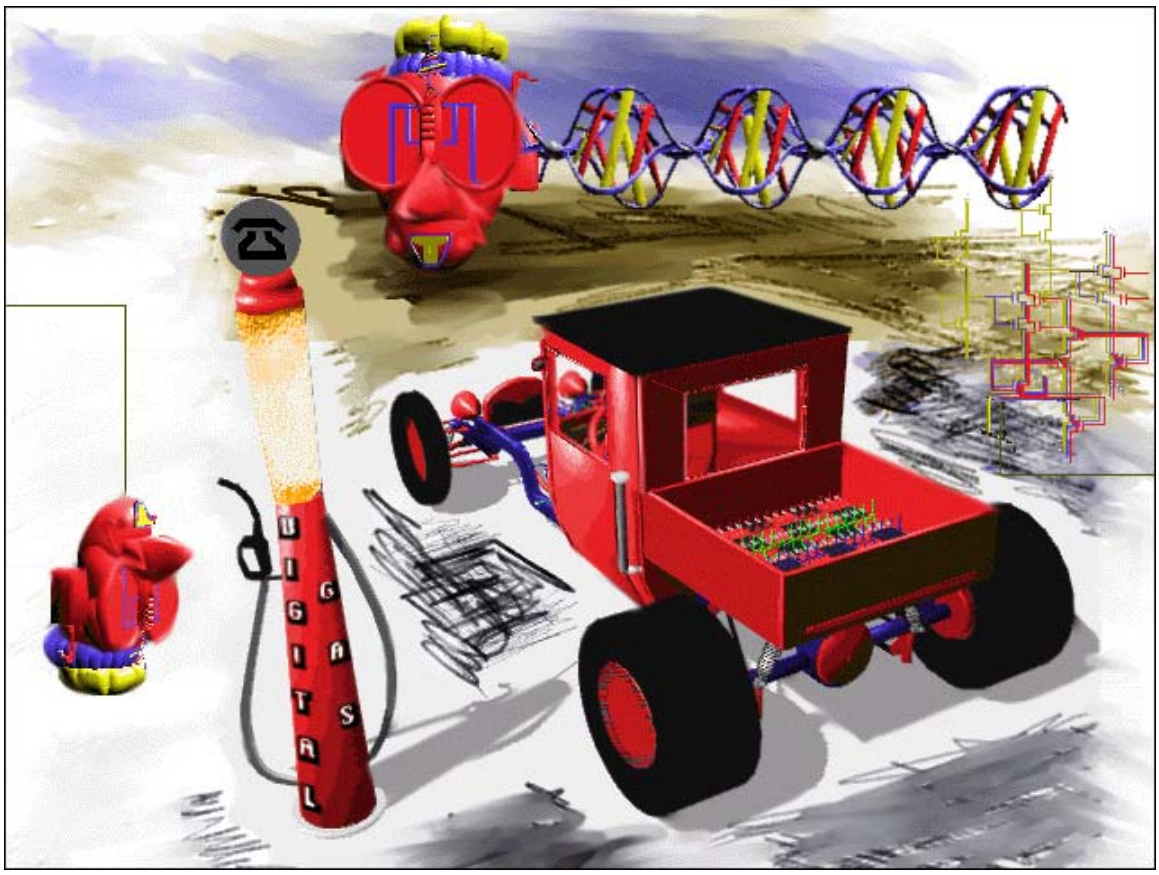
1. Often, one color-coded layer would feed another. That is, the output of one layer served as input for the next layer. As long as I was working in CAD/CAM space or animation, I could have those connections be hypothetical, or I could indicate them by simultaneous movement. I feared diagonals might disrupt the grid structure.
2. How would an Analog Engine sculpture stand? Suspend it from the ceiling? Support it from a rear wall? Could it stand on the floor somehow by itself?

While I put these issues in the back of my mind for analysis and digestion, I did a series of prints suggesting issues of interest and directions for the future that are still not, as of this writing, fully realized.

Digital Gas and Mobile Computing

The first computer I bought was an Osborne I portable microcomputer. It had a tiny 5.5” diagonal screen, two disk drives, 64K of RAM and weighed about 35 pounds, thus making it marginally portable. Compared to the laptops or palm computers of today (2002), it was absurdly clunky but it keyed on a basic need most Americans have: the need to get up and go and to take whatever they want with them.

This perception led to a series of prints called Digital Gas. The first print has the same name as the series.



The Red Truck in this image appears frequently in my work. The Red Truck is a hot rod based on a 1929 Ford Closed Cab Pickup Truck. The Memory Device is in the bed of the rod, which is powered by Analog Engine, though in this image, that fact is not visible. Next to the Red Truck is an antique gas pump. Though the pump is labeled as “Digital Gas,” at the top is a telephone symbol, where an oil company logo usually appears. The Red Truck is fueled here, not by steam as Analog Engine is, or gasoline as a car would be, but by telecommunications. Information.

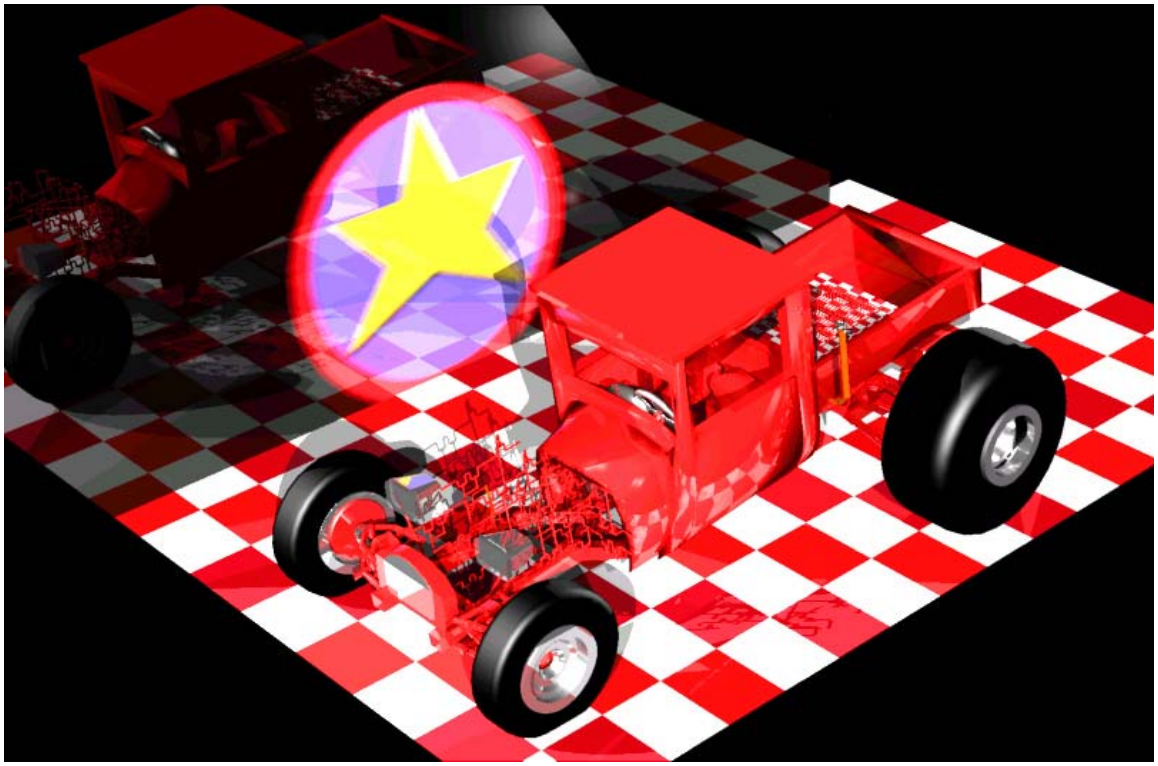
The Mayan Sun God is a frame for the image. The Sun God is derived from classic Mayan sun god imagery, with some differences. Where the classic god has a sky band body, my Sun God’s body is made up of a double helix of DNA, with Analog Engine making up another segment. The Sun God is information of another sort. It is information that takes two different things and makes a new third thing out of them.

Drive is a straightforward depiction of information on the move.

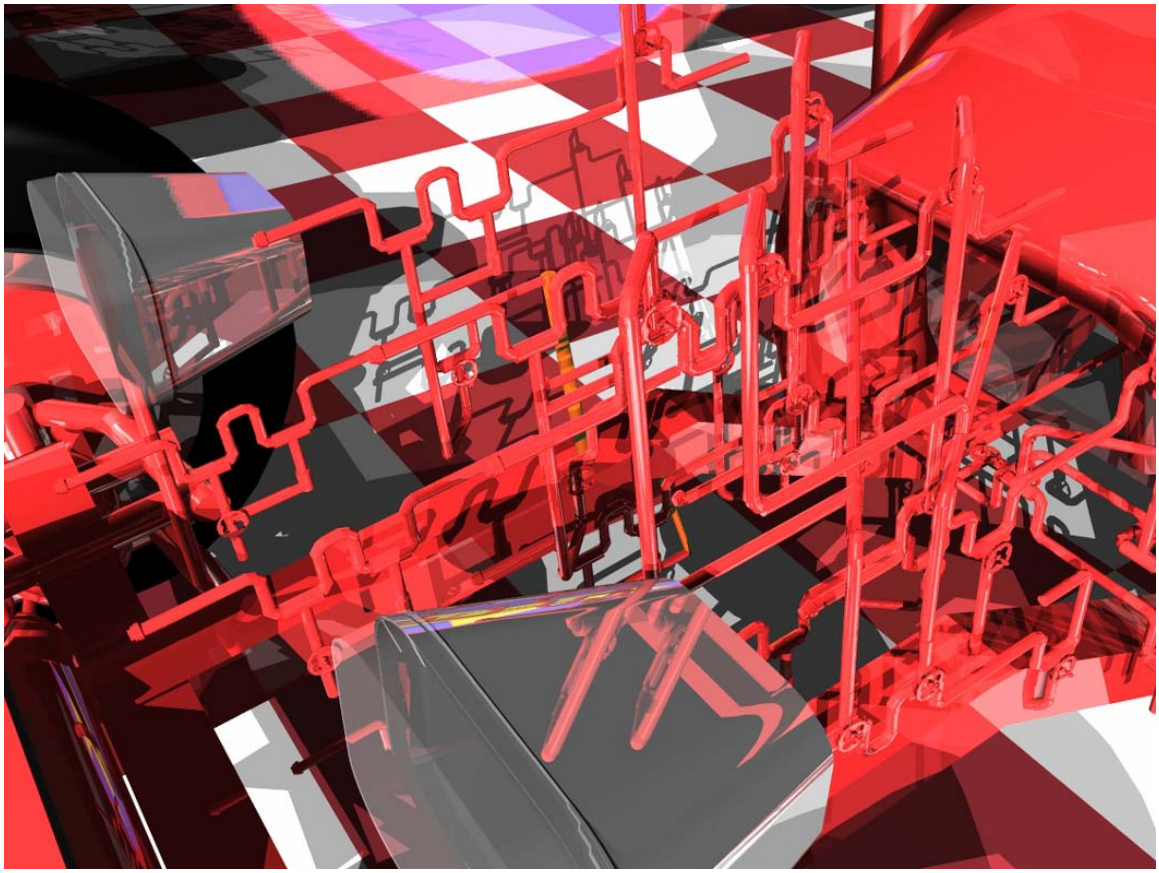
The last image in the Digital Gas series is called American Home. Featuring the Red Truck, the Mayan Sun God and the Digital Gas pump from the series title image, it also shows my house. Many people do most, if not all, of their work with computers at home.

While pursuing these visualizations of Analog Engine and mobile computing, I was busy engaged with other projects. One of these took me to one of the hardware superstores in my area. I needed some PVC plumbing parts. I took one look at the amazing array of parts available to me at a very reasonable price, and realized that by making some small changes in the Engine's design, it might be possible to build a sculpture out of PVC. In particular, a PVC Stop and Waste valve was very interesting to me.

In March of 2000, I got a new computer with new CAD/CAM software. This prompted me, over the next 9 months, to do a new version of the Red Truck, as well as a new version of the Engine. While the Red Truck remained substantially the same, Analog Engine now featured hand wheels and valves rather than pistons. Part of the reason I did this was that very early computers did not have transistors, but assemblies of vacuum tubes. Switches were called valves and were set by hand. The other reason I used hand wheels of course was I had begun to think seriously about using PVC for a sculpture and I wanted to see how stop and waste valves would look.



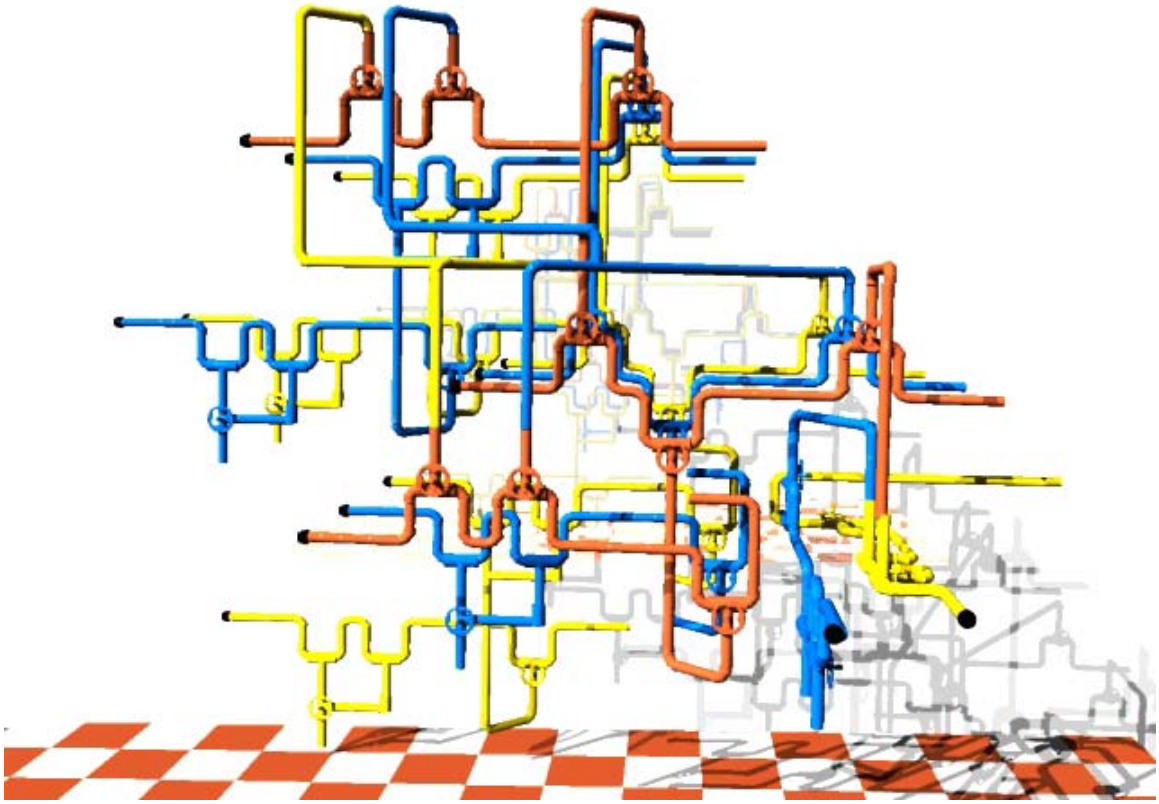
This print is called Rollout. The Badge of Quality, a fictional corporation that is a frequent subject of my work, is rolling out the first production version of their retro hot rod, the Red Truck. A checkerboard floor, both on the ground and in the bed of the truck, is prominently featured. Analog Engine drives the truck, and the Memory Device is in the bed.



This image is called Engine Abstraction, and is a close up view of Analog Engine in the Red Truck. The hand wheels can be seen more clearly, and also, in the right center area one can see diagonal connections allowing the output of one layer to feed the next layer. This version of the Engine is monochrome, in keeping with the monochrome styling of the hot rod.

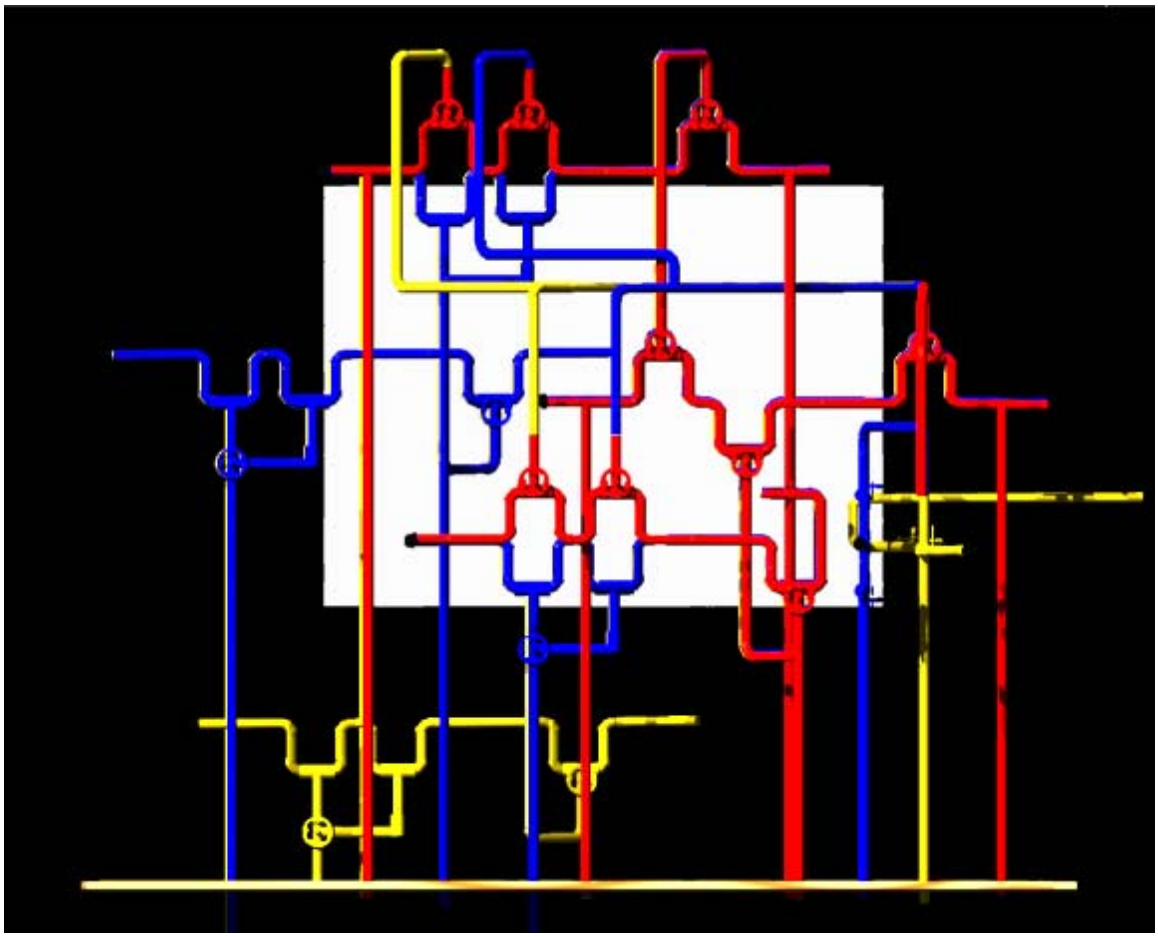
Considering Rollout and Engine Abstraction, issues of representation and abstraction cannot be avoided. Analog Engine itself *is* an abstraction of symbolic logic functions, but it is also a very physical realization. When it is placed in the Red Truck, which is more clearly representational, it blends seamlessly into the environment, but when the Engine is focused on by itself, in a manner similar to a camera highlighting the weave of a carpet, as Andreas Gursky has done, its abstract qualities are obvious.

The Sculpture

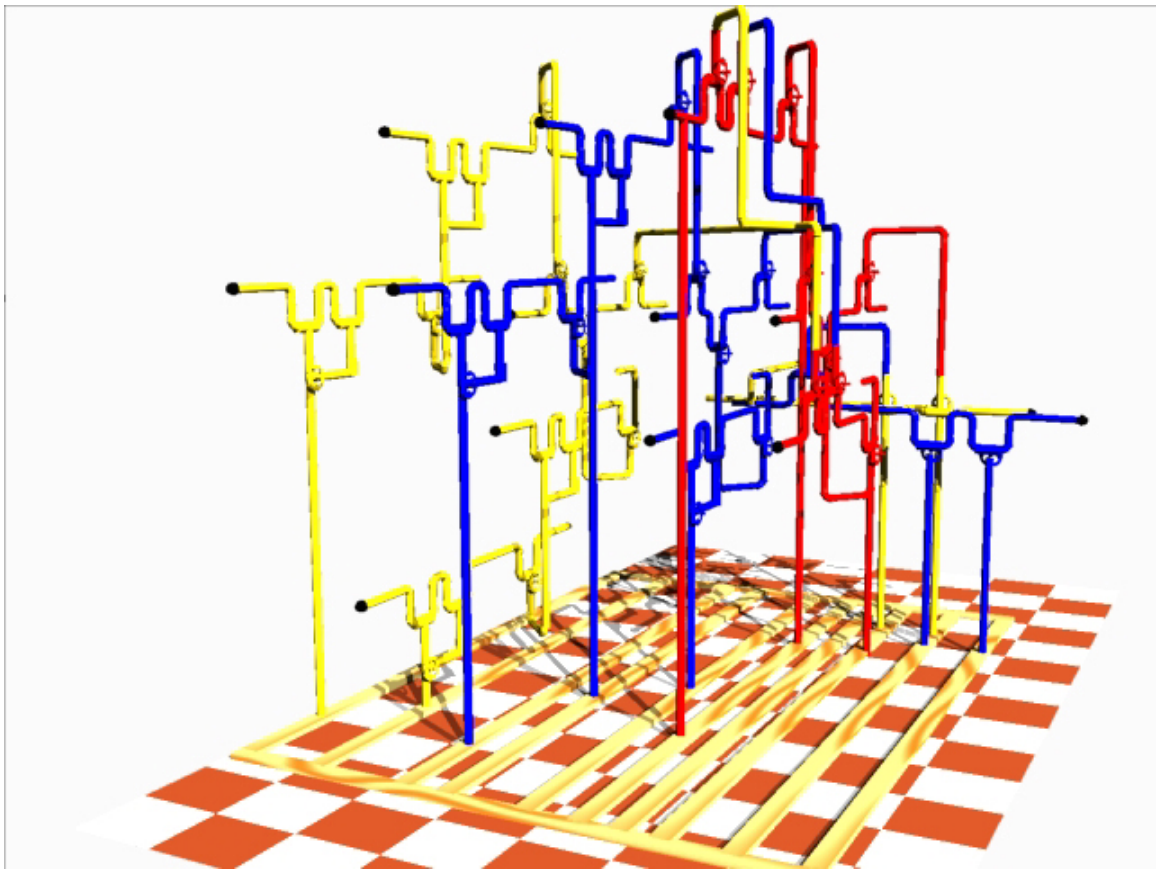


This version of the Engine is the same one as is in the Red Truck, complete with hand wheel set valves, but here a solution to the support for a sculpture is being explored. The colored layers have returned, and the diagonal feeds are clearly visible. The back wall is a mirror, and hidden pipes extending from it support the sculpture. The checkerboard floor also plays some role in support.

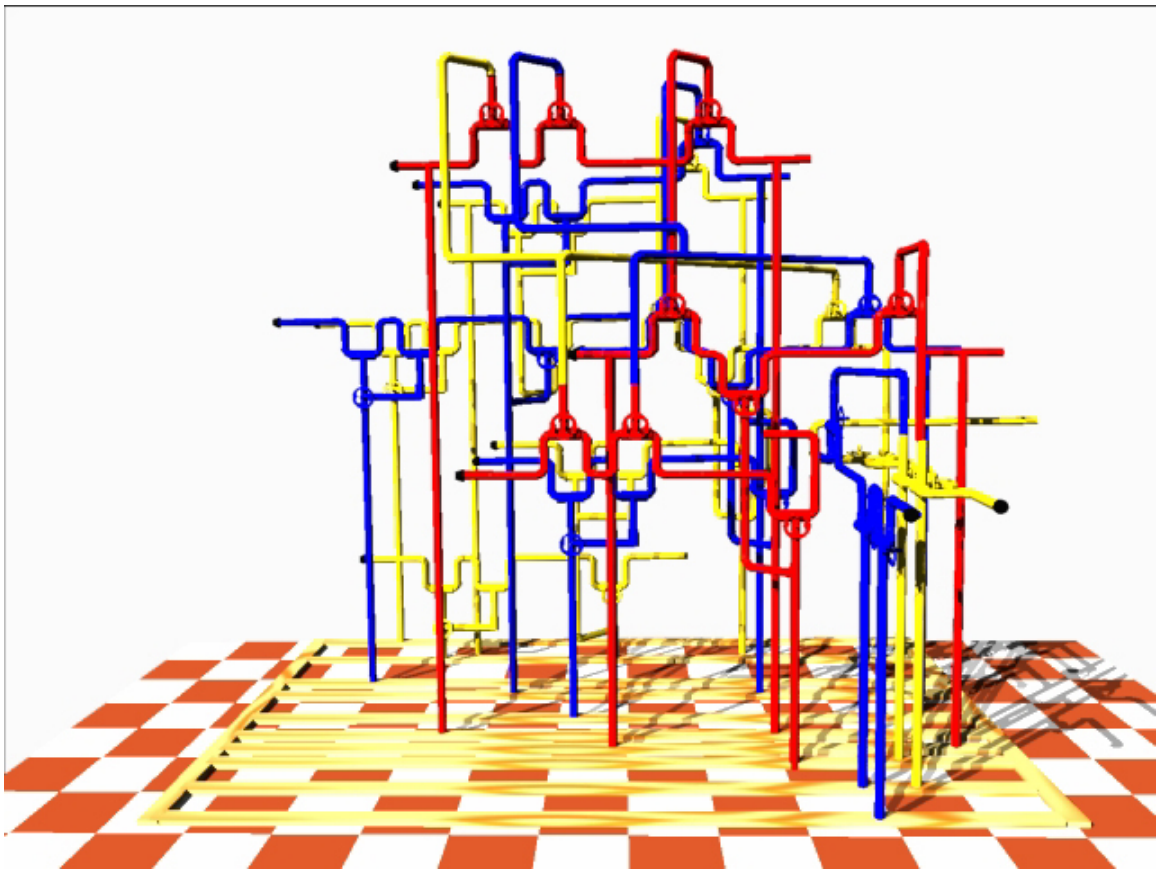
I became dissatisfied with the back-wall-support idea. From rotating the Engine around and around in CAD/CAM space, I came to the conclusion that the back was as interesting as the front, so I began thinking about making the Engine self-supporting.



Isometric Projection View



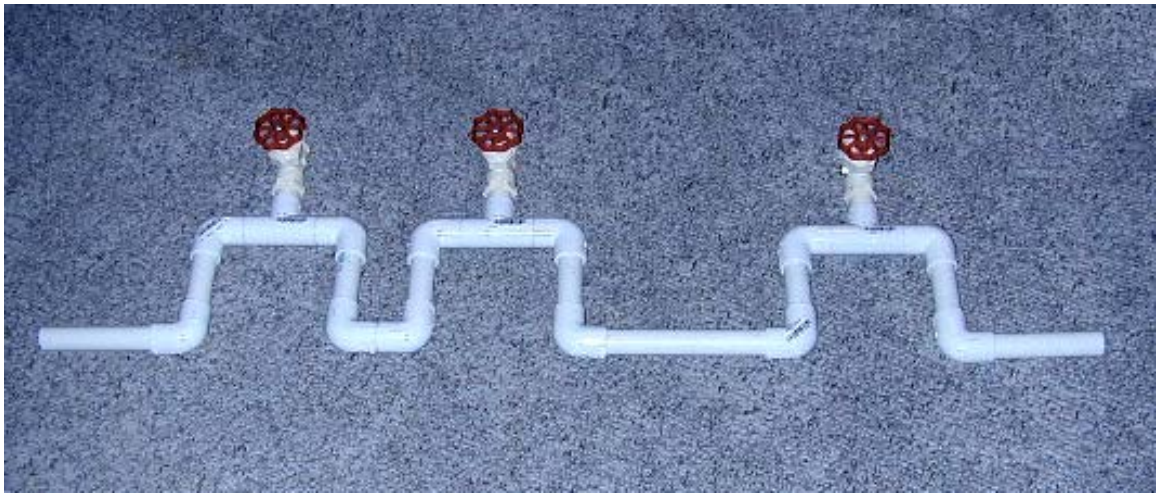
Counter-clockwise Rotation



Front View in Perspective

These three images show the base design I came up with that I thought would make the Engine stand on its own. I extended some input pipes to the floor, reasoning hypothetically that the steam source would be hidden the next story down. I added a few additional vertical braces, which I colored the same as the layer they supported. The problem with PVC pipe, as anyone knows who has worked with it, is that though it appears to be rigid, it actually has quite a bit of flex in it, as any pipe made for conducting water does. This means that any structure built from PVC pipe will not support its own weight without flexing. I thought that if I made a wood frame from 2x4 pine, and accurately measured where I wanted the vertical supports to be, I could drill holes in the pine, which would then brace the PVC against its tendency to flex.

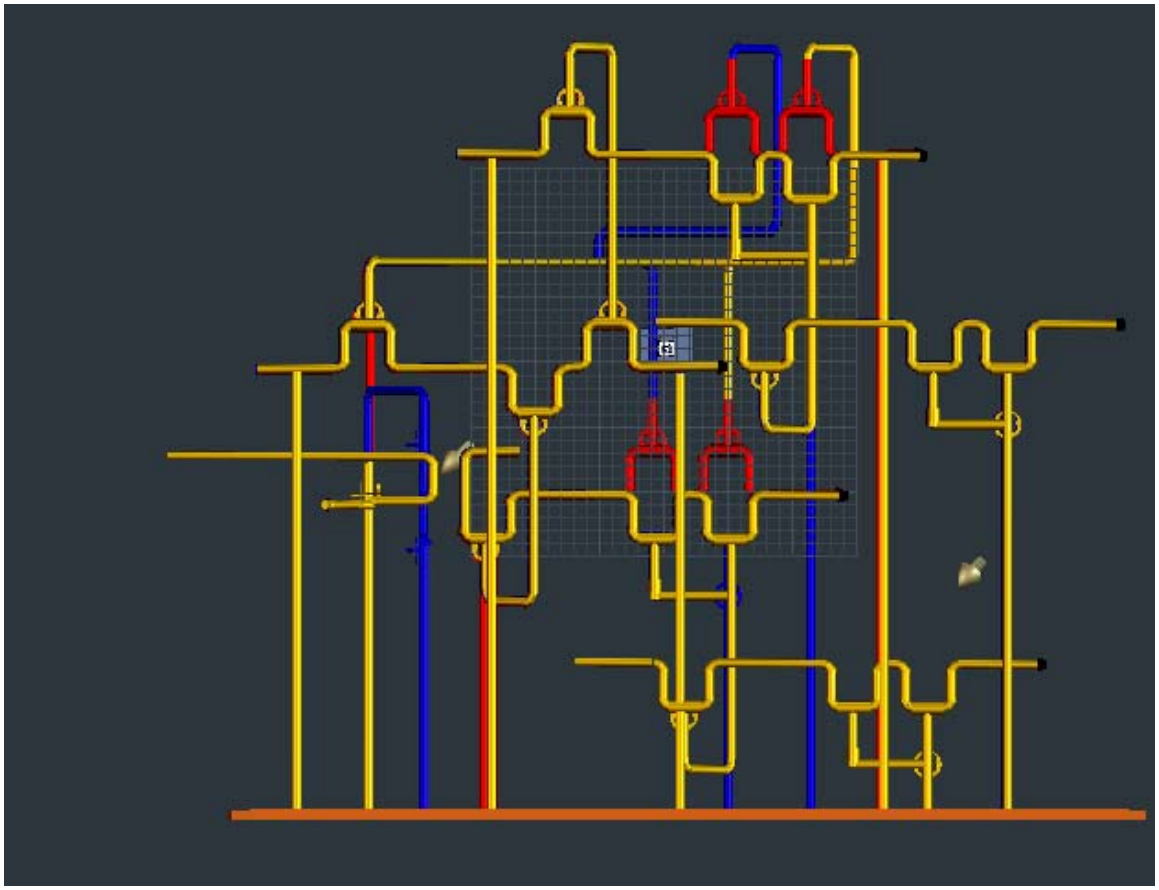
I finished these designs in August of 2000, and then thought about them for almost two years. During that time, I built some test “gates.” Their construction was routine. But painting them turned out to be difficult. Basically, the only thing that will stick to PVC is PVC-based paint. I had envisioned all kinds of pearlescent finishes, but it was not too be. Later, I did some research and discovered that latex paint adheres well, but it can’t be acrylic latex. It has to be latex, period. I found some glossy latex paint that was fabulously laden with pigment, and tested it. It worked quite well.



A test gate

On July 5, 2002, I began building the sculpture. I still did not know exactly how my base would work, but I knew it would not be made of wood with holes drilled in it.

I began with the back layer of the machine, the yellow layer.



Isometric projection from rear of Analog Engine

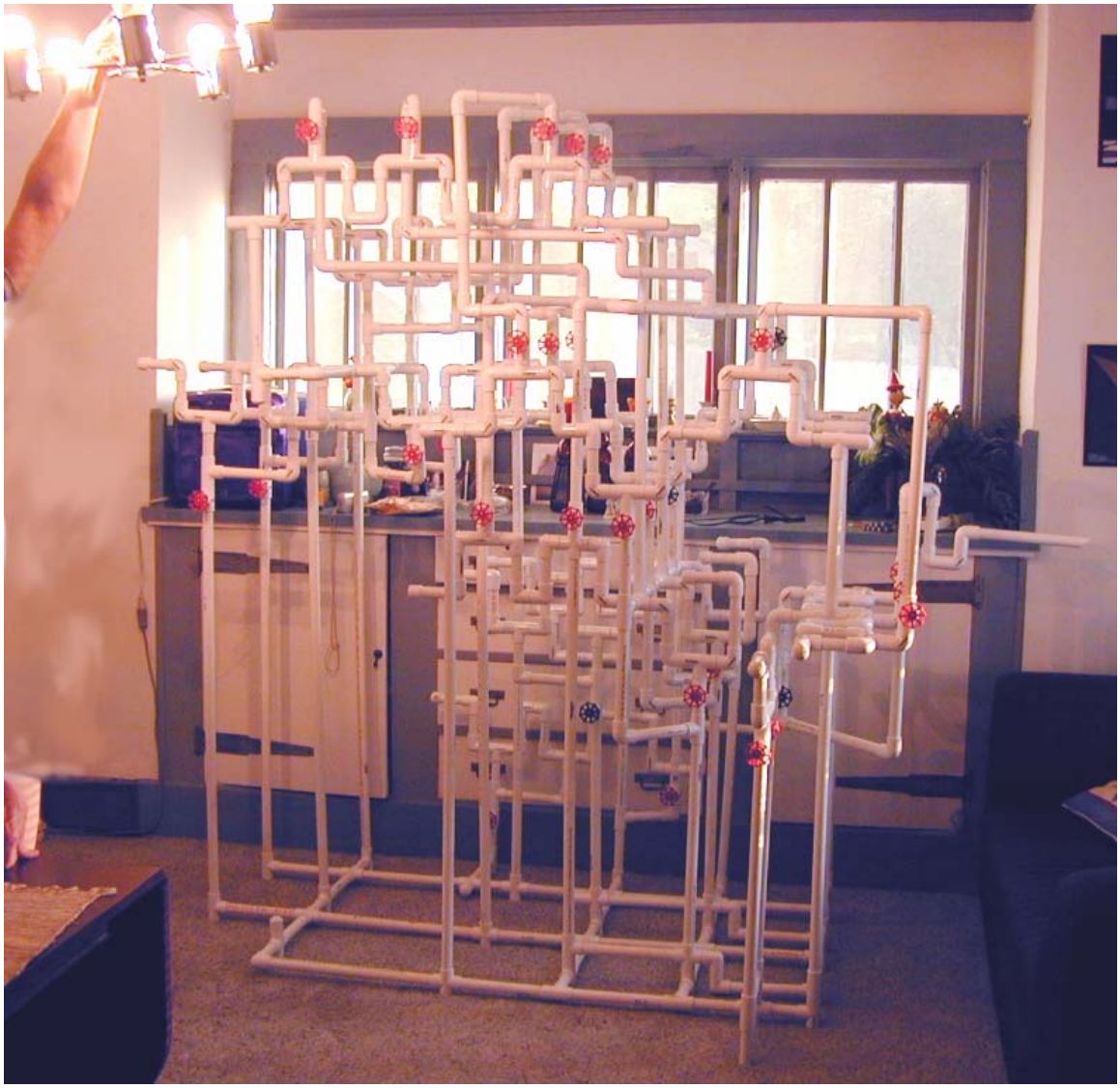
I decided I would make everything from PVC. Using the rear isometric projection as a guide, I built the yellow layer and found it would not stand on its own, so I kept adding braces and supports until it did. I then connected the vertical supports with an ad hoc rectangle, doing whatever I needed to do to make the layer stand.

The results were amusing. The verticals still bowed, and sometimes the horizontal gates sagged. I also found through the process of moving the layer from my basement to my living room to my dining room to the back yard, which required disassembly and assembly frequently, that no matter what I did, I could never force the PVC to go back together again the way it had been before. PVC seems to breathe, and how level the floor was that I put it on affected it greatly. Nevertheless, I found this quality pleasing.

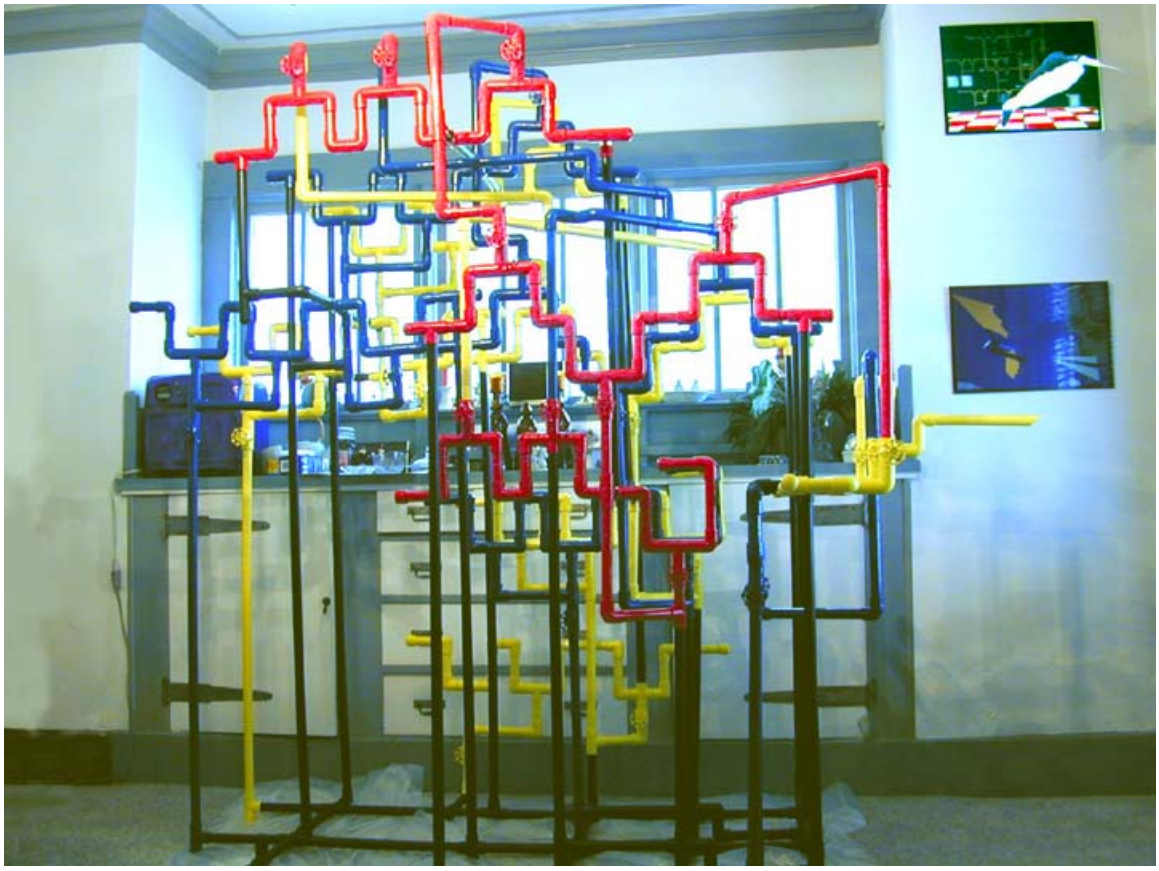
I grew up in Mt. Pleasant, Iowa, a small rural community in southeastern Iowa. One of the seemingly few advantages of growing up there was that I was exposed at an early age to antique steam traction engines used on farms from the late 19th century up until World War II for threshing. In Mt. Pleasant, every fall, there was a huge festival celebrating these machines and the people who worked them called The Midwest Old Settlers and Threshers Reunion. From its inception, when it was mainly a gathering of a few wealthy farmers with some time on their hands after harvest who loved these old machines and saw it as an occasion to bring their families together to have some fun, to when I left Mt. Pleasant, and the Reunion featured hundreds of steam engines and drew thousands of people from all over the world, I have been fascinated by these roaring hot, hissing giants and their incredible power. I also became acquainted with the Corliss stationary steam engine, often used to generate electricity and perform other duties like pump water. The Corliss was extremely quiet, but featured a gigantic flywheel, the size of which was the source of its power. Once that wheel began turning, moved by the slow “chook” of the Corliss’ single piston, its momentum was fearsome. The Corliss sound is the one I imagined Analog Engine making in its piston phase, when I did animations.

As a child, playing on the Avery Undermount Steam Tractor, I learned firsthand that nothing on those machines was straight. Practically everything was handmade and aligned by eye. Peering though the cab window, down past the long barrel of the high-mounted boiler, I could see the pipes running along it were bent and distorted by heat and accident, the usual stuff of daily work. These memories came back to me in force as I considered where to lay the next brace on my wobbly yellow layer.

I planned, early on in the construction, to distinguish vertical and horizontal supports from vertical input pipes by painting the supports flat black, as well as the rest of the support structure. The input pipes bore the same color as they layer they fed. This decision continued my basic color code design and made it possible to trace a path steam traveled for almost anyone.

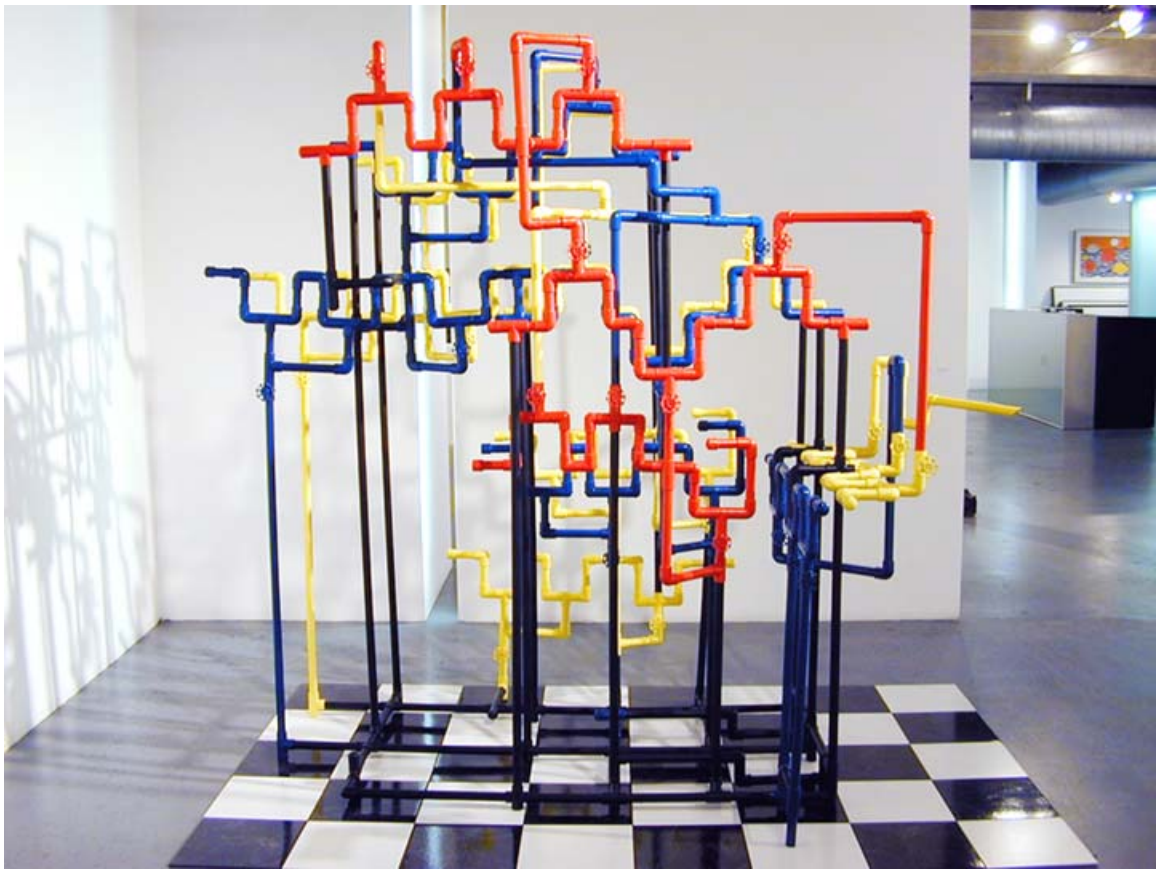


Analog Engine, Unpainted



Analog Engine Painted, in the Dining Room

Everyone should have an Analog Engine around the house, don’t you think?



Analog Engine is 83x97x44 inches resting on a base that is 60x96 inches. The sculpture is made of PVC and gloss latex paint. The base is ceramic tile. Installation view at Karolyn Sherwood Gallery (formerly Steven Vail Galleries), November, 2002 through January 2003.

Displaying Analog Engine and the Memory Device

At this writing, Analog Engine has had a gallery showing, but the Memory Device has not. If they were ever to be displayed simultaneously in the same gallery, the Engine should be by itself in one room, and the Memory Device should be by itself in another, adjoining room. They are parts of an as yet unstated whole. Within themselves, they give no indication of what their relationships to the whole may be or what their relationship to each other is. Even the original ArtEngine software I wrote does not contain a clue, because there is no section of the software called the Memory Device. There is an Engine, to be sure, but no Memory Device.

The reason this is the case is because Analog Engine is an analog computer and the Memory Device is an array of switches. A digital computer is a device that can receive many different kinds of instructions in the form of software and can execute all of them. It is as close as we have to a universal machine. An analog computer is hardwired software. It is both the instructions and the executor of those instructions so it is by definition and in practice, a single task computer.

So far, the Memory Device has been described only as an array of 18 switches. Why not 24 or 108 switches?

When I was in high school and just beginning to wrestle with art issues, a perceptive teacher told me to pay attention to my dreams. I did this for a number of years. By the time I was at the end of

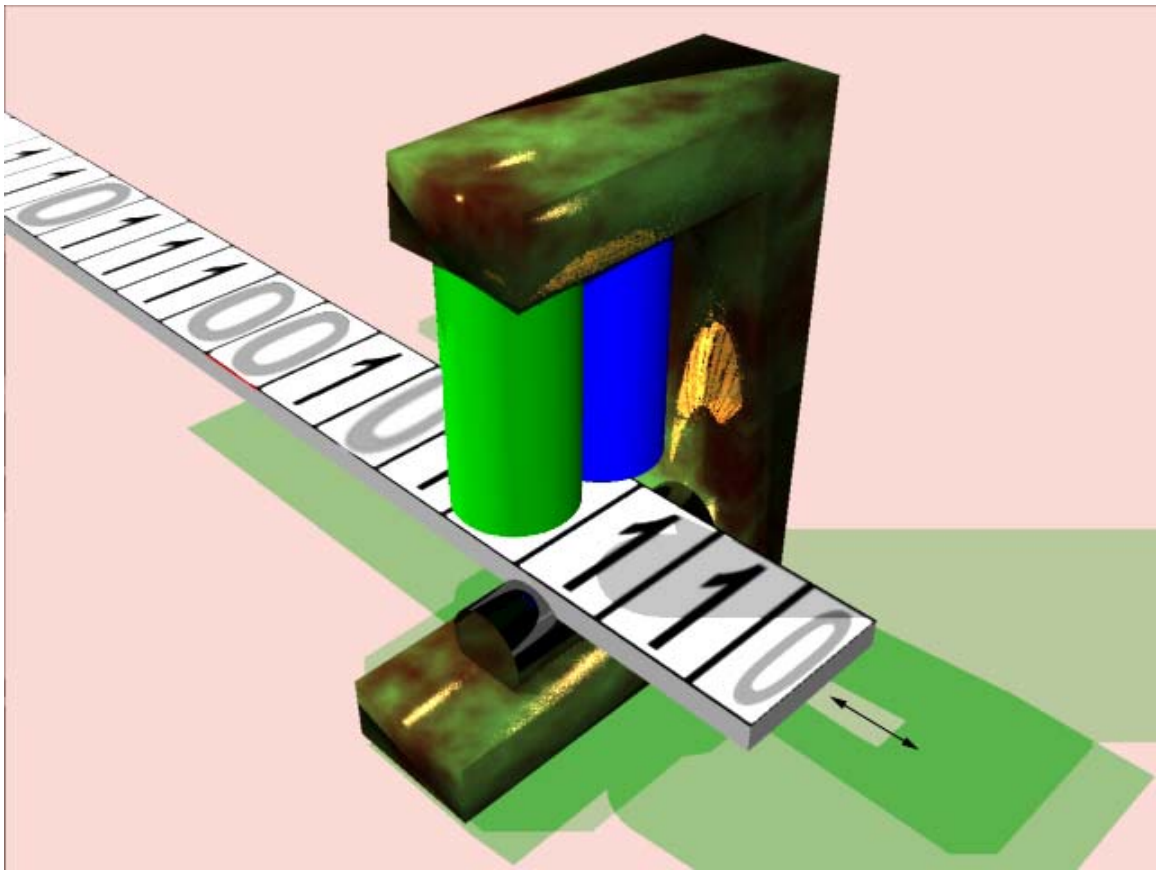
my college career, I found that I did not have many repeating dreams, but I did have many repeating images.

Over the next few years, I tracked those images. In 1974, I finally formalized these images in a language of 18 images, including the caduceus, the ouroboros (snake devouring itself), a bowl of water, the sun, twin girls, games and others. This language has changed somewhat over the years, but its essence has remained the same. One other element, a feature of all my most intense dreams, was an extremely clear sense of perspectival space; that is, my most powerful dreams all seem to be enacted in a rationalized space.

At this time in my artistic practice, I no longer arrange this language by chance or a grammar, as I did when I began using it, because it comes from so deep within me that it is always a part of my work, intentionally or not. When I externalized my creative process in the form of the Memory Device, I hard-wired it, because it was the best way to make my process quantifiable. The Memory Device keeps track of these 18 dream images. It is a checklist that feeds Analog Engine a record of which of the 18 dream images is present in the images under consideration.

The Universal Turing Machine

The precise relationship of the Memory Device to Analog Engine can be clarified by a brief comparison of my analog devices with the Universal Turing Machine. Alan Turing was an English mathematician and code breaker (he solved the puzzle of the German's Enigma machine during WWII) and was instrumental in the development of the digital computer.



The Universal Turing Machine

The Universal Turing Machine is a device that has a read head and a write head, shown in the illustration by the green and red cylinders. It reads one symbol written in one cell of the infinitely long tape. It then consults a previously given table of instructions for that symbol. It then writes the symbol given in the table, and moves the tape one cell in the direction determined by the table of instructions.

The symbol written is determined by the state of the machine, which is given in the table of instructions. For example, imagine that the state is called “Replace 1 with 1.” Then we can construct the following table:

State	Symbol Read	Written	Move	Next State
Replace 1 with 1	0	0	forward	Replace 1 with 1
Replace 1 with 1	1	1	forward	Replace 1 with 0

Notice that this table gives rise to another state “Replace 1 with 0.”

Alan Turing proved that this machine can solve any computable problem; that is, anything that today’s computers can solve, provided it is given enough time. Therefore, all computers and software are variations on the Turing Machine theme.

How Does It Work?

In light of the Universal Turing Machine, the Memory Device may bear the wrong name, since it is part of the read head. It is not memory at all, but the lens through which images are scanned. If part of an image being scanned corresponds to one of the 18 values symbolically represented by one of the 18 valves, then that valve is opened. It is true.

Analog Engine corresponds directly to the table of instructions, which makes sense since it is basically hard-wired software.

When I show people the Analog Engine sculpture or the Memory Device, I am frequently asked, “Does it work?”. There seems to be the expectation that since I am working with computers and computers perform real work that an artist’s computer will perform real work also. Art today exists in the pale light of confusion. At the base of this confusion is a profound (but misdirected) desire to have art change the real world in some way, to have definable impact. Sometimes this confusion is the result of feeling that art is trivial or somehow doesn’t measure up or may even be dying.

First, concerning the question of whether it works or not, the answer is, “It might, but not in its present form.” PVC pipe is made to conduct water, not compressed air and certainly not steam. But suppose Analog Engine and the Memory Device were made of iron pipe—would they work then? The Memory Device certainly would work, because all it does is generate an 18-place binary number that indicates by place which of the 18 visual values is present in a given image.

Analog Engine is trickier issue. Unlike the Memory Device, in which each valve is independent of all other valves, Analog Engine’s valves feed the next valve down the information flow so an output valve that is closed will deprive all others following it of steam, rendering the on/off states meaningless. This is why I used stop and waste valves in Analog Engine, rather than the simpler stop valves found on the Memory Device.

A stop and waste valve has a small screw that allows excess flow to escape, acting as a safety valve to lower pressure. Therefore, when Analog Engine is up and running, all valves are open. A valve that is to be in the open state has its waste screw closed. A valve that is registering closed has its waste valve open. In this way, two different steam pressures can be generated, a high one

for True and a low one for False, that correspond to the two voltages that open and closed transistor gates measure.

Above and beyond these engineering-type queries, the question of whether my sculptures work as actual machines indicates some would be more comfortable seeing them as machines than art. Of course, my software (digital machinery) worked well. That was a machine. But, Analog Engine and the Memory Device are sculptures in the classic sense. They don't work any more than one would expect the Venus de Milo to breathe. The idea is to create in the mind of the viewer the feeling that these machines might work, to make them believable. Because I have taken care to work out their mechanics, they are believable, but paradoxically, the fact that they are displayed in a non-working state, as traditional sculptural objects, creates tension and raises their visual impact above any other quality they have.

Well, OK, Conceptually, How Might They Work?

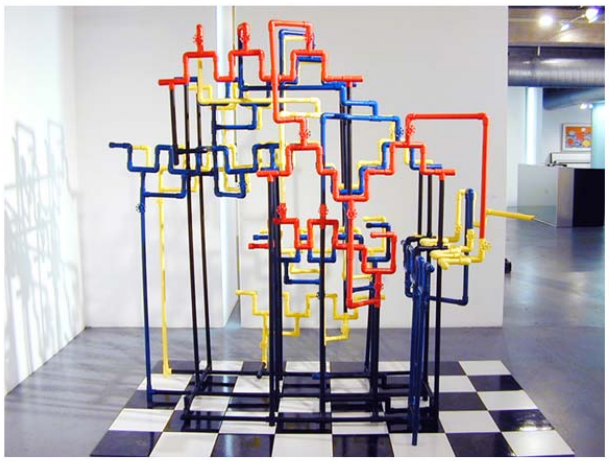
The central concept of my ArtEngine software is that the user presents the Engine with two images and the Engine then makes a new third image from them. The initial factor in this process is human because the selection of two images is crucial and something no machine can do as yet. In order to compare two images, or anything else, to determine if they are different, the two images must be virtually identical. Otherwise, as the cliché goes, you are comparing apples and oranges.

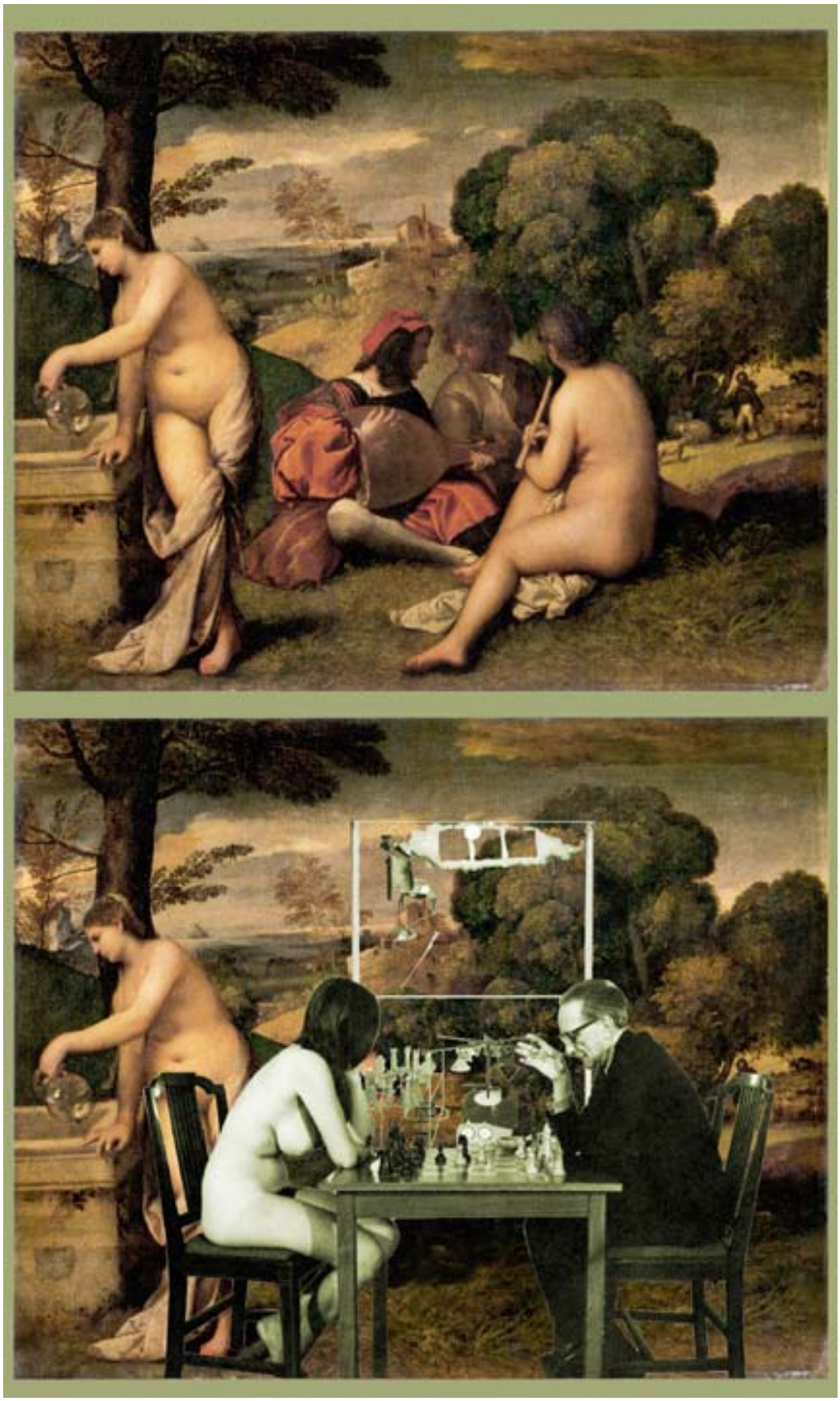
The 18 values represented by the Memory Device play a significant role in ensuring both that the images are virtually identical and that there are small but significant differences between them. The following illustrations show how two images, Concert Champetre by Titian or Giorgione and a photograph of Marcel Duchamp and Eve Babitz by Julian Wasser, are synthesized into a new third image by the Engine.

How to Make a New Large Glass

Concert Champetre by Titian or Giorgione

Colorized photo from original B&W of Marcel Duchamp and Eve Babitz by Julian Wasser





Accepting the use of metonymy in the case of the Wasser image, the New Large Glass is a complete statement of the Engine's method.

Recursion

Recursion is one of the more intellectually exciting features of LISP programming because it has philosophical implications. Recursion happens when a procedure contains data, and after one iteration, loops back on itself, modifies the data, and executes repeated iterations until there is no data left. In his book, Introduction to LISP Programming, David Touretsky visualizes recursion as an ouroboros, a snake devouring itself.

Now, let us imagine that Analog Engine has the ability to photograph itself. The photos are presented to it and processed.

Analog Engine Self-Portrait

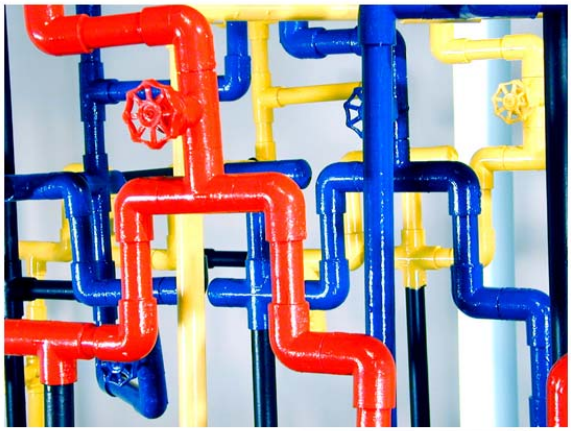


Image 1.

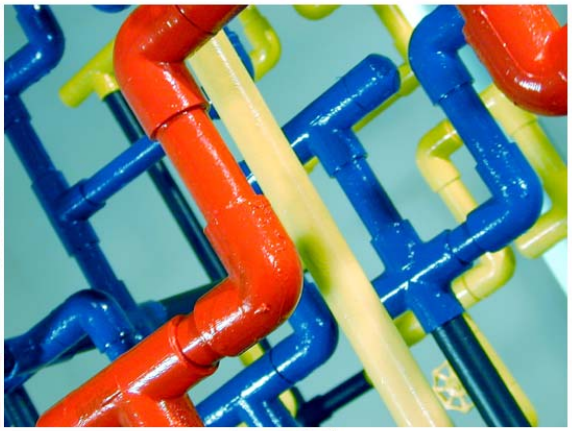
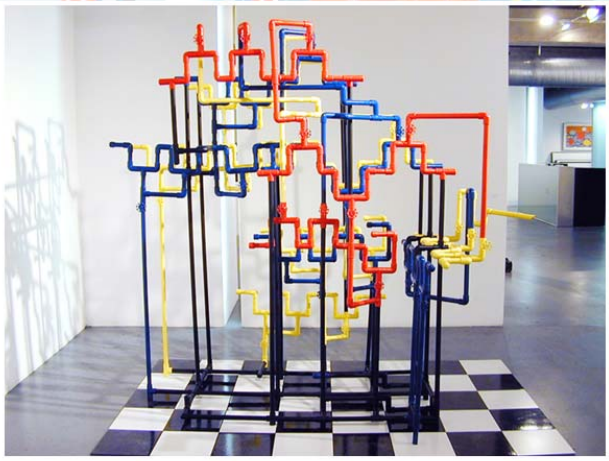
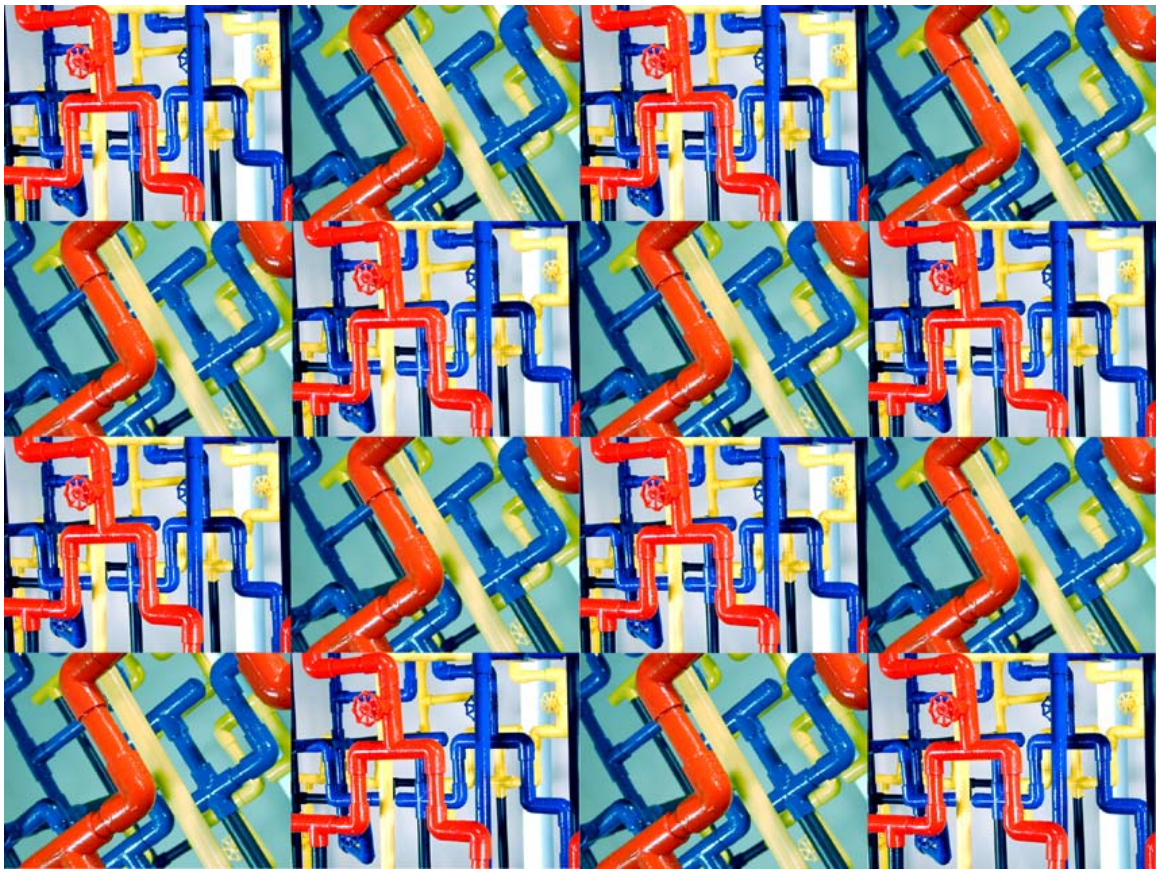


Image 2.



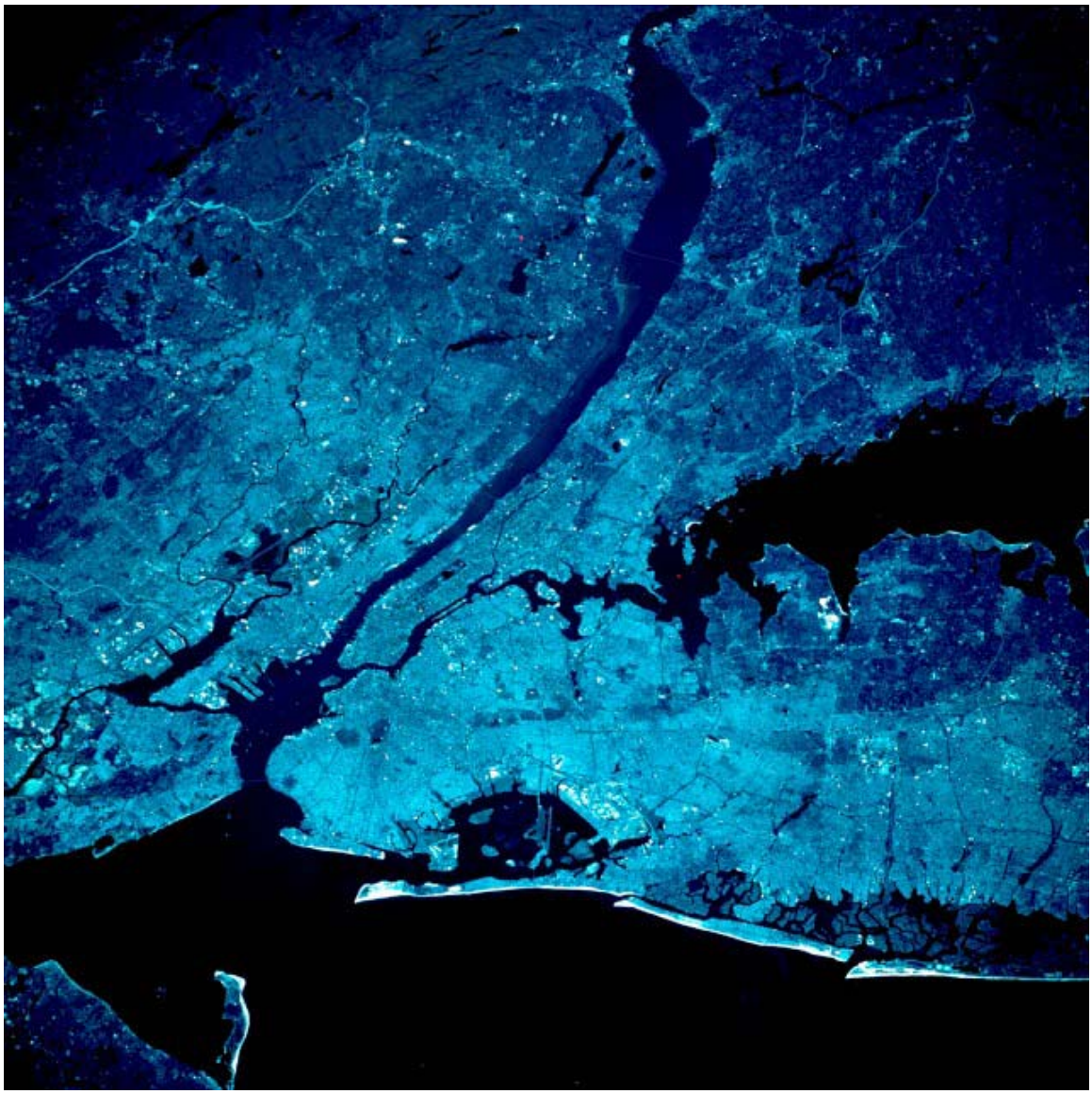


In these two images, the only significant difference between them is the perspective and the attending light. Analog Engine can only see part of itself at any one time without a mirror, so the best it can do is take two photos of itself with slightly different points of view. Consequently, the more these two images are repeated, the less apparent the original ones are because a new network of pipes appears. A new third image emerges.

This image is also an example of one that begins solidly rooted in physical reality but is in fact a very abstract picture.

Analog Engine, Satellite Photography and Digital Imagery

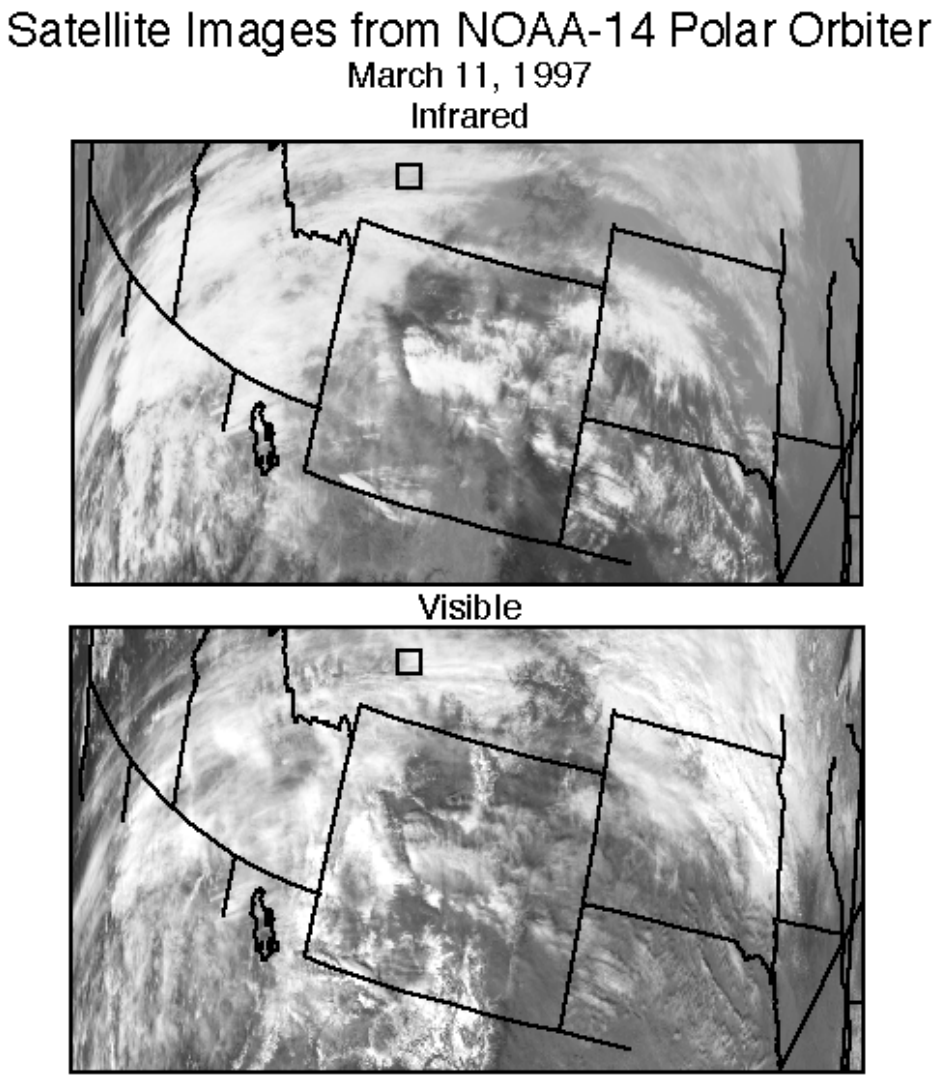
In the early 1960s, the government of the United States began using satellite photography as a means of conducting surveillance all over the globe. Here are some satellite photographs of New York City, with commentary, downloaded from the Johnson Space Center.



STS039-088-054 Metropolitan New York City Area, New York, U.S.A. May 1991 Since this color infrared photograph covers the same general area as STS-058-081-038, almost all of the physical features identified and described in the caption for that photograph are applicable to this one. It is important to note that color infrared film is designed to enhance vegetation signatures. The film records reflected energy from plants and presents the information as a reddish signature. Central Park in the middle of Manhattan Island shows green trees and grass as a reddish color. Similarly, a line of rectangular parks (red blocks) can be traced eastward from the borough of Queens toward the other end of Long Island. Other features that are discernible in this photograph are three large airports—John F. Kennedy International, La Guardia, and Newark International—as well as smaller airports southeast of Brooklyn. Some segments of the extensive ground transportation network pattern (even individual thoroughfares and streets) can be identified. The recent scar created by disturbing natural vegetation (highly reflective area) is evidence that a new highway is either under construction or has just been completed through the hill and lake region northwest of the metropolitan area. It appears that this highway is part of an interstate bypass around the metropolitan area and links with Interstate Highway 287.

--Johnson Space Center

The key problem with satellite photography is knowing what you are seeing. The photograph of New York City was taken using color infrared film to highlight vegetation information. Here is another satellite photograph, this one of a forest fire in Montana:



The outlines of the states have been drawn on the image. The little box in the top center area is where the forest fire was.

Both the New York and Montana images use infrared to highlight information. The Montana series has an advantage in that it shows both infrared and visible spectrums. The New York image achieves infrared spectrum by means of special film. It is not clear how the infrared image was obtained in the Montana image, software or film, but it is clear that the state borders were drawn by an operator using computer software.

Many of the most familiar tools in Adobe's Photoshop software were originally developed to highlight visual information hidden in satellite photographs. Tools such as "Find Edges" and "Trace Contour" are excellent examples as are "Sharpen" and "Sharpen Edges." It was a stroke of genius for Adobe executives to realize that commercial and graphic artists constituted a new and growing market for these tools, and they quickly capitalized on their perception.

What is the relationship of this development to Western Art History?

During the Italian Renaissance, the development of the techniques of perspective rationalized pictorial space. The checkerboard floor was a feature of images done in perspective then, continuing through to the present, if the image is so constructed. Vermeer's "The Art of Painting" is my particular favorite image showing the checkerboard floor.

David Hockney in his recent book, "Secret Knowledge: Rediscovering the Lost Techniques of the Old Masters," suggests that many artists, certainly Vermeer and before him, Caravaggio and possibly as far back as Van Eyck, were using lenses and optical instruments such as the camera obscura, to attain their effects. This seems likely to be the case, and so the development of the modern camera in the 19th century is the logical technical outcome of their art and the introduction of mathematical perspective.

The camera had devastating effects on the careers of many portrait painters, as is well documented, because now almost anyone could take a reasonable likeness, sometimes a very

good one, and have the image developed quickly. Most of the history of 20th century art is a testament to this fact.

The advent of satellite photography in the 1960s has signaled another such revolutionary event as the development of the camera, but this time, it has given artists a huge array of tools they can manipulate digital imagery with in artistically unique and highly personal ways. Now, let me place these developments in the context of contemporary art practice. What do I find…

The Art World?

Digital practice is slowly creeping into fine art, not without a furious resistance. Andreas Gursky occasionally alters photographs digitally. Jeff Koons uses Photoshop to assemble his collages which are then scaled up and hand-painted on a colossal scale. There are many more examples, some good, some bad, but these two artists are among the best known, and neither has begun to tap the potential offered by digital art.

The reasons for this are many. Education is one. You have to go outside the standard teaching of art to really understand what computers are and how to use them. I was shocked to discover most dealers prefer to see tiny 35mm slides they can peer at with loupes, instead of seeing a large image on a large computer monitor, though all of them have computers…But chief among the reasons is the prevailing theoretical climate. Laura Hoptman, curator of a current show of drawing at MoMA QNS, said in an interview published 12-17-02 on artnet.com:

"Drawing Now: Eight Propositions" concerns New York in the 1990s, for better or worse. It deals with trends that are finished works rather than sketches; and they are narrative, illustrative and for the most part, figurative. Because of this, some of the artists in the show have been criticized as conservative figures. But the arriere garde can be subversive too. Some critics get worked up when they see retro art, but theirs, I'm afraid is an old fashioned, teleological view of art history that is based on the notion that over the centuries art has been progressing towards some Utopian ideal of perfection. That's just not pertinent anymore. We are all too pluralistic.

I take issue with her definition of progress, which I find widespread, certainly not unique to her. To deny the 19th century's notion of progress towards some utopia is one thing, but to deny that progress exists is foolish. The reason cameras put so many portrait painters out of work was because they did the job better. The images, as judged by the people of the day, were better. Just ask Thomas Eakins!

The truth is, we go forward and we go backward. There is no end until we make an end, or an asteroid augurs to the center of the earth. The good intentions of pluralism are being used to mask a fearful quagmire of doubt, self-pity and indecision.

I place Analog Engine and the Memory Device in opposition to the lackluster, timid, unthinking, unfeeling, blind-as-Oedipus artistic spirit of the times. Analog Engine, standing on the checkerboard of Renaissance perspective, proclaims the arrival of the age of Digital Pictorial Space, complete with the algorithms for its manipulation, derived from the satellites that circle our globe, and aware that new digital processes will emerge as surely as the great sun rises. The artist is in the pilot's seat, again. Digital process rules space.