AHST 2331-001 (20045)
Understanding Art
Dr. Charissa N. Terranova
Tuesdays and Thursdays 11:30-12:45
ATC 1.102

Tuesday April 25

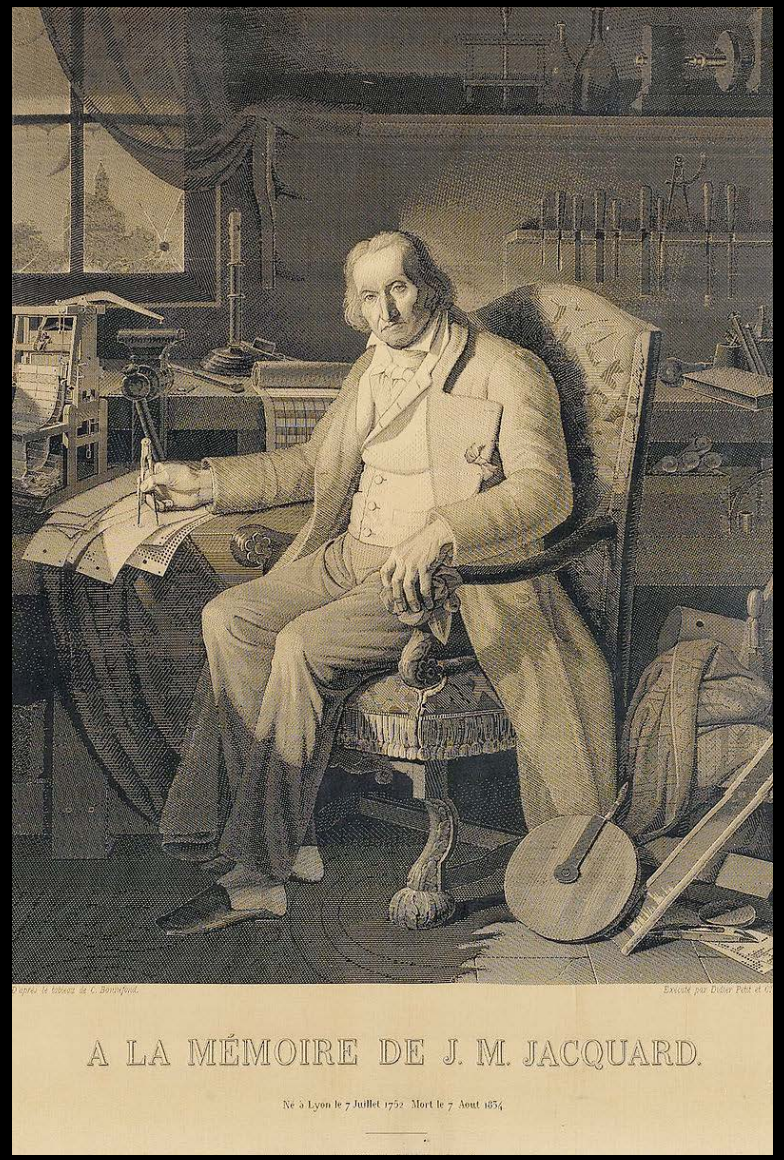
The Digital Image in Art

# VIRTUAL REALITY
# spectrum of experience and meaning

**literal virtual reality**
**replicating reality**
**immersion without distance**
**reproducing nature to best nature**
**cinema**
**market proximity/embeddedness**

**metaphorical virtual reality**
**interpreting reality**
**immersion with distance**
**reproducing nature to comment on reality**
**Expanded Cinema**
**art/autonomy [?]**

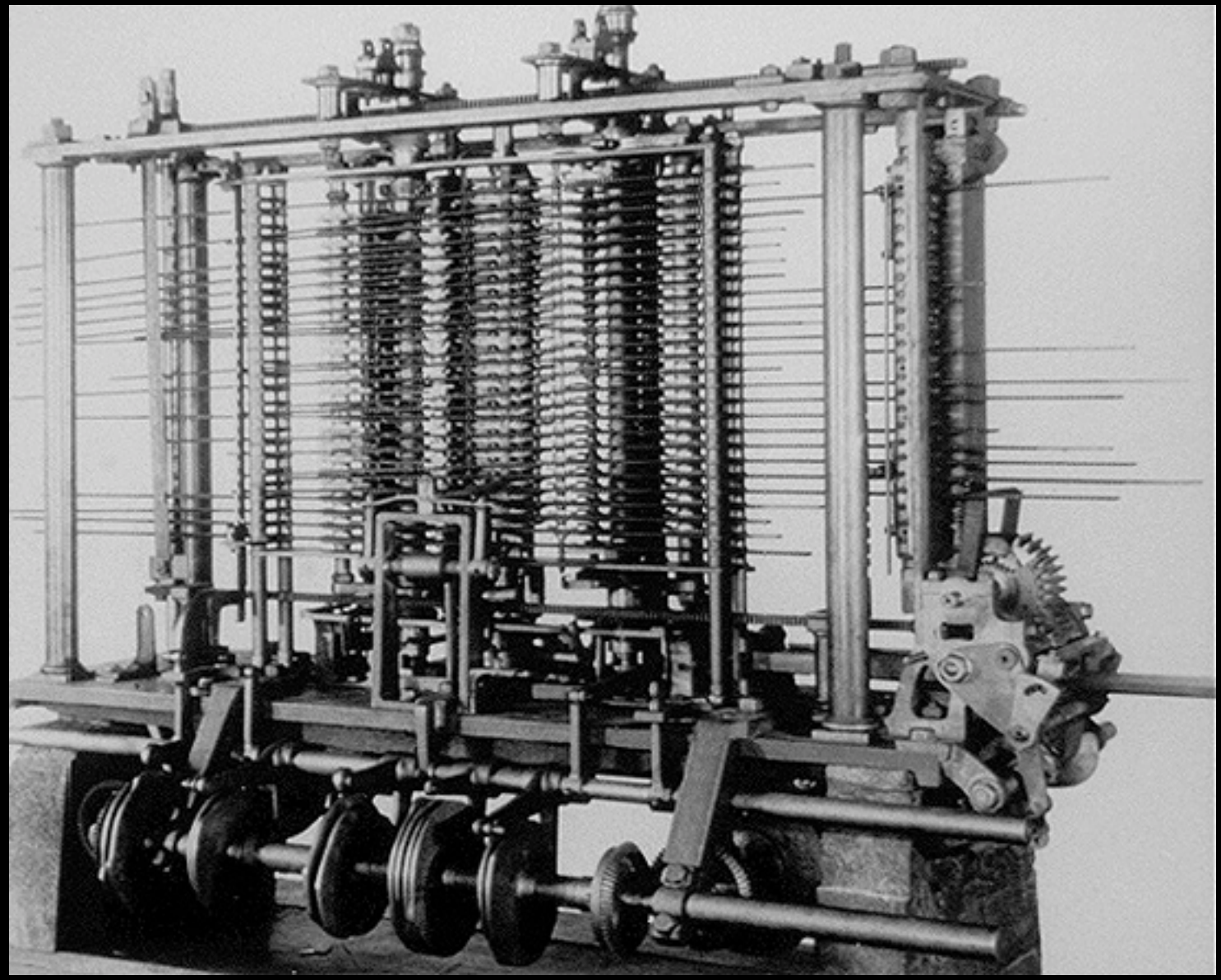
# The Digital Image:
# Coded Form and Electronic Production




Joseph Marie Jacquard [1752-1834] portrait of Jacquard was woven in silk on a Jacquard loom and required 24,000 punched cards to create (1839).

Joseph Marie Jacquard, Jacquard Loom/Punch-Card Loom, 1801

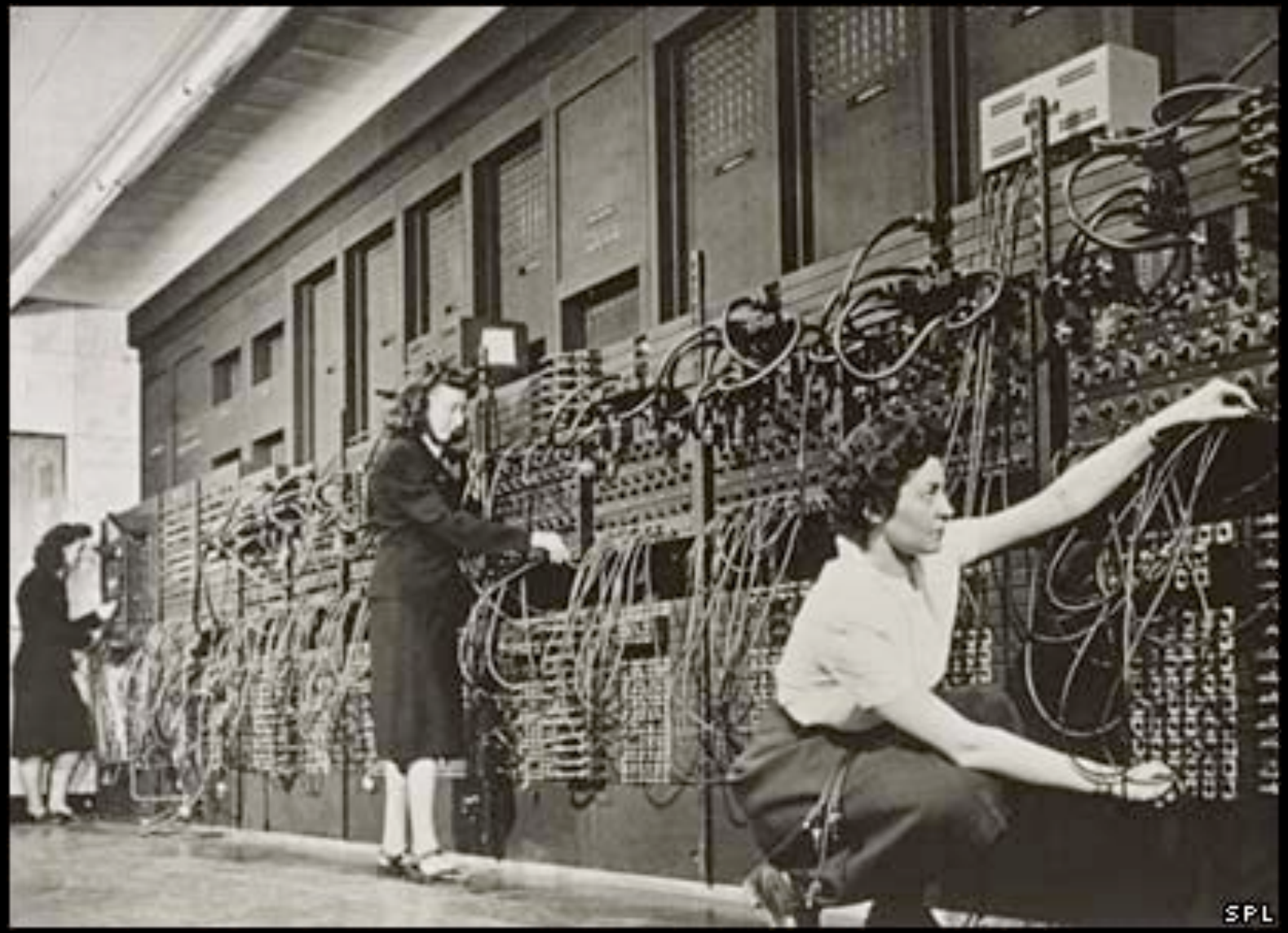
Jacquard Fabric Sample



Babbage Engine 1822/1999

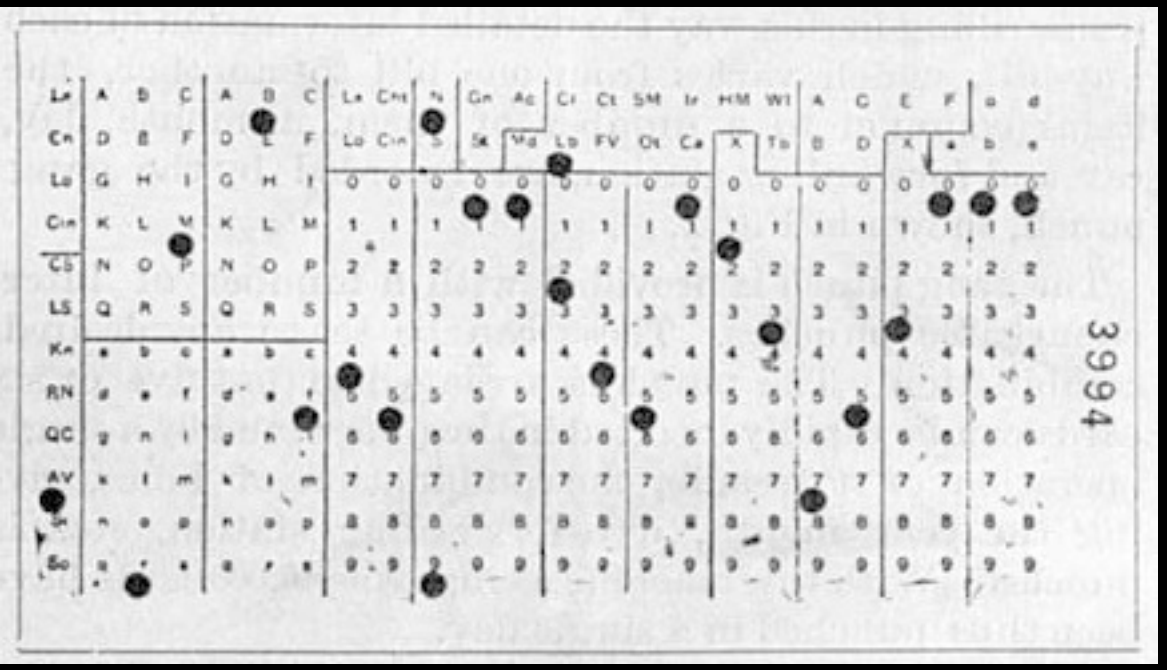
http://www.computerhistory.org/babbage/

Charles Babbage [1791-1871]

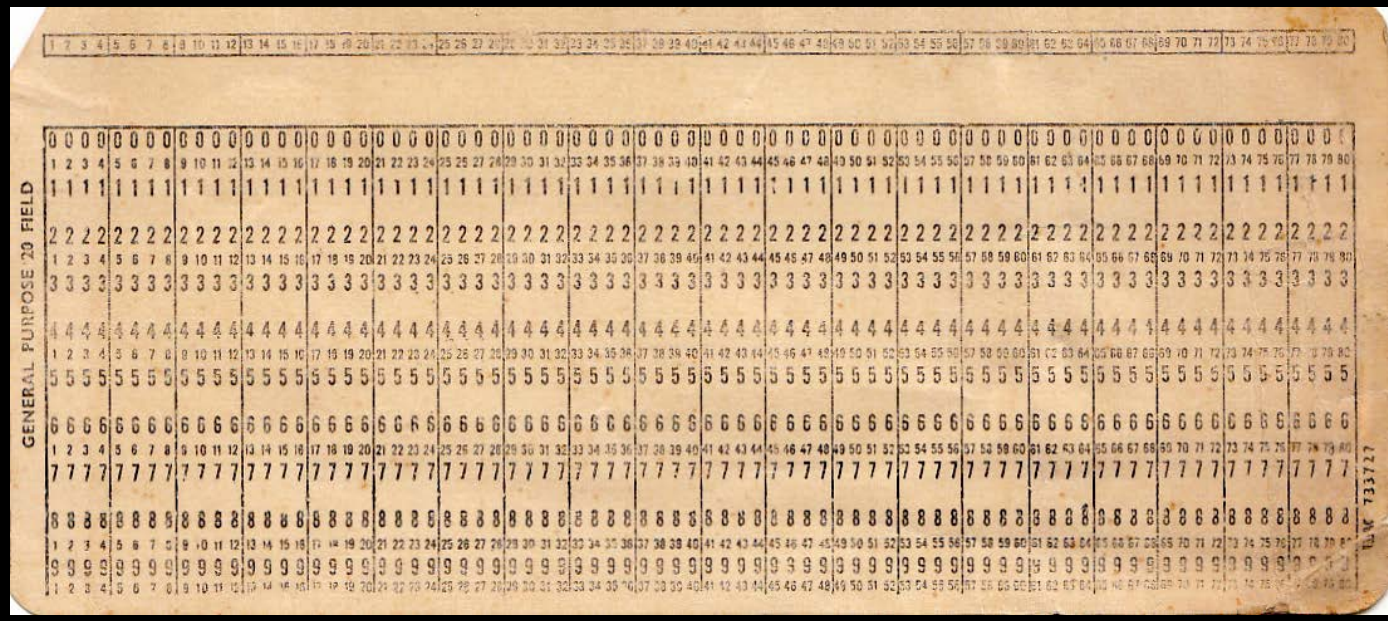



ENIAC [Electronic Numerical Integrator and Computer] Computer at the University of Pennsylvania, 1946, conceived by John Mauchly and J. Presper Eckert

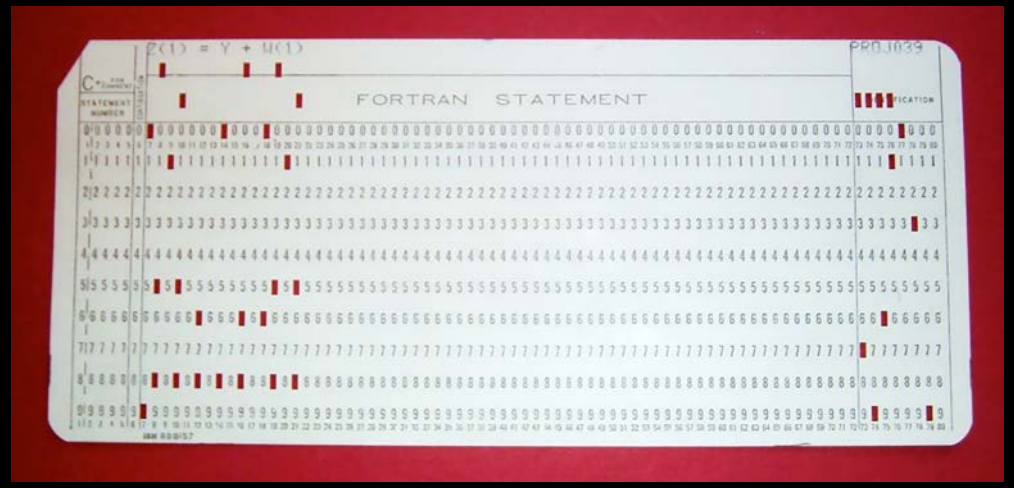
ENIAC vacuum tubes



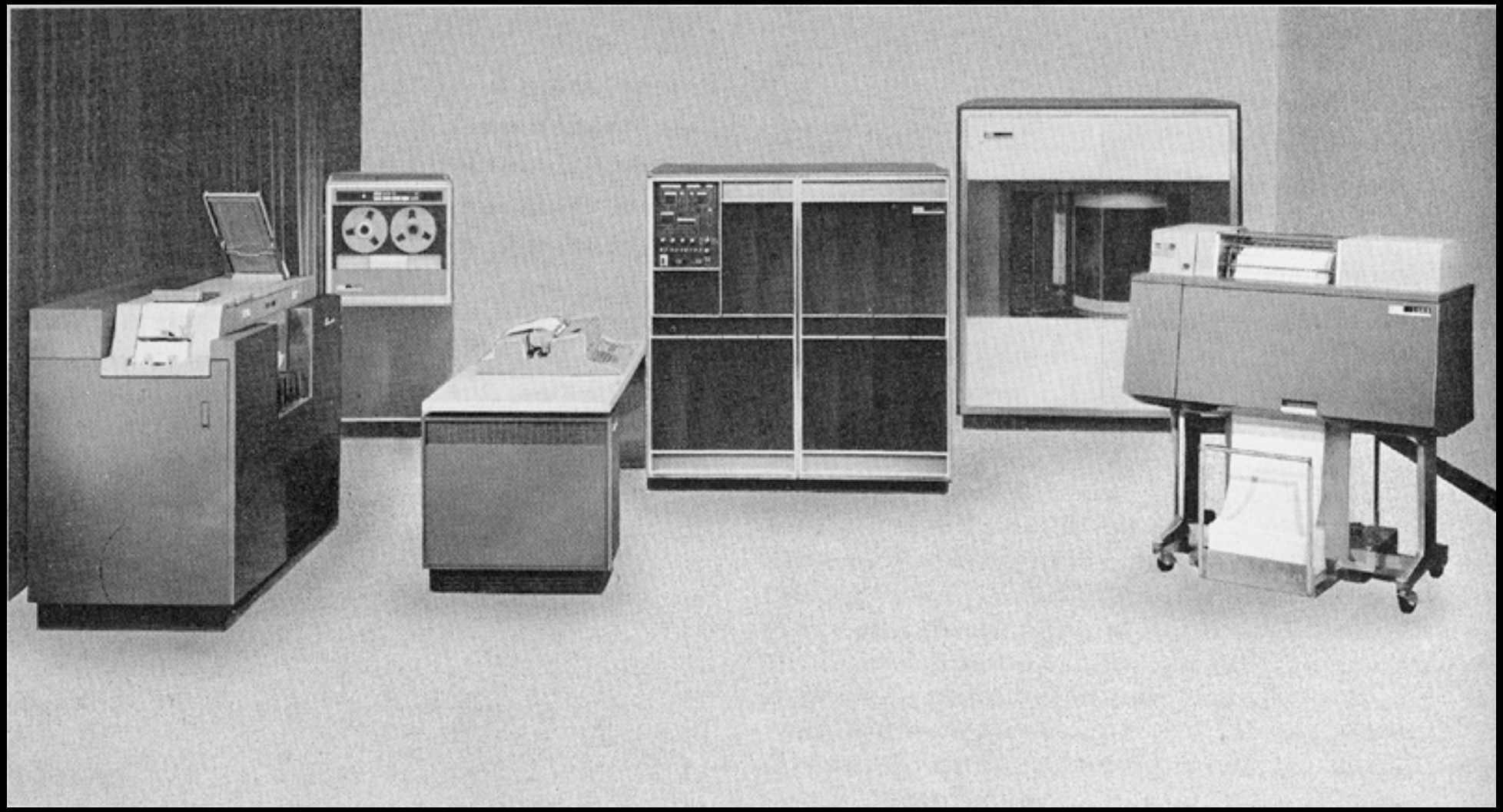

Herman Hollerith's Holerith card as shown in the *Railroad Gazette* in 1895



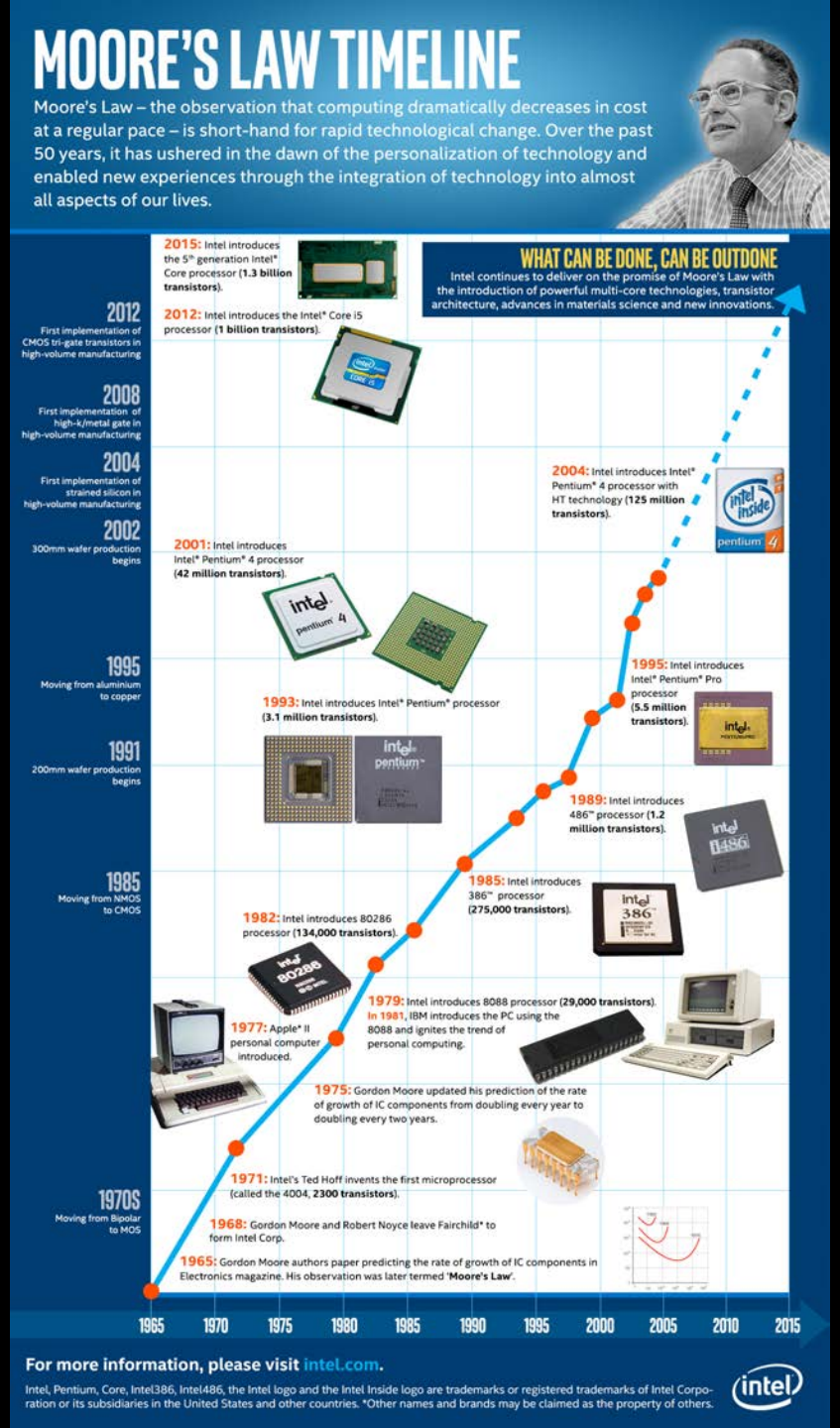

A general-purpose punched card from the mid twentieth century.




Card from a Fortran program: Z(1) = Y + W(1)



IBM 1401 Data Processing System, 1959




# MOORE'S LAW

Named for Gordon Moore (b. 1929). It is the idea that the number of transistors in a dense integrated circuit doubles approximately every two years. He developed this idea in a 1965 paper.

# 1 The accelerating pace of change ...

Agricultural Revolution ← 8,000 years → Industrial Revolution ← 120 years → Light-bulb ← 90 years → Moon landing ← 22 years → World Wide Web ← 9 years → Human genome sequenced

# 2 ... and exponential growth in computing power ...

Computer technology, shown here climbing dramatically by powers of 10, is now progressing more each hour than it did in its entire first 90 years

# 3 ... will lead to the Singularity

**2045**
Surpasses brainpower equivalent to that of all human brains combined

Surpasses brainpower of human in 2023

Surpasses brainpower of mouse in 2015

**Colossus**
The electronic computer, with 1,500 vacuum tubes, helped the British crack German codes during WW II

**UNIVAC I**
The first commercially marketed computer, used to tabulate the U.S. Census, occupied 943 cu. ft.

**Apple II**
At a price of $1,298, the compact machine was one of the first massively popular personal computers

**Power Mac G4**
The first personal computer to deliver more than 1 billion floating-point operations per second

**Analytical engine**
Never fully built, Charles Babbage's invention was designed to solve computational and logical problems

## COMPUTER RANKINGS

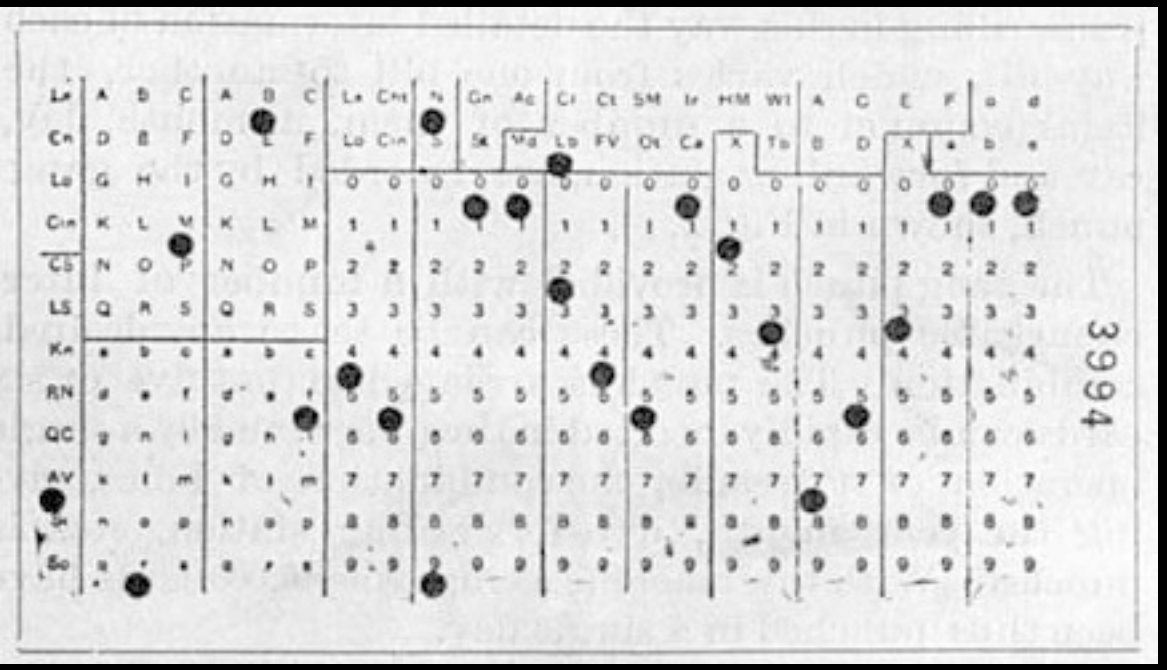
By calculations per second per $1,000

$10^{26}$
$10^{20}$
$10^{15}$
10,000,000,000
100,000
1
0.00001

Hollerith Tabulator
IBM Tabulator
National Ellis 3000
Zuse 2
Zuse 3
ENIAC
BINAC
IBM SSEC
Whirlwind
EDVAC
Datamatic 1000
IBM 1620
DEC PDP-4
IBM 1130
DEC PDP-10
Data General Nova
Intellec-8
IBM PC
Compaq Deskpro 386
Pentium PC
Pentium II PC
Dell Dimension 8400
Mac Pro
Nvidia Tesla GPU & PC

ELECTROMECHANICAL → RELAYS → VACUUM TUBES → TRANSISTORS → INTEGRATED CIRCUITS →

1900 1920 1940 1960 1980 2000 2011 2020 2045

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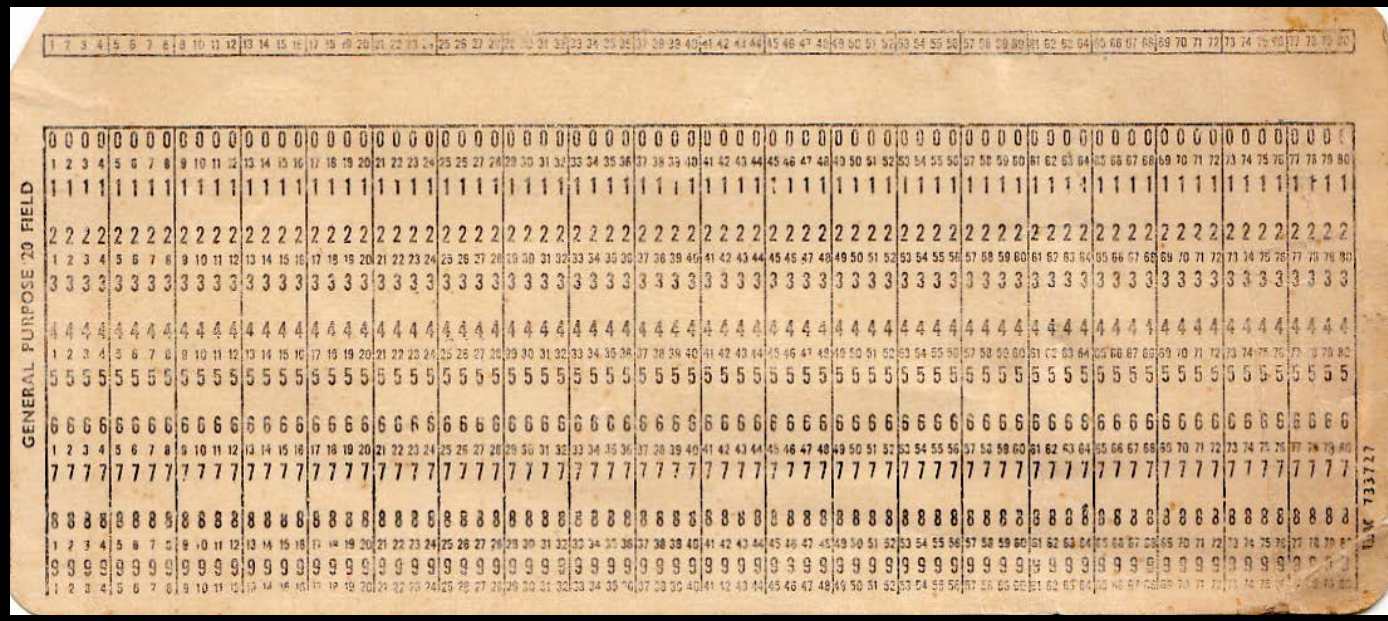


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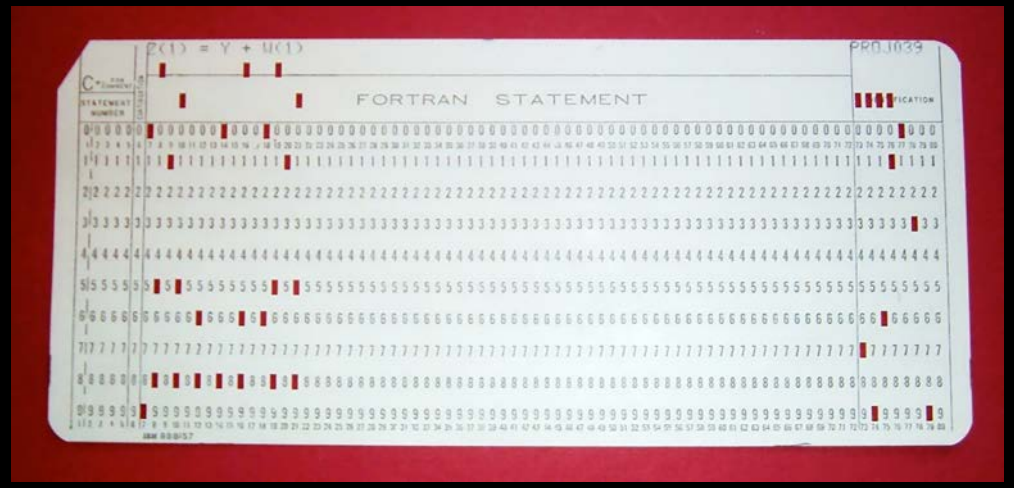
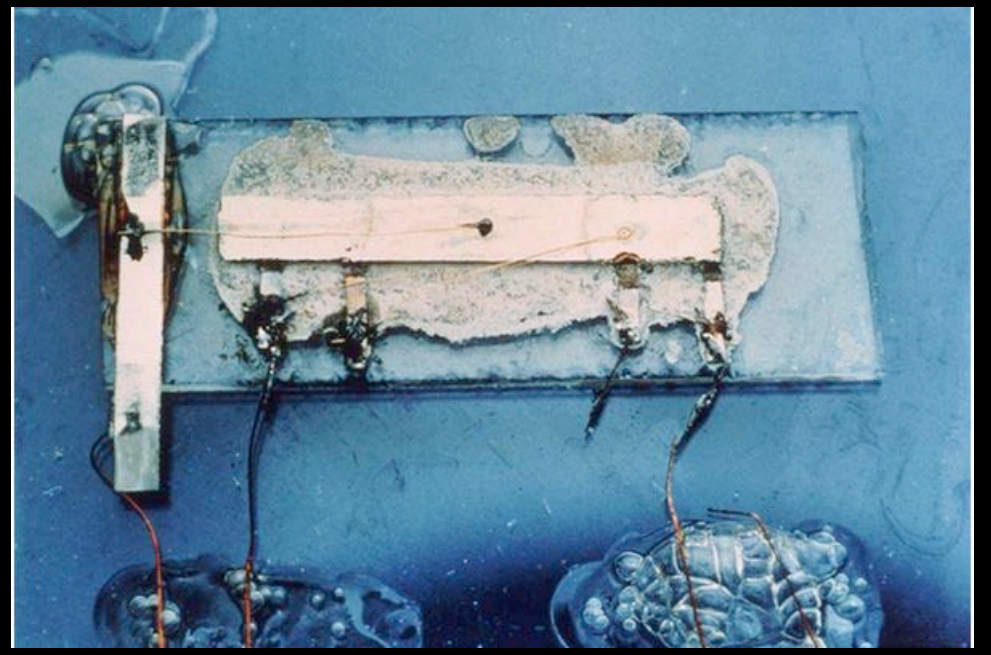
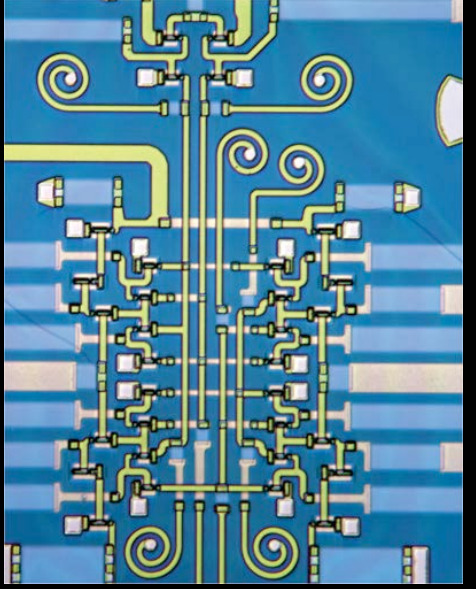



Card from a Fortran program: Z(1) = Y + W(1)

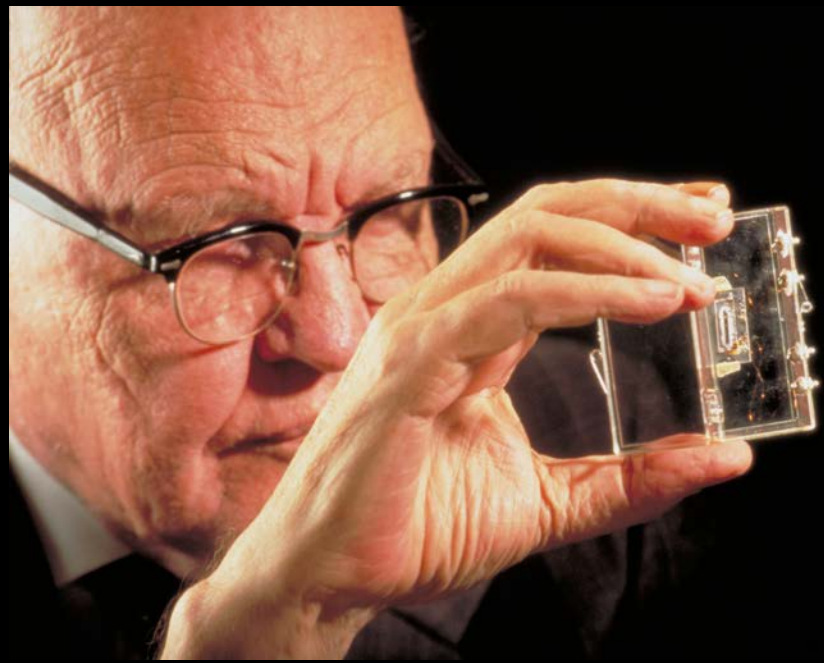
The Bell Labs team of John Bardeen, Walter Brattain and William Shockley won the 1956 Nobel Prize in Physics for their work in developing transistors.



Jack Kilby's original integrated circuit created at Texas Instruments, 1958

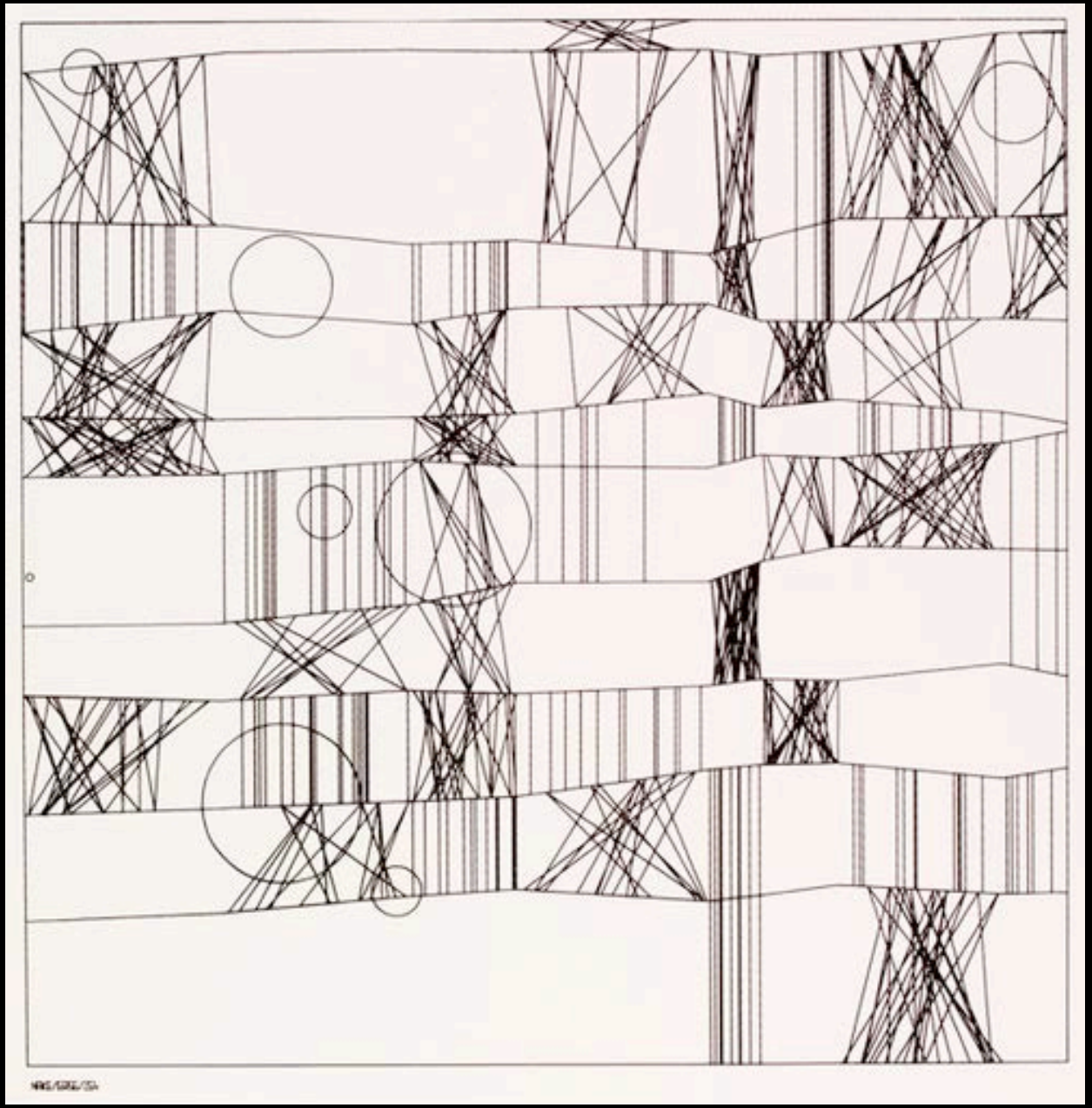


Integrated Circuit 1958

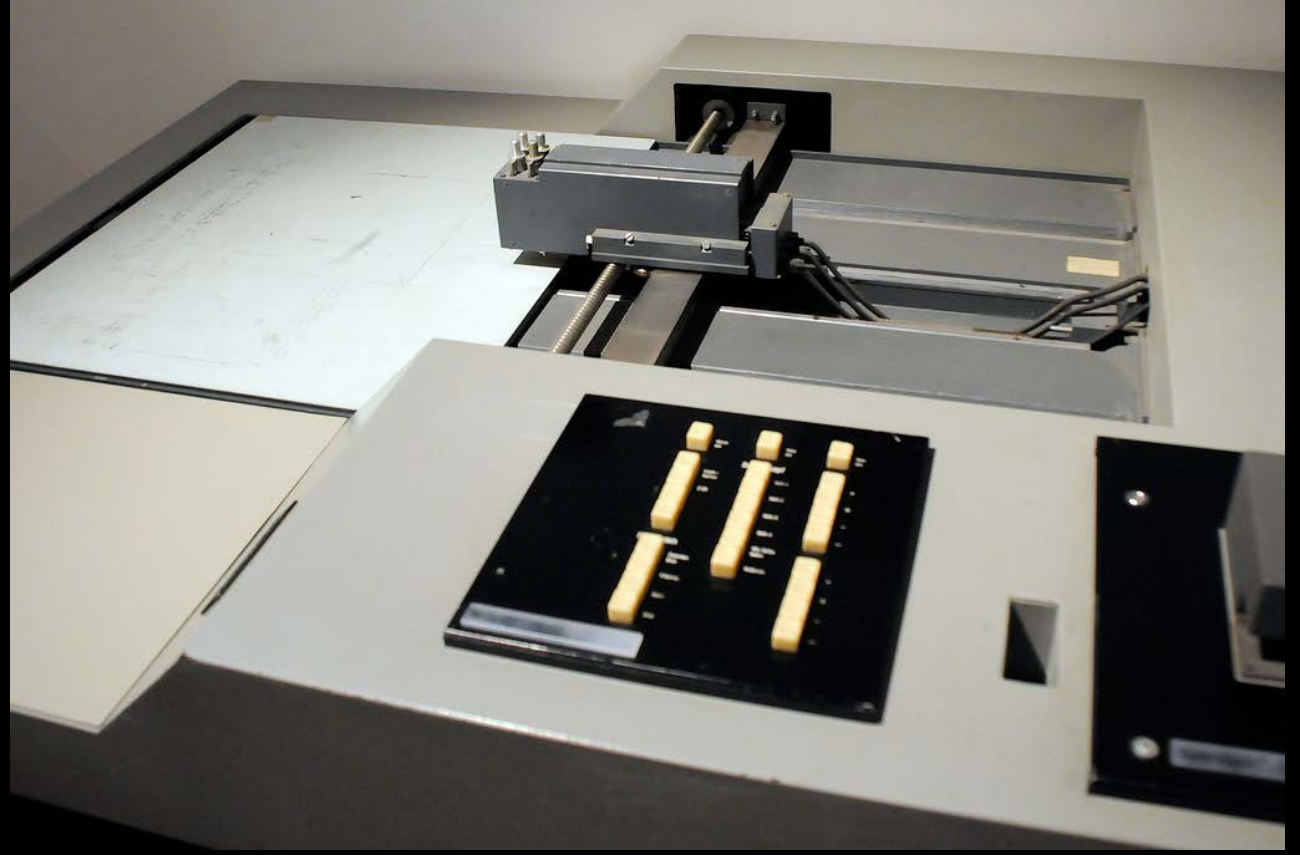


Untitled photographs by Jack Kilby, c. 1955

Microprocessors and personal computers, 1970s



Frieder Nake, Homage to *Paul Klee* 13/9/65 No. 2, 1965

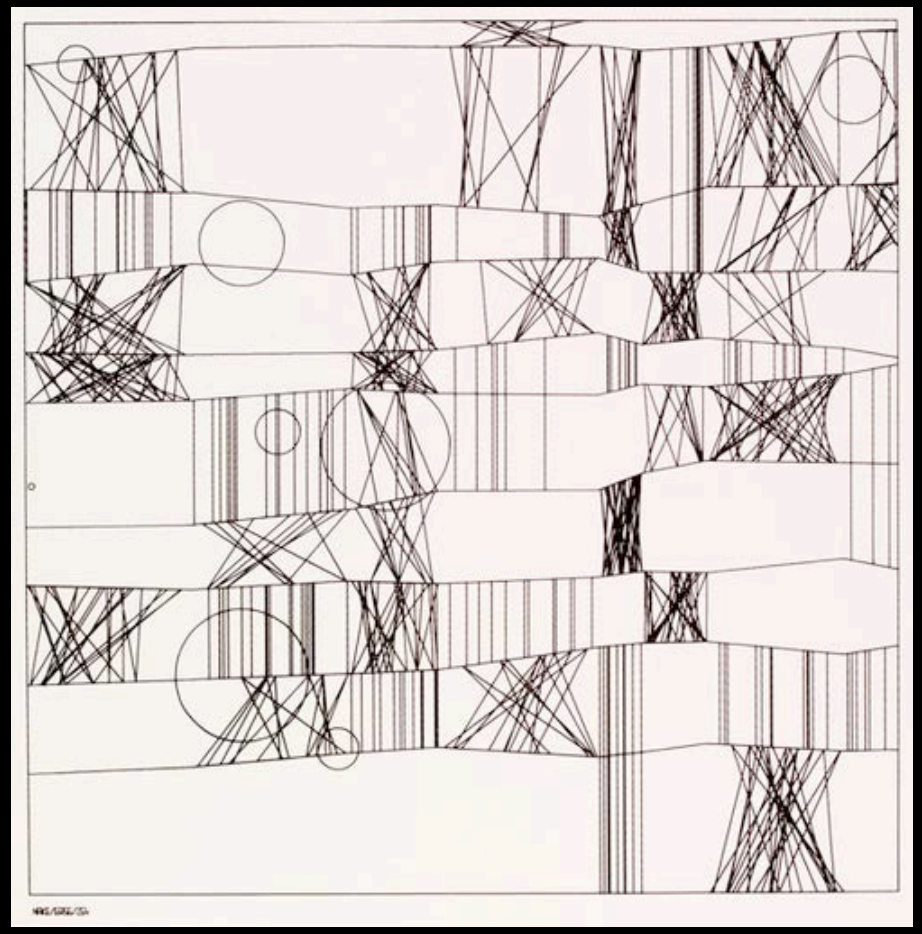


## ZUSE Graphomat Z 64

The ZUSE Graphomat Z64 was a flatbed drawing machine of high precision. Its engineer, famous computer pioneer Konrad Zuse, had originally intended it to be used for the production of maps and for land registration purposes. Both Georg Nees and Frieder Nake did their first computer art pieces on the Graphomat. This historic fact may be seen as a case of an unintended use of a technical innovation. 'The Graphomat Z64 was fully based on transistor technology. It was controlled by a code that had to be input on punch tape or punch cards. The machine was first presented in 1961 at the Hannover Fair. Even though the first set of machines was ordered within a relatively short period of time, it did not become a great financial success.

http://dada.compart-bremen.de/item/device/5

Paul Klee, Haupt- und Nebenwege [Main and Sideways], 1929

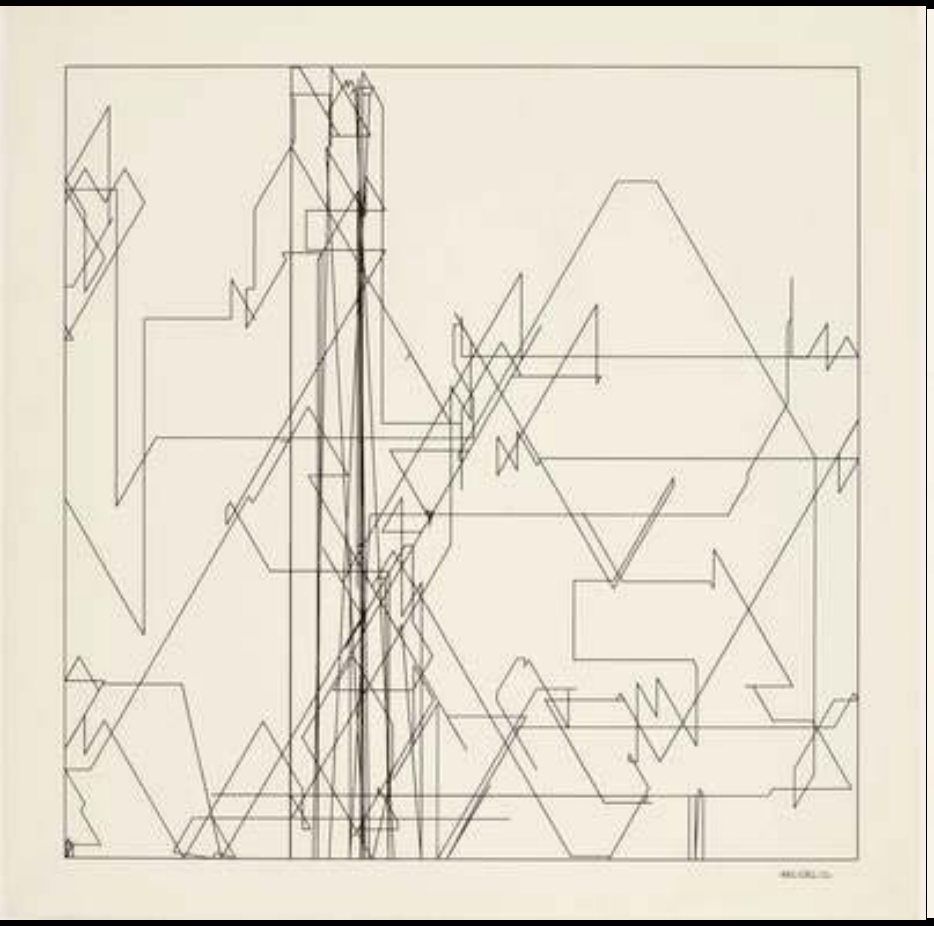


Frieder Nake, Hommage to *Paul Klee* 13/9/65 No. 2, 1965

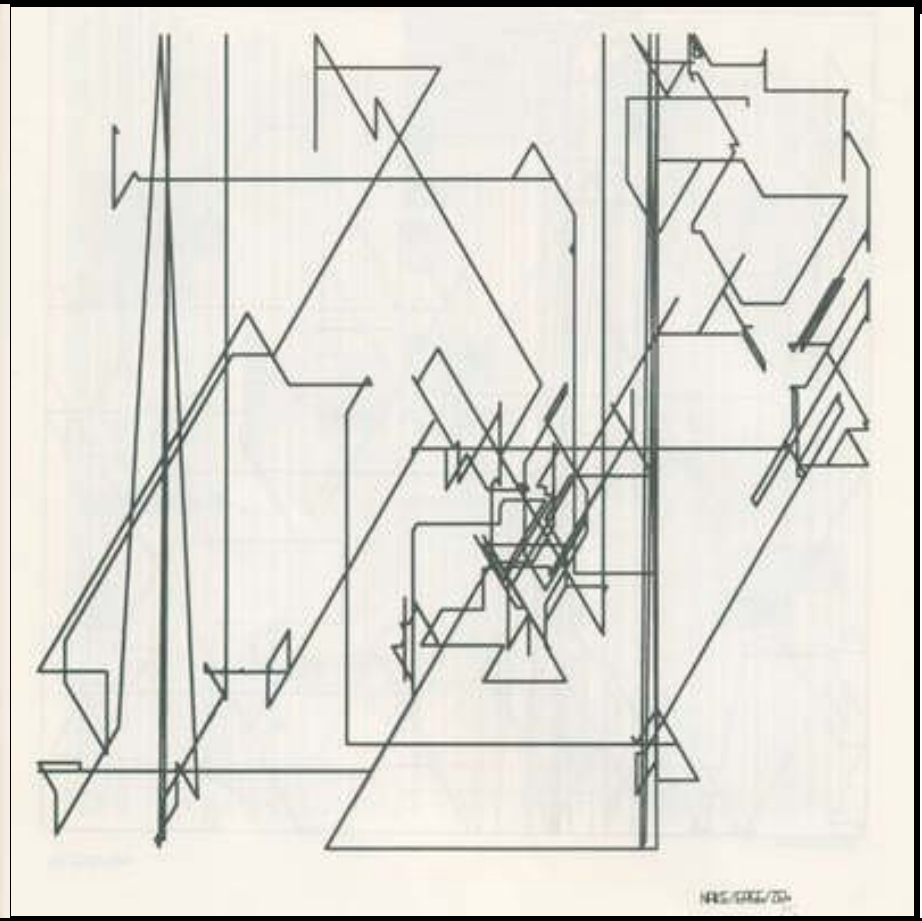
# Algorithms in Art

algorithm, noun: a procedure for solving a mathematical problem in a finite number of steps that frequently involves repetition of an operation; *broadly* :  a step-by-step procedure for solving a problem or accomplishing some end especially by a computer

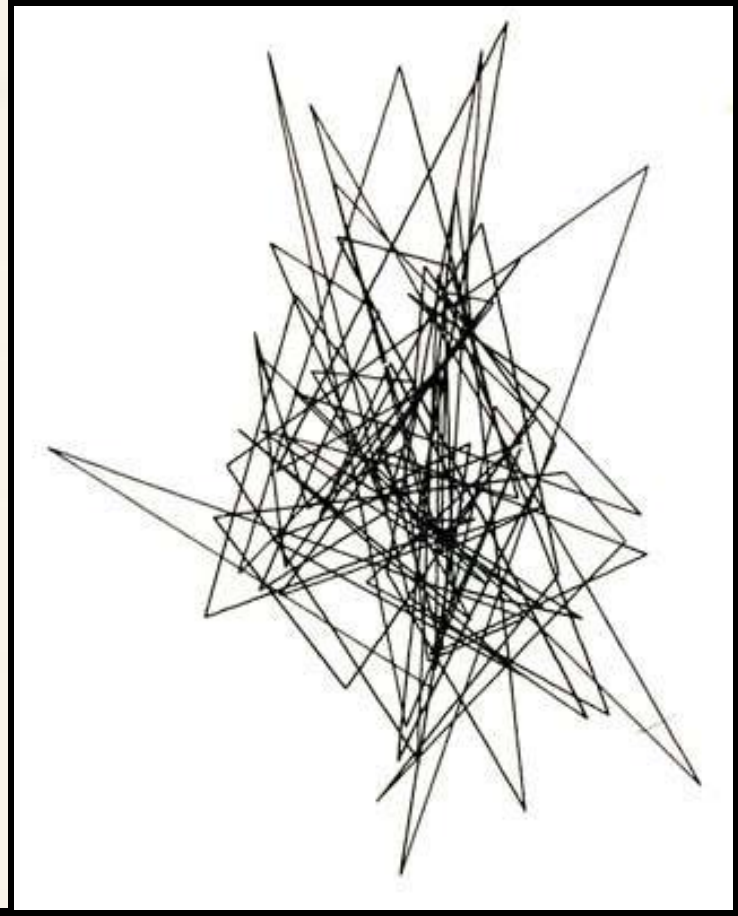
Etymology: 1690s, "Arabic system of computation," from French algorithme, refashioned (under mistaken connection with Greek arithmos "number") from Old French algorisme "the Arabic numeral system" (13c.), from Medieval Latin algorismus, a mangled transliteration of Arabic **al-Khwarizmi** "native of Khwarazm" (modern Khiva in Uzbekistan), surname of the mathematician whose works introduced sophisticated mathematics to the West



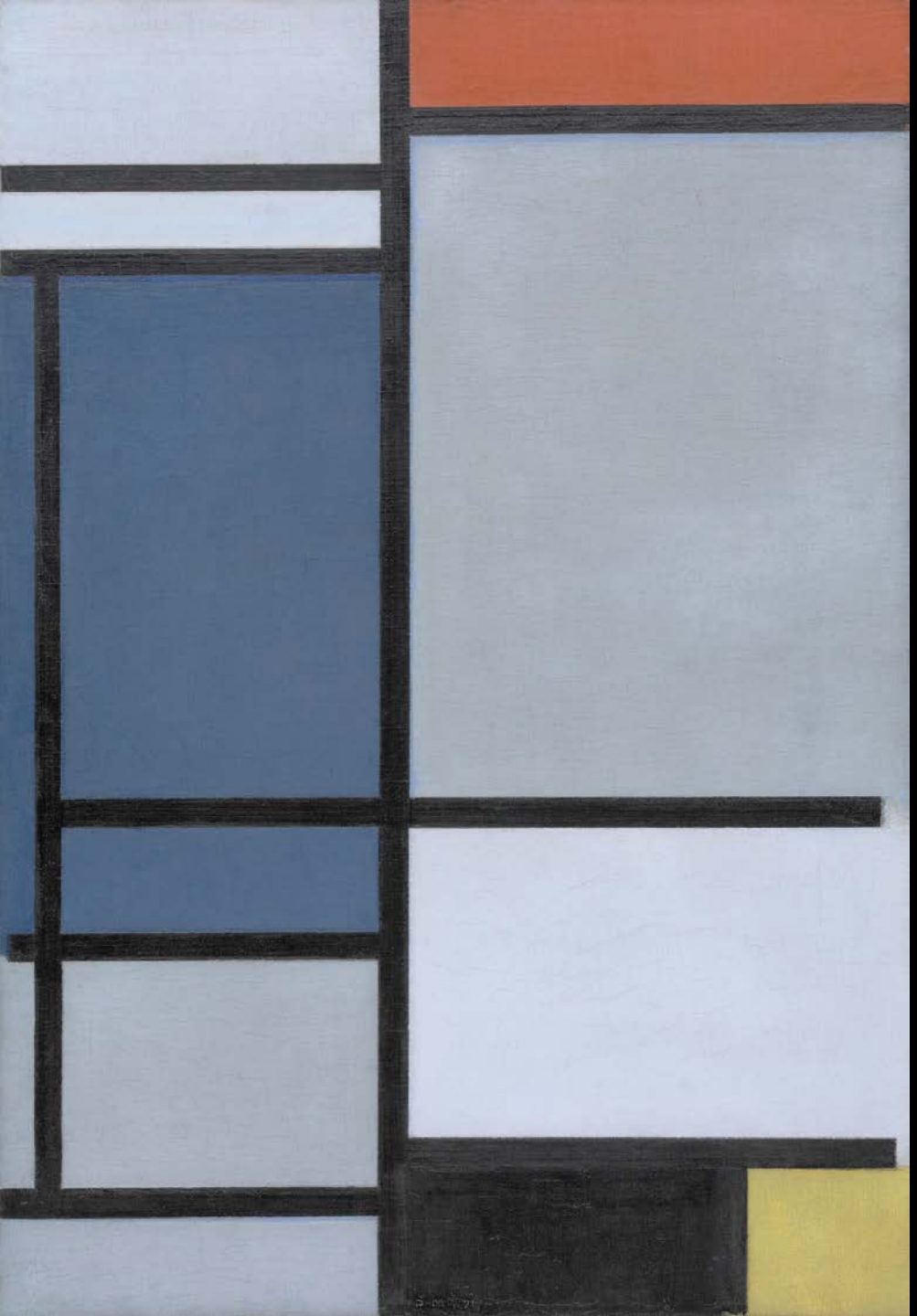
Frieder Nake, Random Polygon, 1965



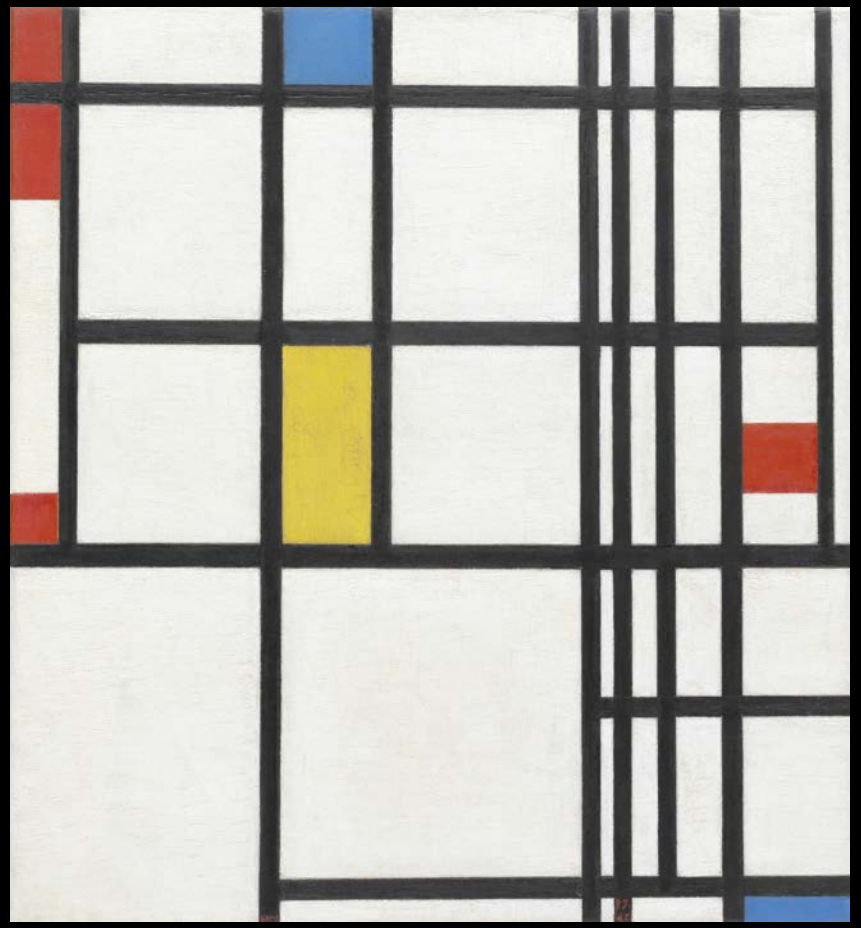
Frieder Nake, Polygonal Course No. 7, 1965



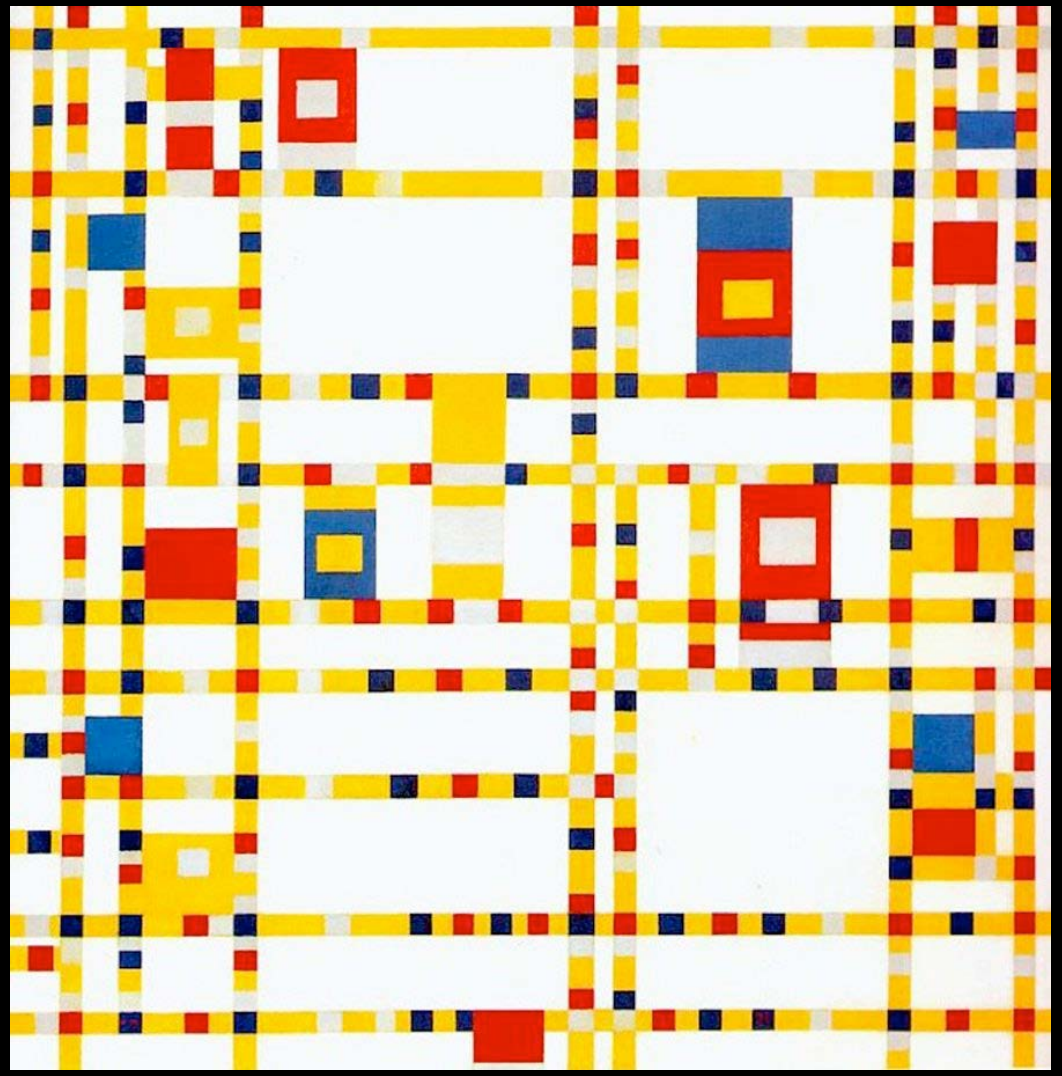
Frieder Nake, Polygonal Course No. 20, 1965



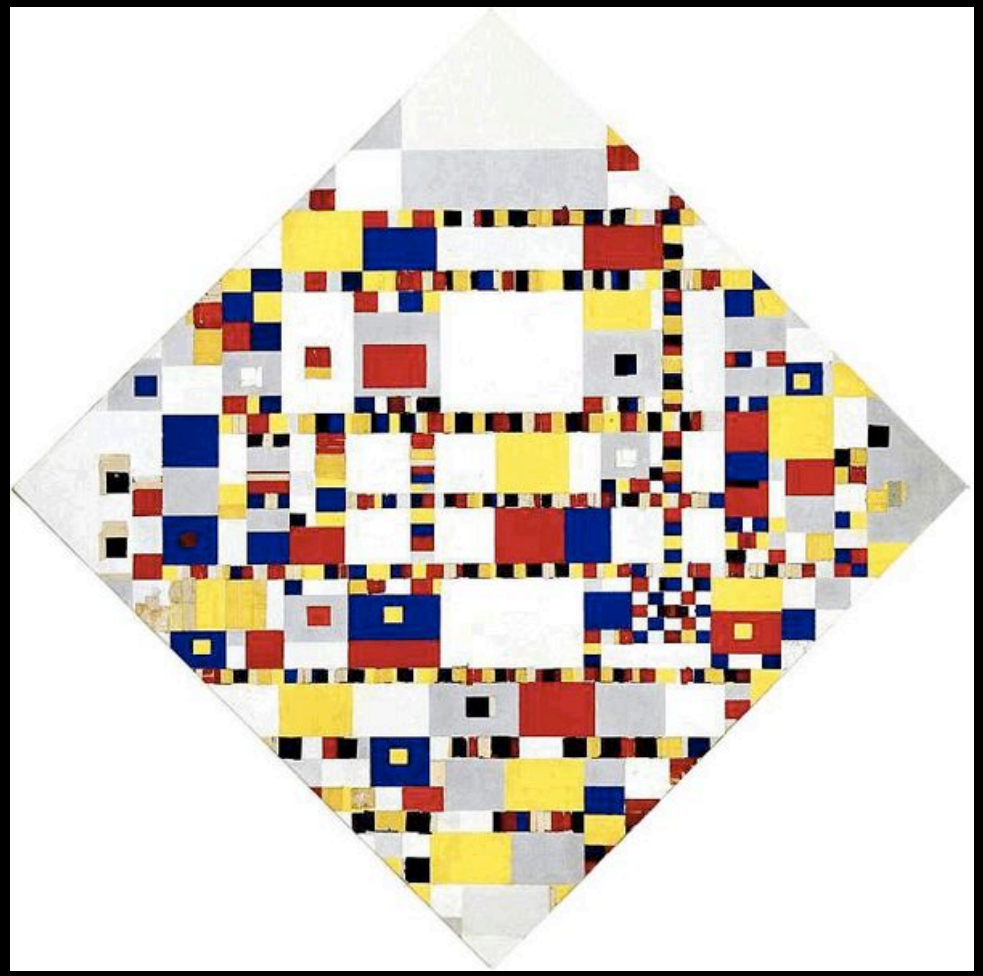
Piet Mondrian,
Composition
with Red, Blue,
Black, Yellow,
and Gray,
1921



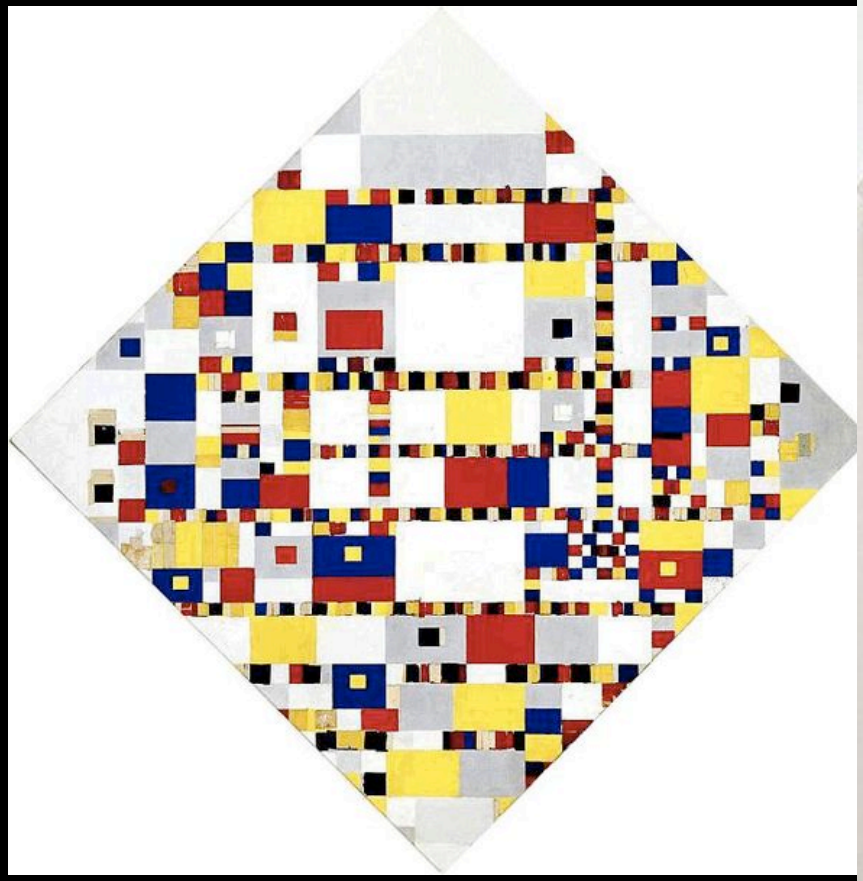
Piet Mondrian, *Composition in Red, Blue, and Yellow,* 1937-42

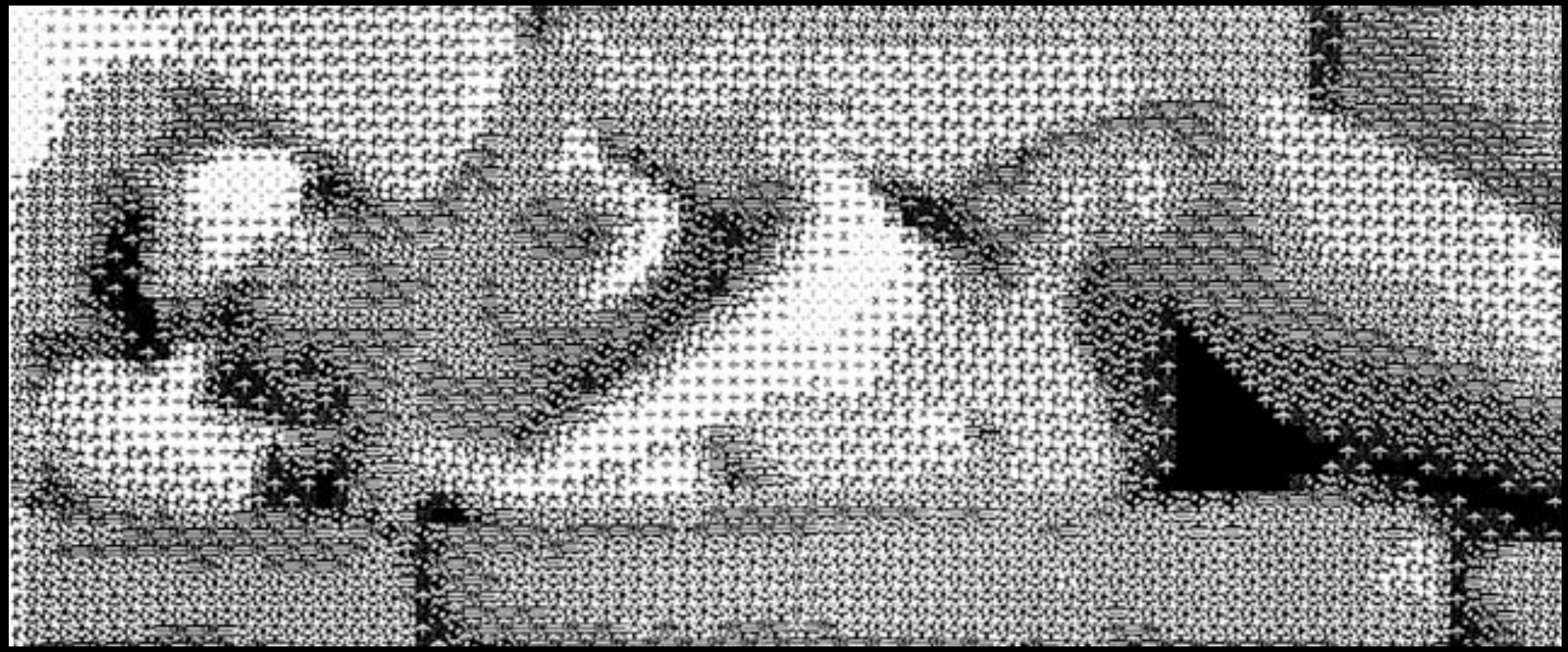


Piet Mondrian, Broadway Boogie Woogie, 1942-43

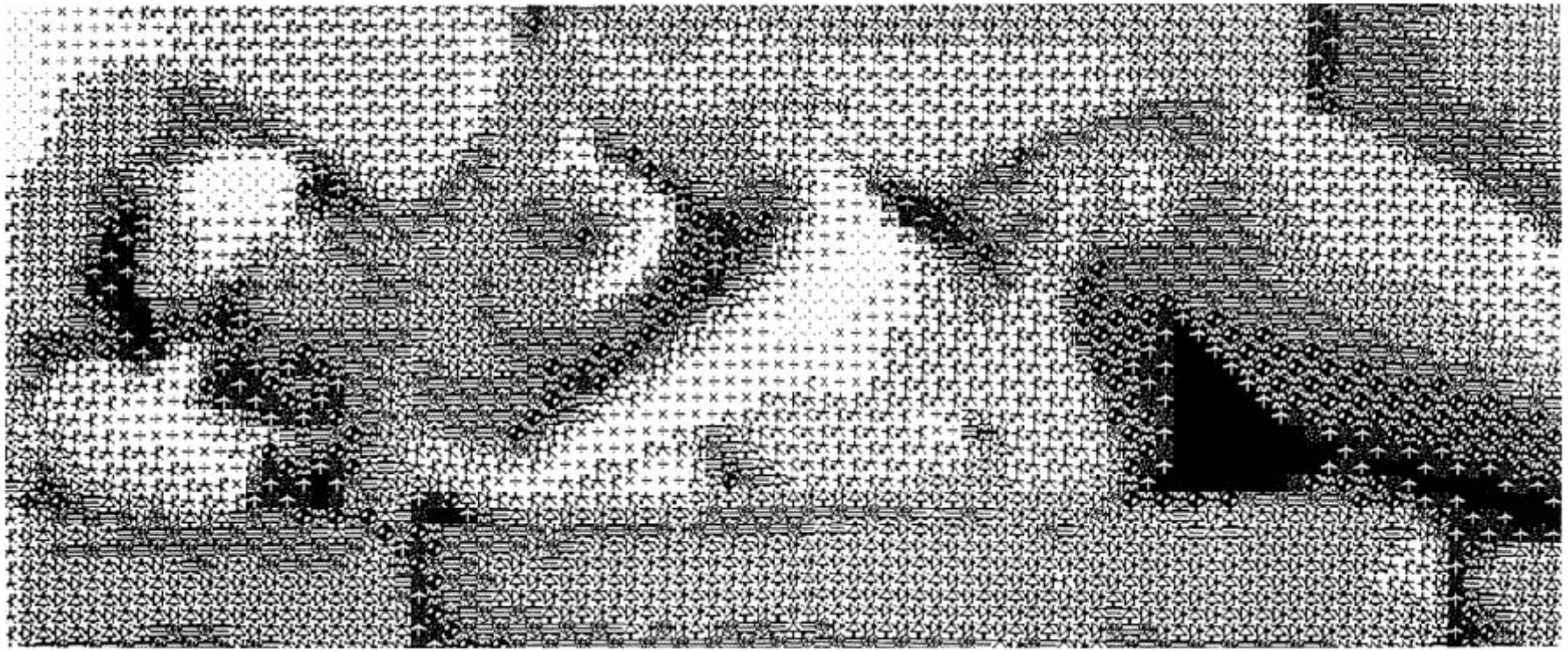


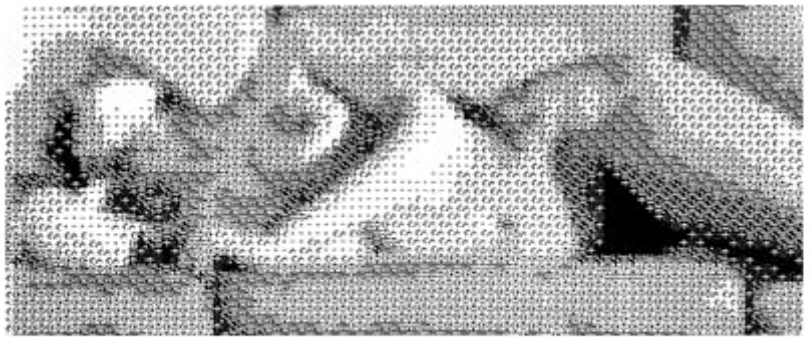
Piet Mondrian, Victory Boogie Woogie, 1943-44





Kenneth Knowlton and Leon Harmon, Studies in Perception 1, 1966





Studies in Perception #1. Computer-produced mural, as shown in the 10/11/67 New York Times, and the 1968 MOMA Machine Show, 5x10 feet, © Leon Harmon & Ken Knowlton, 1966.

The New York Times

L+++ 49

# Art and Science Proclaim Alliance in Avant-Garde Loft

By HENRY R. LIEBERMAN

In a sound-drenched Lower Manhattan loft building that was enlivened by revolving painted disks, film projections, floating pillows and miniskirted girls in paper smocks, representatives of industry and labor joined a number of artists and scientists yesterday to proclaim a "working alliance" between art and technology.

This modest and uncertain merger seeks to bridge the gap between the two worlds. It is intended to bring modern technological tools to the artist for creating new art forms and fresh insights and viewpoints to the engineer for creating a "people-oriented" technology.

The event was celebrated at a news conference "happening" in the six-story loft building at 381 Lafayette Street used for studio purposes by Robert Rauschenberg, the avant-garde artist.

**Kheel's 'Biggest Mediation'**

Mr. Rauschenberg, along with Dr. Billy Klüver, an electronics engineer who is specializing in laser research at the Bell Laboratories, and Theodore W. Kheel, the lawyer-labor mediator, are prime movers in the art-technology merger.

with a device operating like a television camera.

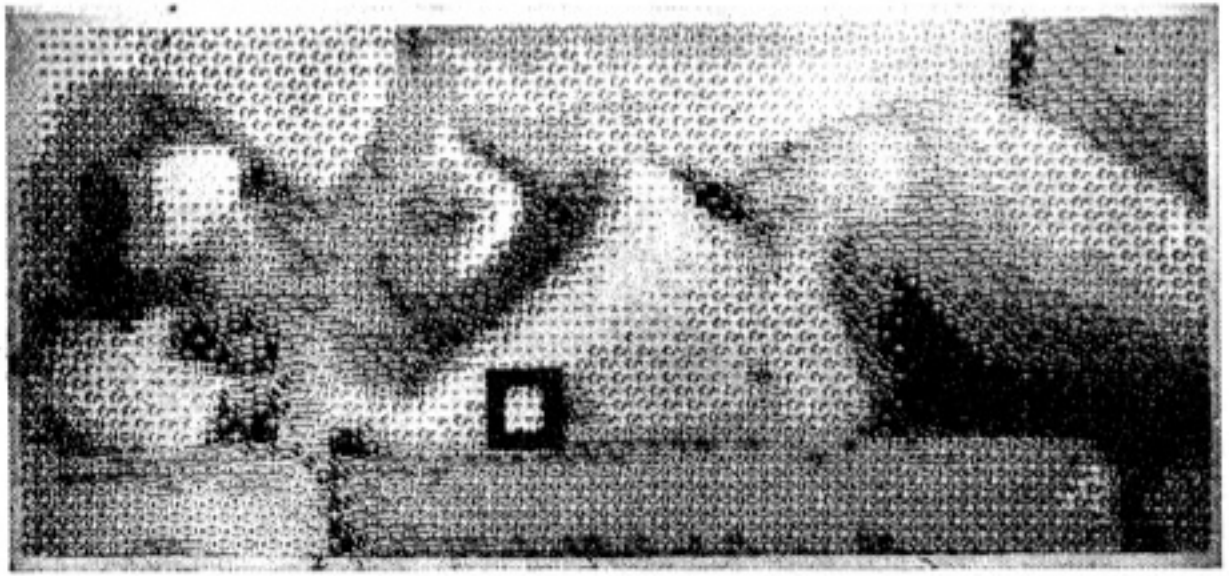
The information on the transparency was then stored on magnetic tape in the form of pulses standing for digits, with the brightness level of the picture elements represented by numbers ranging from 0 to 7. After processing all the numbers, the computer printed a drawing of micropatterns formed by clusters of symbols used in electronic design.

Visitors at the studios were intrigued by a sculptural representation of a woman taking a shower. As droplets of water dripped from the shower-head in a white stall, moving-picture images of the woman were registered by a projector behind the stall on a sand-blasted Plexiglass panel.

**Rauschenberg's 'Oracle'**

Another sculptural construction was a sound-emitting assembly consisting of a tire, truck door, window frame, bathtub and air vent. This is Mr. Rauschenberg's "Oracle."

Five radios are used, with the tuning dial of each being rotated by motor. Thus, each radio picks up snatches of the broadcasts of all the local



Drawing of nude above was generated by a computer under direction of L. D. Harmon and K. C. Knowlton, engineers. Black square encloses the detail shown.

contribution dollar that goes to the arts."

"Along with its obligation to be a profit-maker for its owners, the modern business corporation has an obligation to be a good citizen in the community," he said. "As a basic part of this obligation, the corporation must examine carefully its responsibility to

dividuals in seeking to make "valuable contributions."

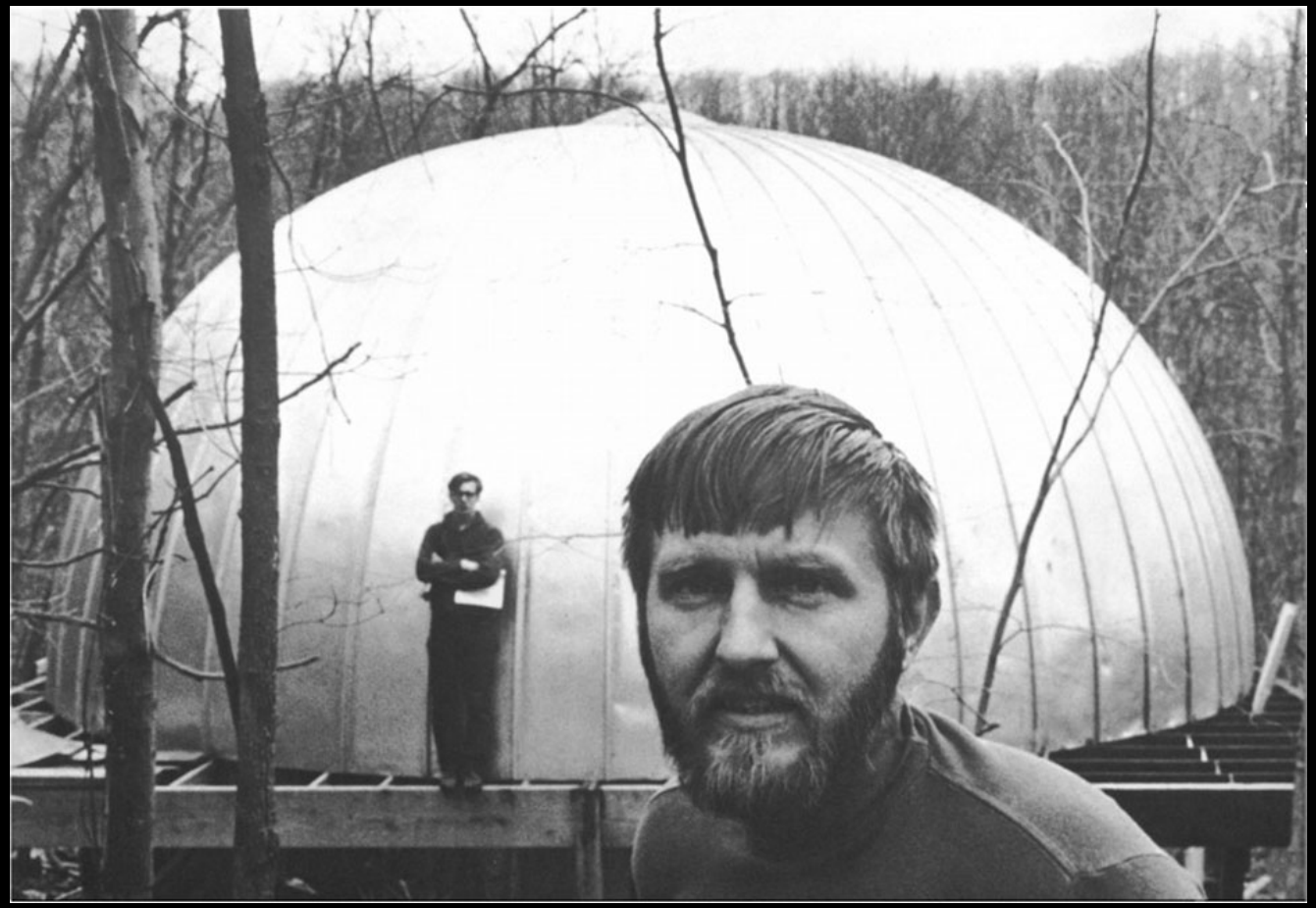
He noted that union members were also consumers, members of audiences and citizens concerned with the quality of society.

The event served to dramatize a drive to win organizational support for the art-technology merger and to mark the transfer of Experi-

with human problems caused by automation — notably the problem of individual "isolation."

Dr. Brodey, who heads M.I.T.'s science camp for underprivileged youngsters, noted that new technologies had opened large new areas of creativity. While the in-

Stan Vanderbeek and Ken Knowlton, Poem Field No. 2, Life LIke, 1967
https://www.youtube.com/watch?v=V4agEv3Nkcs



Stan VanDerBeek, Movie-Drome, 1957-1969

Influenced by Buckminster Fuller's spheres, VanDerBeek had the idea for a spherical theater where people would lie down and experience movies all around them. Floating multi-images would replace straight one-dimensional film projection. From 1957 on, VanDerBeek produced film sequences for the Movie-Drome, which he started building in 1963. His intention went far beyond the building itself and moved into the surrounding biosphere, the cosmos, the brain and even extraterrestrial intelligence.

http://www.medienkunstnetz.de/works/movie-drome/

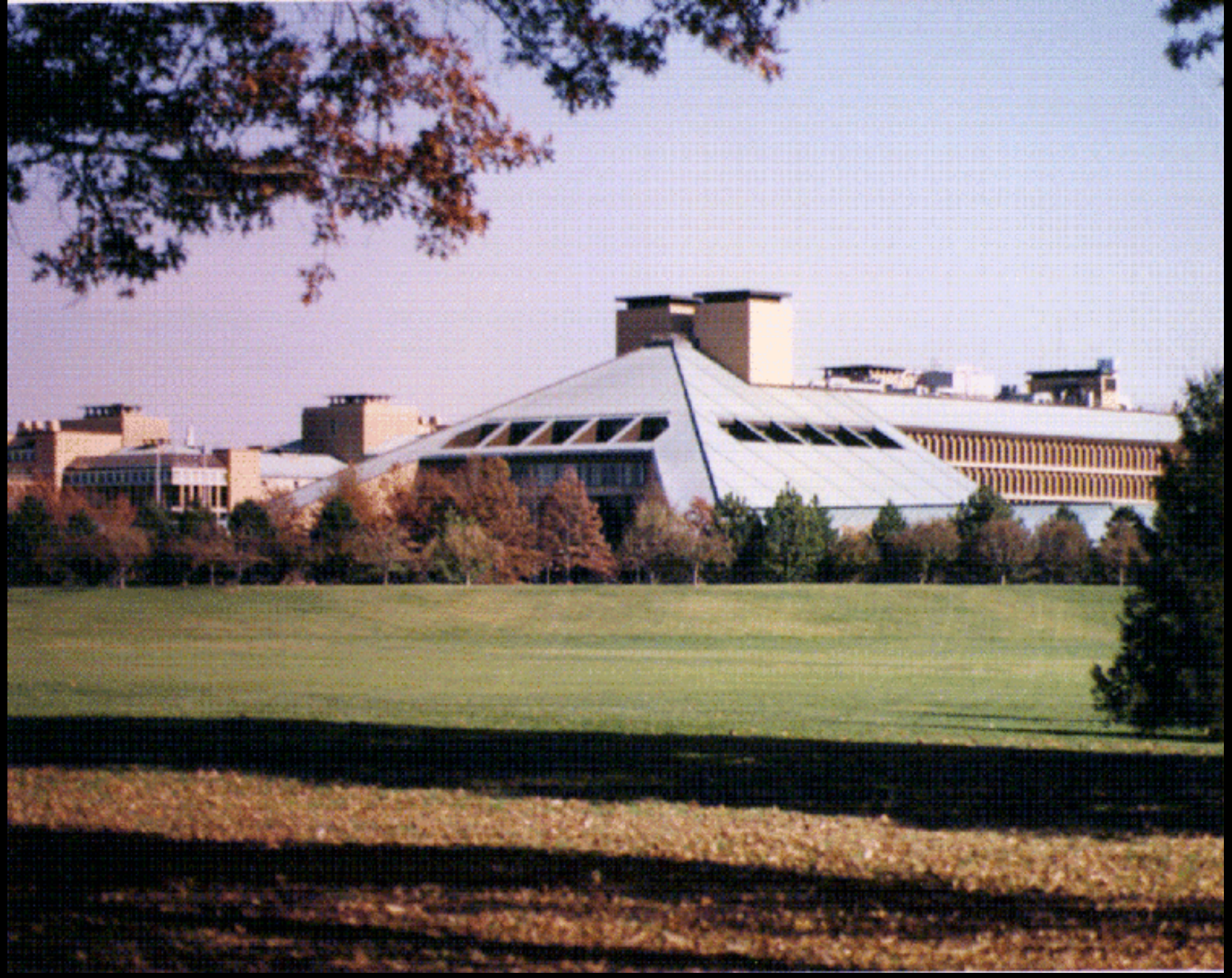
# Collage and animation

**Stan Vanderbeek - (1959) - Science Friction**
**https://www.youtube.com/watch?v=ZRcppZ5Sg7I**

**Stan Vanderbeek - (1960) - Achooo Mr. Kerrooschev**

https://www.youtube.com/watch?v=C-1rQ_76seI

Stan Vanderbeek and Ken Knowlton, Poem Field No. 2, Life LIke, 1967
https://www.youtube.com/watch?v=V4agEv3Nkcs

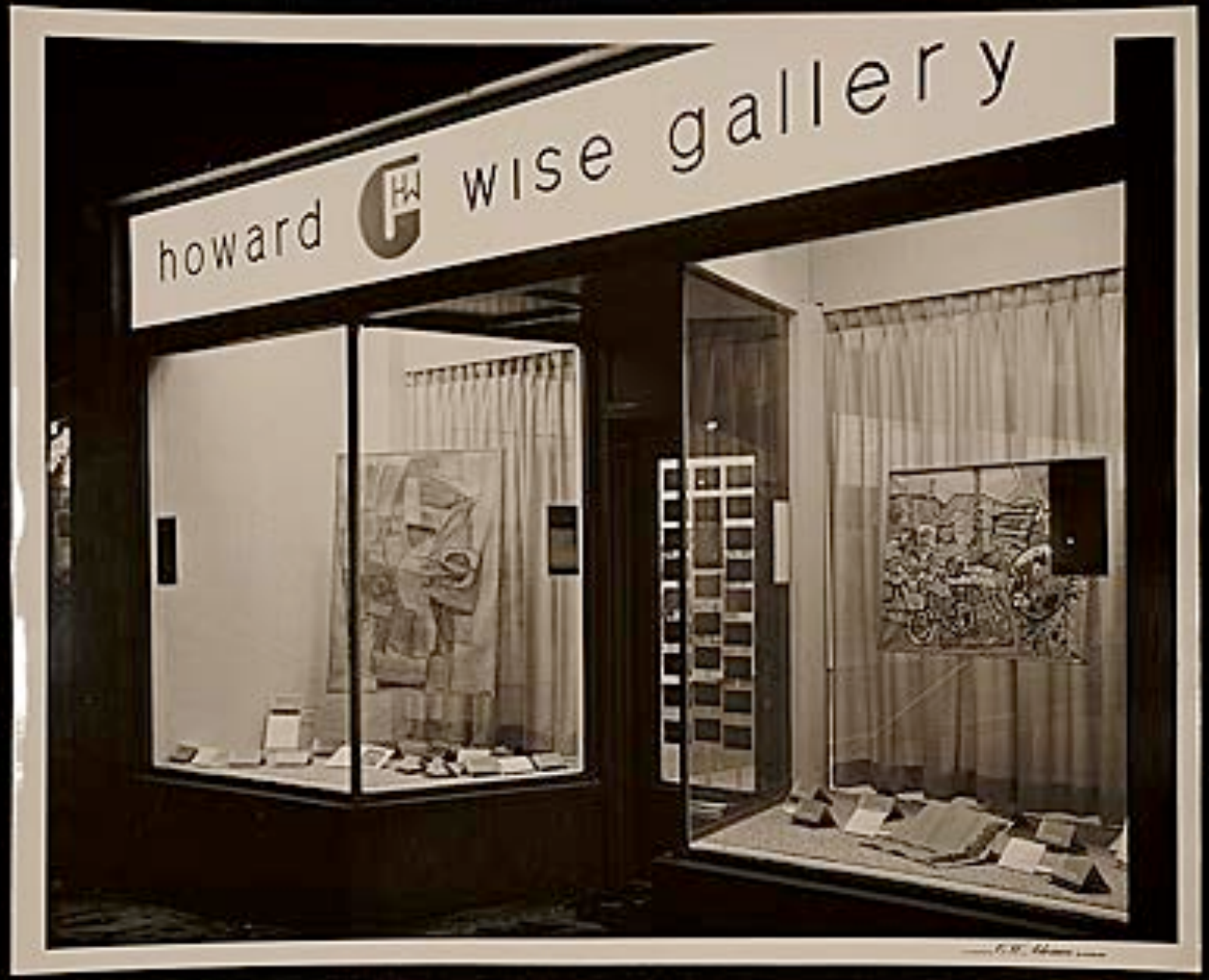


Bell Labs, Murray Hill, NJ

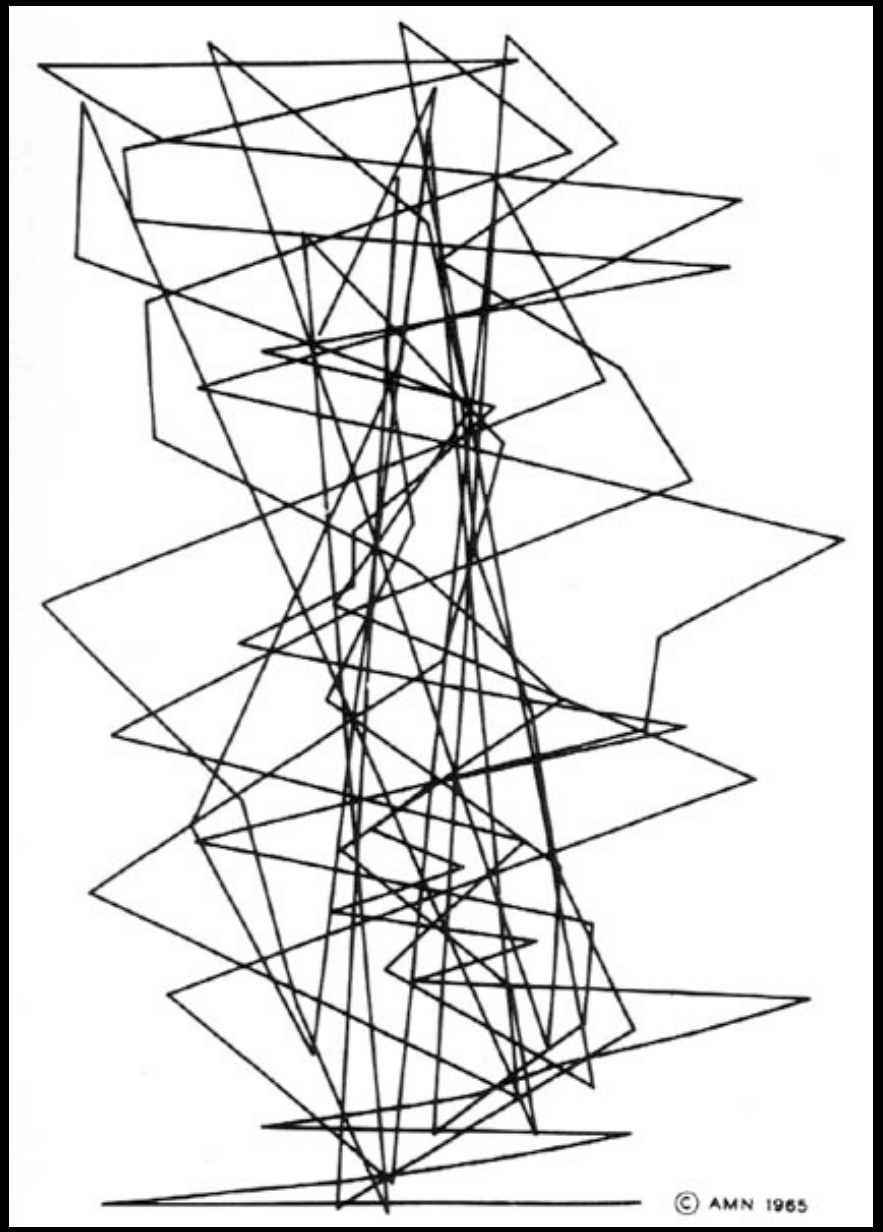
# R&D

[research and development]

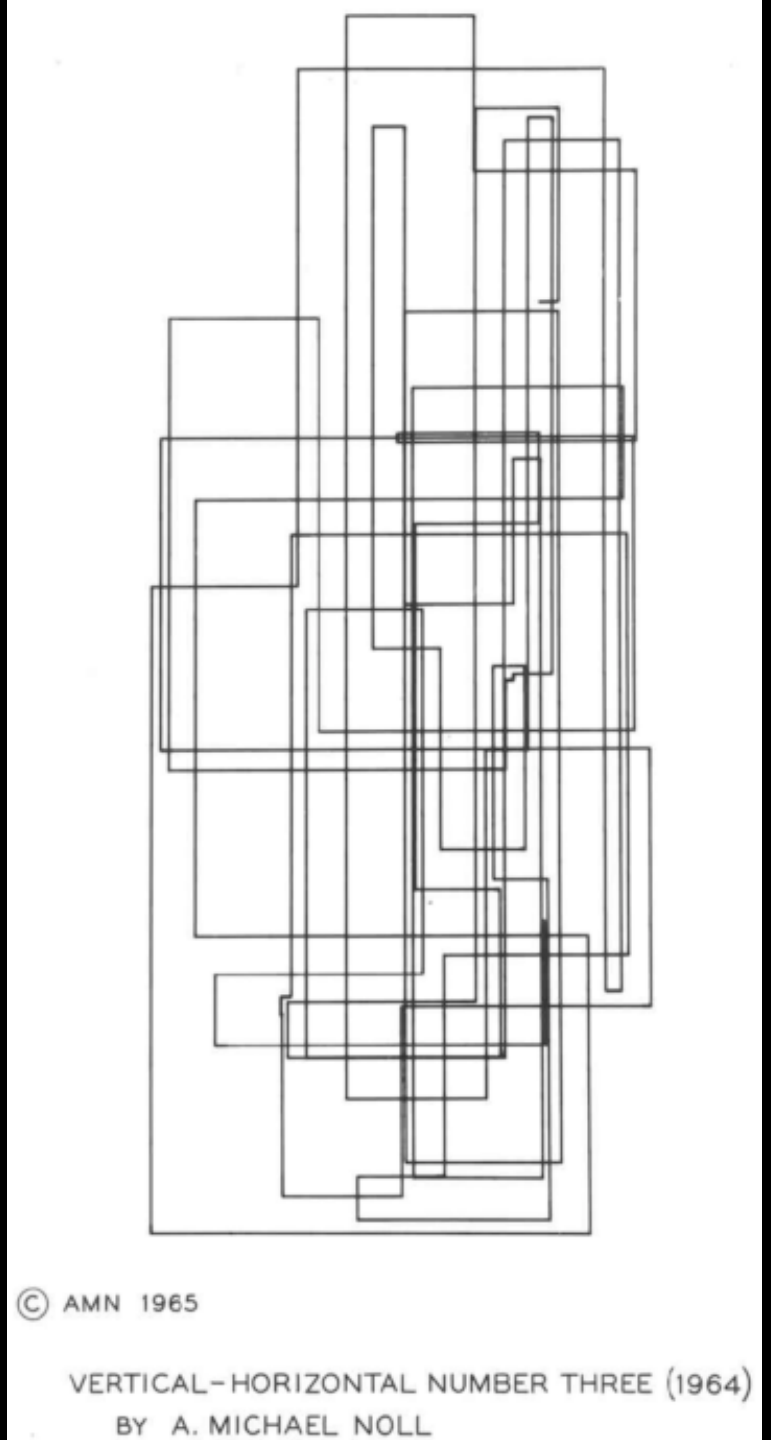
BELL LABS MEMOIRS:
Voices of Innovation
EDITED BY A. MICHAEL NOLL
AND MICHAEL GESELOWITZ


howard wise gallery

Exhibition of works by A. Michael Noll and Bela Julesz at the Howard Wise Gallery in New York City in 1965




A. Michael Noll, Gaussian Quadratic, 1962

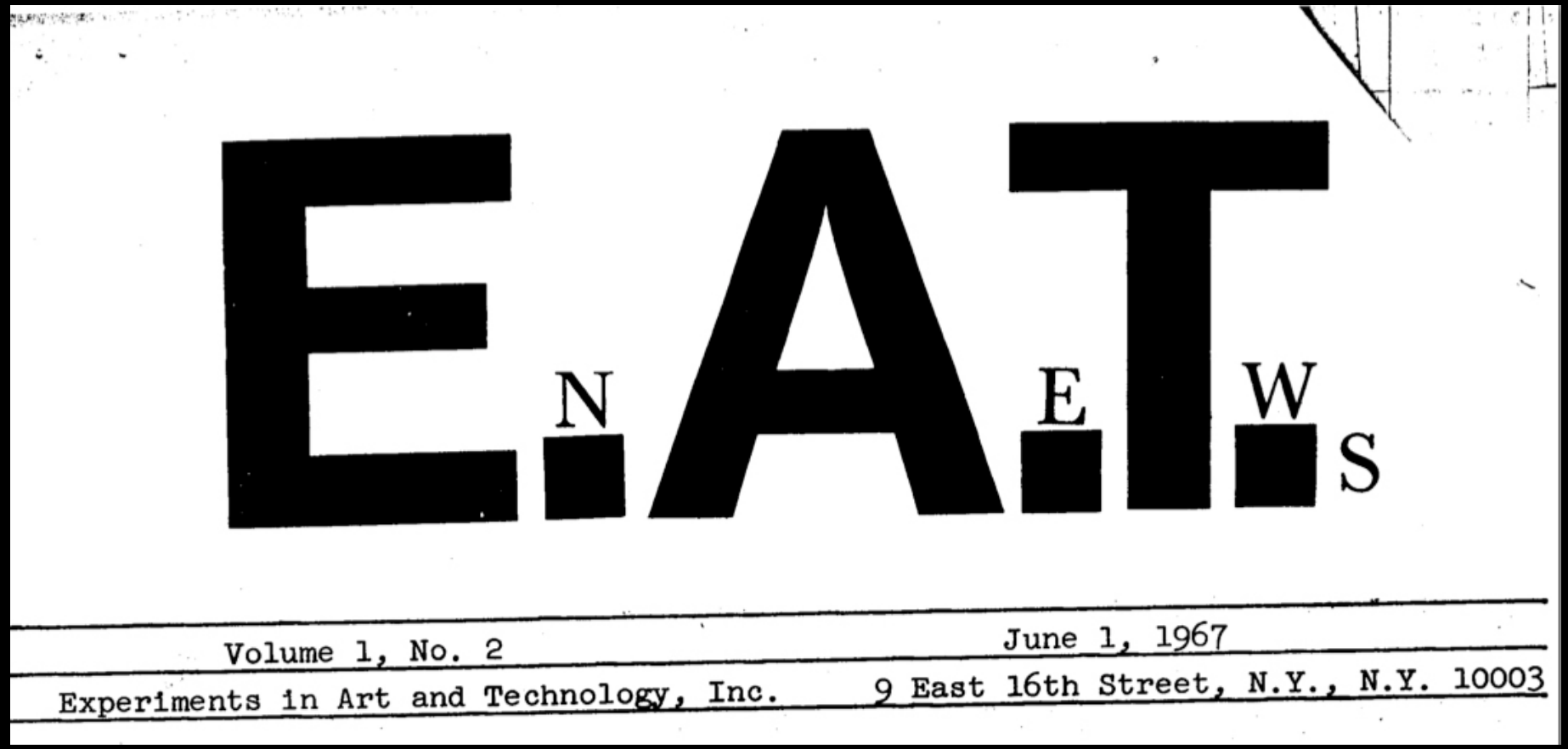


Mondrian

Noll

In the late 1960 and early 1970's, he constructed interactive three-dimensional input devices and displays and a three-dimensional, tactile, force-feedback ("feelie") device that were the forerunners of today's virtual-reality systems. He also was one of the first researchers to demonstrate the potential of scanned displays for computer graphics.

From A. Michael Noll’s website
http://noll.uscannenberg.org/




Experiments in Art and Technology was founded in 1966 by engineers Billy Klüver and Fred Waldhauer and artists Robert Rauschenberg and Robert Whitman.

**Billy Klüver, Fred Waldhauer, Robert Rauschenberg, John Cage, David Tudor, Yvonne Rainer, Deborah Hay, Robert Whitman, Steve Paxton, Alex Hay, Lucinda Childs and Öyvind Fahlström**

# E.A.T. PROJECTS OUTSIDE ART

December 8, 1969 — 235 Park Avenue South, New York, New York 10003

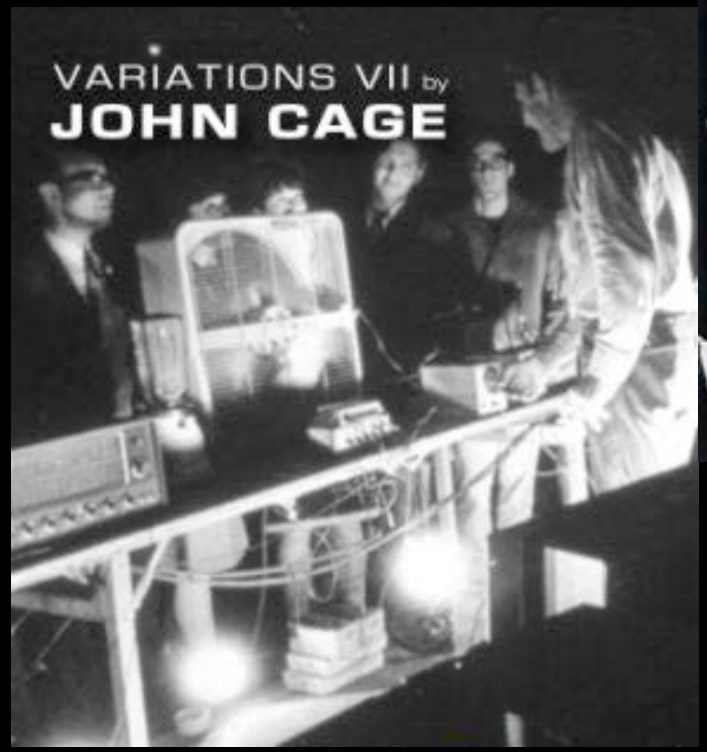
E.A.T. announces an exhibition, PROJECTS OUTSIDE ART – an exhibition of realizable projects in the environment – and requests submission of proposals.

Projects for the exhibition

–deal with such subjects as education, health, housing, concern for the natural environment, climate control, transportation, energy production and distribution, communication, food production and distribution, women's environment, cooking, entertainment, sports, etc.;

–use state-of-the-art technology;

–recognize, in particular, the scale adequate for the problem undertaken, social and ecological effects, organizational methods necessary for realizing the projects;



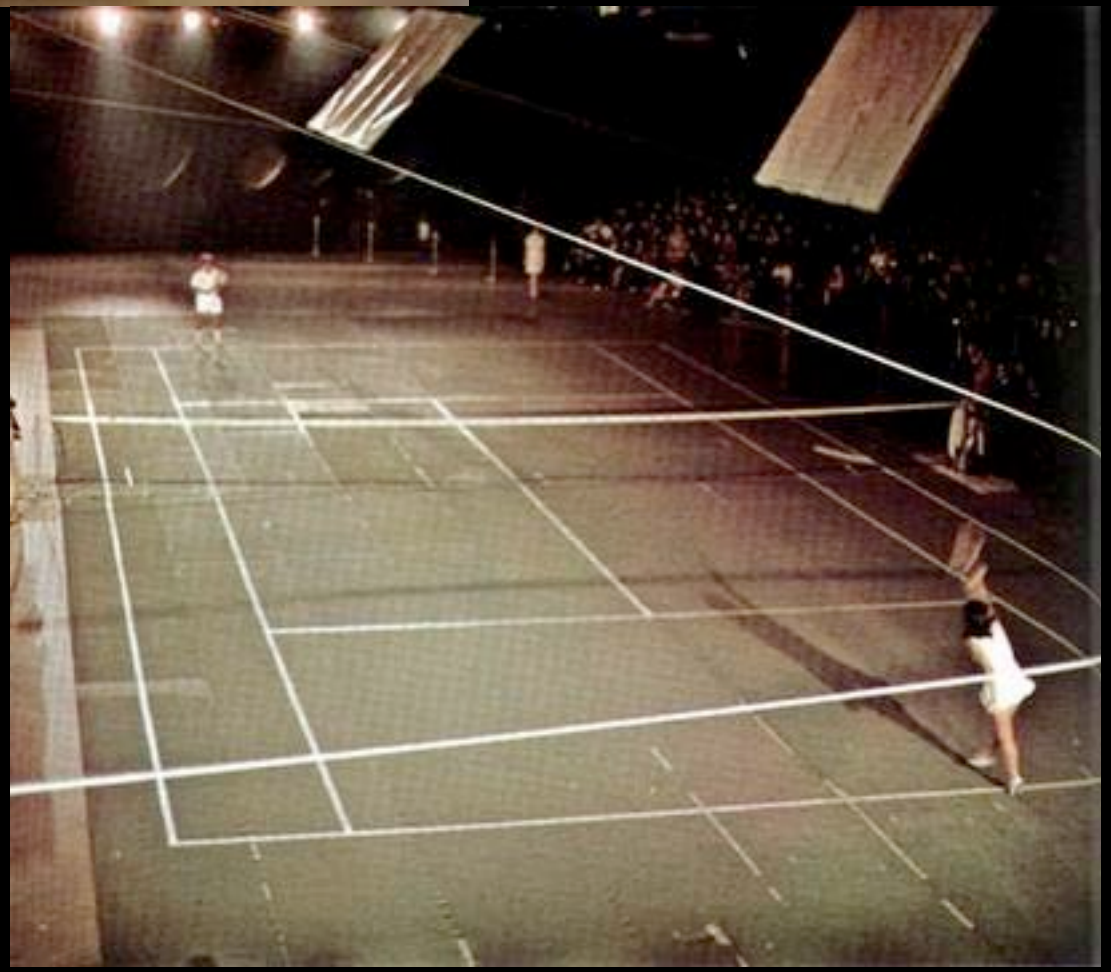
EAT/John Cage, Variations VII, 1966

EAT/Lucinda Childs, Still from *Vehicle*, 1966

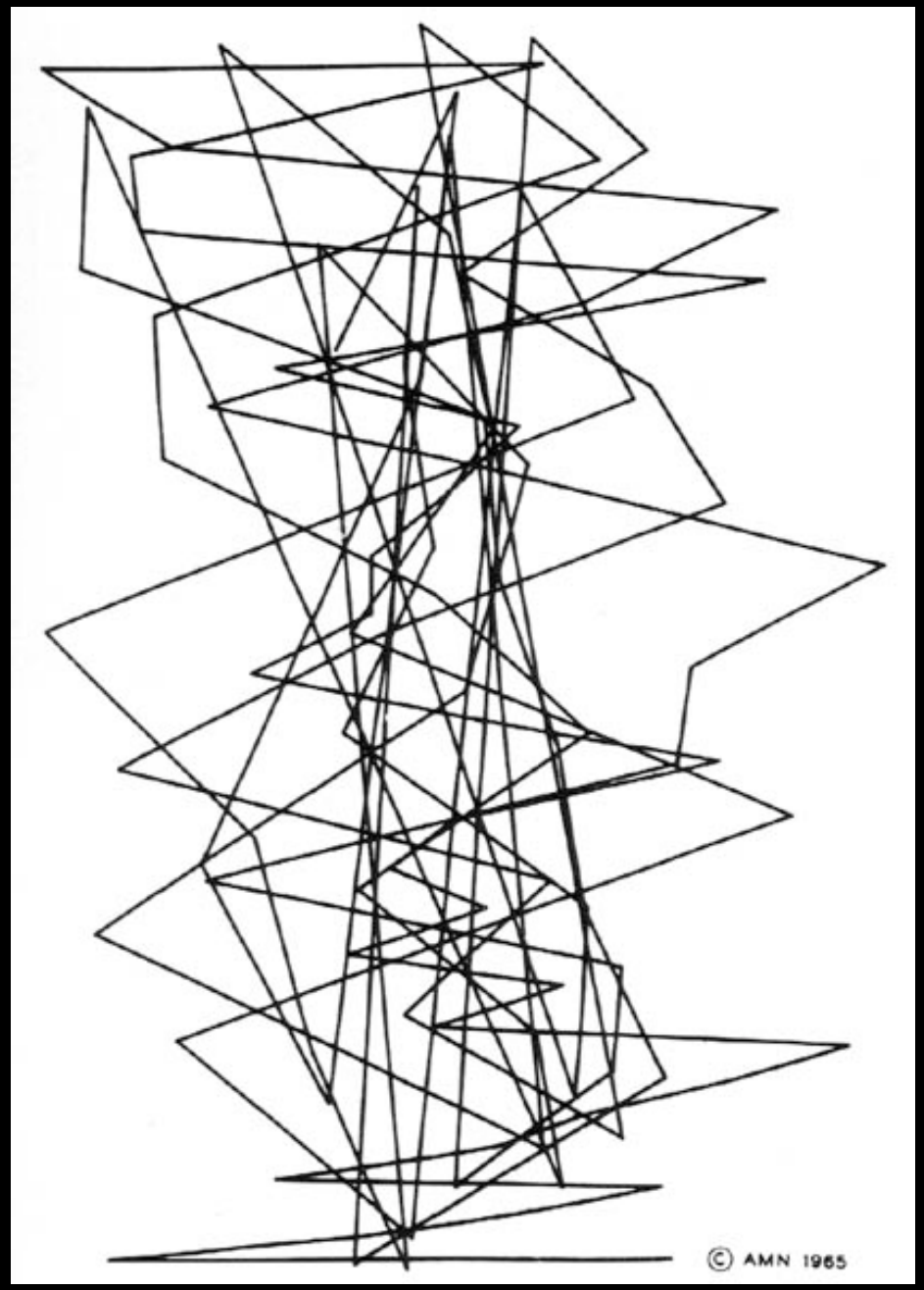
EAT/Robert Rauschenberg, Open Score, 1966

Each time Frank Stella and Mimi Kanarek hit the ball the vibrations of the racquet strings were transmitted to the speakers around the armory, and a loud BONG was heard.

http://www.youtube.com/watch?v=juo0OHsQTWE



# DIGITAL IMAGE WITHIN ART AS TWO-, THREE-, AND FOUR-DIMENSIONAL; FLATNESS OF THE SCREEN EXPANDED, EXTRUDED, AND MADE SPATIAL




A. Michael Noll, Gaussian Quadratic, 1962

Robert Rauschenberg, Open Score, 9 Evenings, E.A.T., Armory, New York, 1966

Whither the conventional medium of art? Whither painting? Whither sculpture?

Whither the “work of art”?

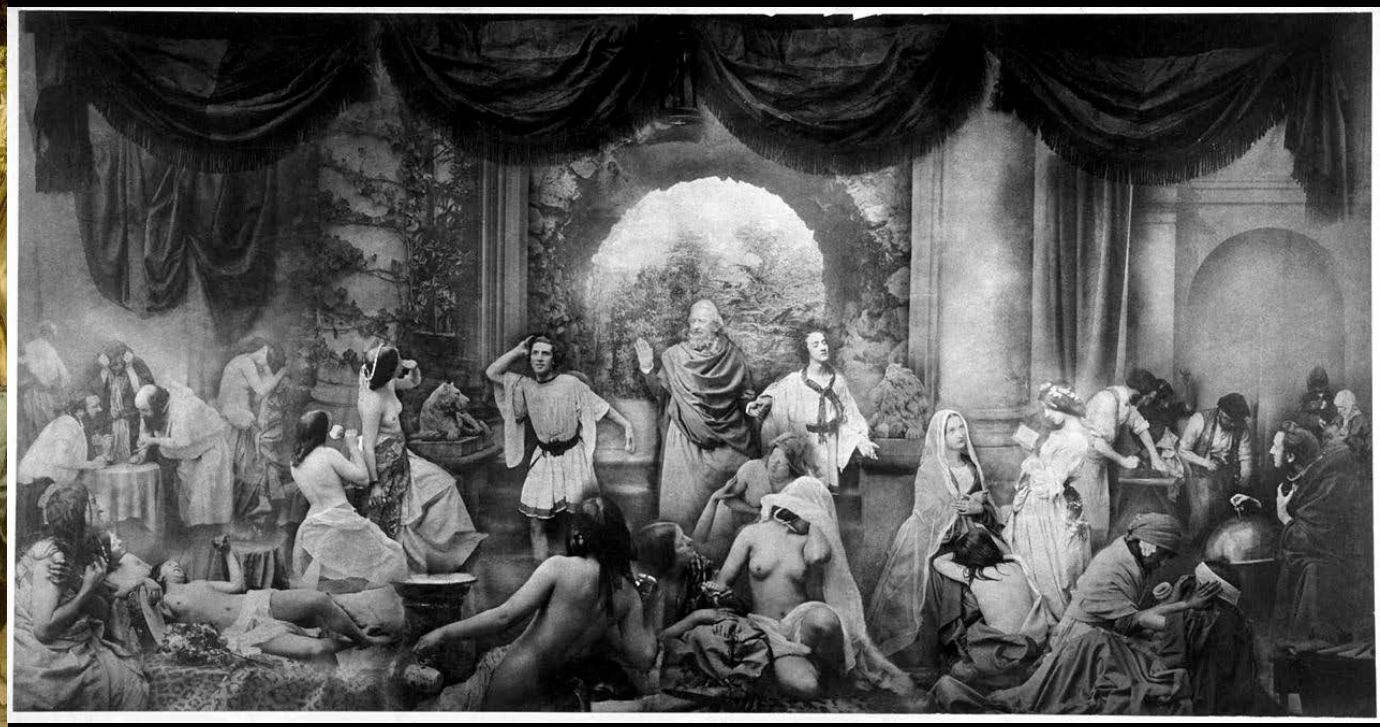
classical artistic medium

media/mass media

mediation

# classical artistic medium

Thomas Couture, The Romans of the Decadence, 1847



Oscar Gustave Rejlander, Two Ways of Life, 1857

# media/mass media

Richard Hamilton

"What Is It That Makes Today's Homes So Different? So Appealing?"

1956

# mediation

Above Right: Jonathan Schipper, The Slow Inevitable Death of Muscle, 2009
Left: John Baldessari, The Back of All the Trucks While Driving from Los Angeles to Santa Barbara, 1963

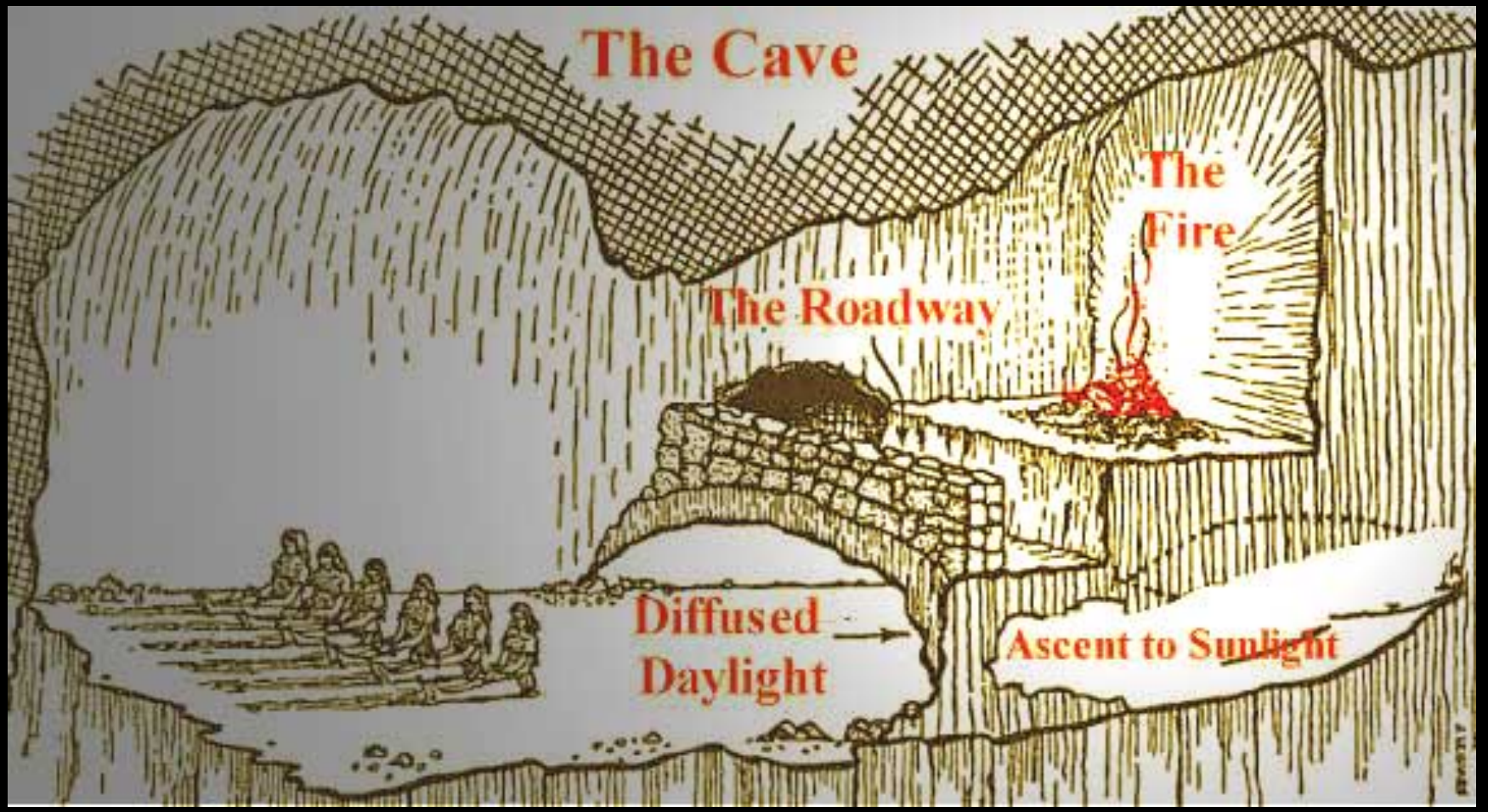
The concept of a “work of art” has always been subject to historical change…The crisis into which this concept of ‘‘the work’’ has now plunged is a sign of developments in art over the last hundred years. The most radical attack was launched by the avant-garde, who rejected the notions of originality, identity, authority, and purposelessness or l’art pour l’art, in an attempt to overcome the dichotomy between art and life and change experience of life through aesthetic means. Action art, performance, and happenings of the 1950s and 1960s mark the point where, at the very latest, the concept of a work of art as a discrete entity starts to break down. Ephemeral interactions with the audience attempted to allow contradictions, layers of meaning, and chance elements to enter into the work. Great expectations were initially placed in this pluralism, the ‘‘virtuality of possible orders,’’ as evidenced by Umberto Eco’s essay ‘‘Opera Aperta” [“Open Work”]. In ‘‘Opera Aperta,’’ the work of art is no longer a sort of encoded or enciphered message, viewed from the inside of production, to be deciphered by the observer using a repertoire of keys. Instead, it is an arrangement of possibilities; according to Eco, an ensemble of forms of organization, where many are entrusted with the initiative of the interpreter. According to this view, an image is the sum of possible narratives, histories, or interpretations that it allows. It is not predetermined, as was the classical artwork, for the substance of the interpreter is bound inseparably to arrangement of material. In Eco’s words: ‘‘The task of an open artwork is to give us a picture of discontinuity; it doesn’t tell of it, it is it.’’

-- Oliver Grau, 204-205

(CAVE = COMPUTERIZED AUTOMATED VISUALIZATION ENVIRONMENT)

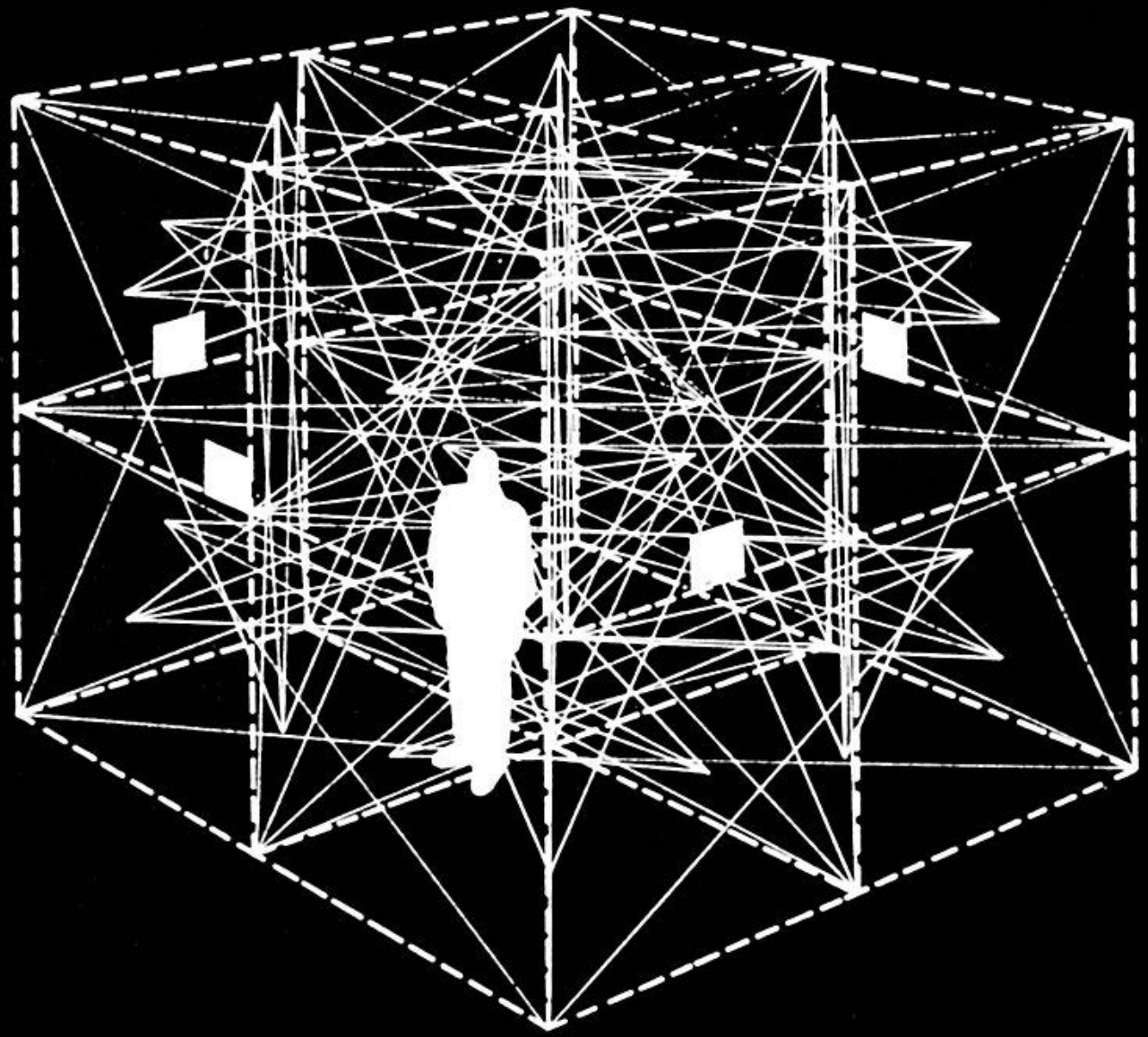
Figure 1.1 *CAVE*. Electronic Visualization Laboratory, University of Illinois, Chicago. Developed by Dan Sandin, Carolina Cruz-Neira, et al. By kind permission of Dan Sandin.

# Allegory of the Cave, or Plato's Cave, *Republic* [380 BC]



Dan Sandin, The Cave, Virtual Reality Theater, 1991-92
https://www.youtube.com/watch?v=-Sf6bJjwSCE

# Ken Isaacs, Knowledge Box, 1962



Ken Isaacs, Knowledge Box, 1962

# STEREOSCOPE

Sir Charles Wheatstone, stereoscope, 1840

# VR HMD/Headset

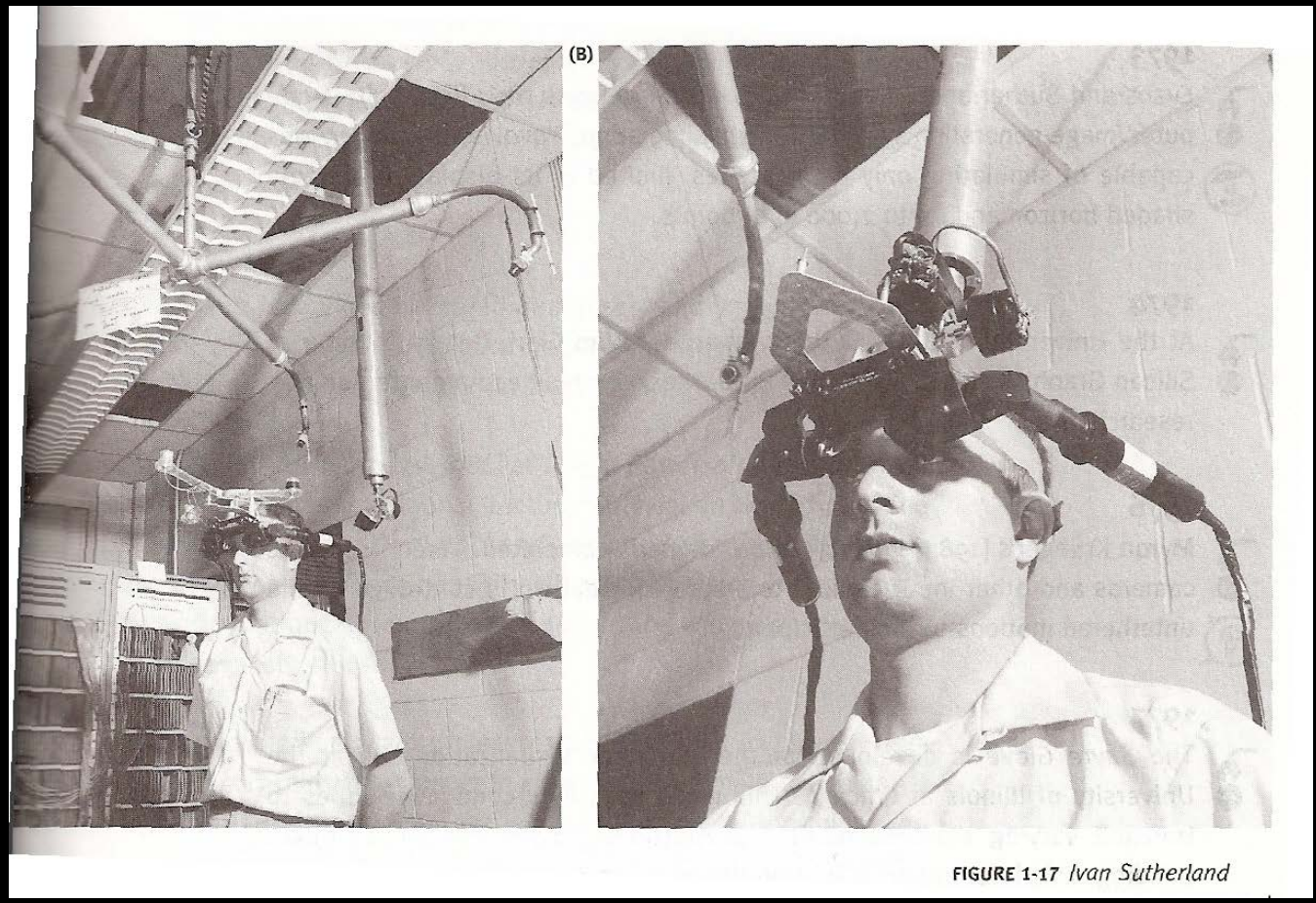



FIGURE 1-17 *Ivan Sutherland*

An early virtual reality headset, named The Sword of Damocles for its formidable appearance (1968) created by computer scientist Ivan Sutherland and his student Bob Sproull. HMD = head-mounted display

# VIRTUAL REALITY
# spectrum of experience and meaning

**literal virtual reality**
**replicating reality**
**immersion without distance**
**reproducing nature to best nature**
**cinema**
**market proximity/embeddedness**

**metaphorical virtual reality**
**interpreting reality**
**immersion with distance**
**reproducing nature to comment on reality**
**Expanded Cinema**
**art/autonomy [?]**

Char Davies, Osmose, 1995

***Osmose*** (1995) is an immersive interactive virtual-reality environment installation with 3D computer graphics and interactive 3D sound, a head-mounted display and real-time motion tracking based on breathing and balance. *Osmose* is a space for exploring the perceptual interplay between self and world, i.e., a place for facilitating awareness of one's own self as consciousness embodied in enveloping space.

Immersion in *Osmose* begins with the donning of the head-mounted display and motion-tracking vest. The first virtual space encountered is a three-dimensional Cartesian Grid which functions as an orientation space. With the immersant's first breaths, the grid gives way to a clearing in a forest. There are a dozen world-spaces in *Osmose*, most based on metaphorical aspects of nature. These include Clearing, Forest, Tree, Leaf, Cloud, Pond, Subterranean, Earth, and Abyss. There is also a substratum, Code, which contains much of the actual software used to create the work, and a superstratum, Text, a space consisting of quotes from the artist and excerpts of relevant texts on technology, the body and nature. Code and Text function as conceptual parentheses around the worlds within.

Through use of their own breath and balance, immersants are able to journey anywhere within these worlds as well as hover in the ambiguous transition areas in between. After fifteen minutes of immersion, the LifeWorld appears and slowly but irretrievably recedes, bringing the session to an end.

http://www.immersence.com/osmose/

All elements combine to endow Osmose with a flowing and coherent quality that envelops the participant totally. As mentioned above, the totality of the effect is strengthened further because it dispenses with the use of portals and clearly defined boundaries between the image worlds in favor of osmotic transitions. For example, the immersant appears to move through a luminous digital tree. **For Martin Buber, contemplating a tree was an occasion to reflect on conscious experience: ‘‘It may so happen, by grace and will combined, that I, in contemplating the tree, become enclosed within the relationship to it and then it is no longer an It. The power of wholeness has captured me.’’** All is unified, indistinguishably: ‘‘Image and movement, genus and example, law and number.’’ An aesthetic impression of immersion is a primary characteristic of virtual reality. **However, being enveloped in a cocoon of images imposes profound limitations on the ability for critical detachment, a decisive hallmark of modern thought that has always played a central role in experience of and reflections on art.**

**-- Oliver Grau, 201-202**

1.)  How does Martin Buber’s contemplation of the tree relate to ecology?

2.) Is VR a persuasive approximation of an ecological experience? Is one more connected or less connected to one’s environment through VR?

3.) Does this immersion propagate critical distance? Where would it fall on the spectrum of Virtual Reality?

# Whither embodiment in VR?

# N. Katherine Hayles
# Embodied Virtuality: Or How to Put Bodies Back Into the Picture [1996]

Cyberspace, we are often told, is a *disembodied* medium. Testimonies to this effect are everywhere, from William Gibson's fictional representation of the 'bodiless exultation of cyberspace' to John Parry Barlow's description of his virtual reality (VR) experience as 'my everything has been amputated.' In a sense, these testimonies are correct; the body remains in front of the screen rather than within it. In another sense, however, they are deeply misleading, for they obscure the crucial role that the body plays in constructing cyberspace. In fact, we are never disembodied. As anyone who designs VR simulations knows, the specifications of our embodiments matter in all kinds of ways, from determining the precise configurations of a VR interface to influencing the speed with which we can read a CRT screen. Far from being left behind when we enter cyberspace, our bodies are no less actively involved in the construction of virtuality than in the construction of real life.

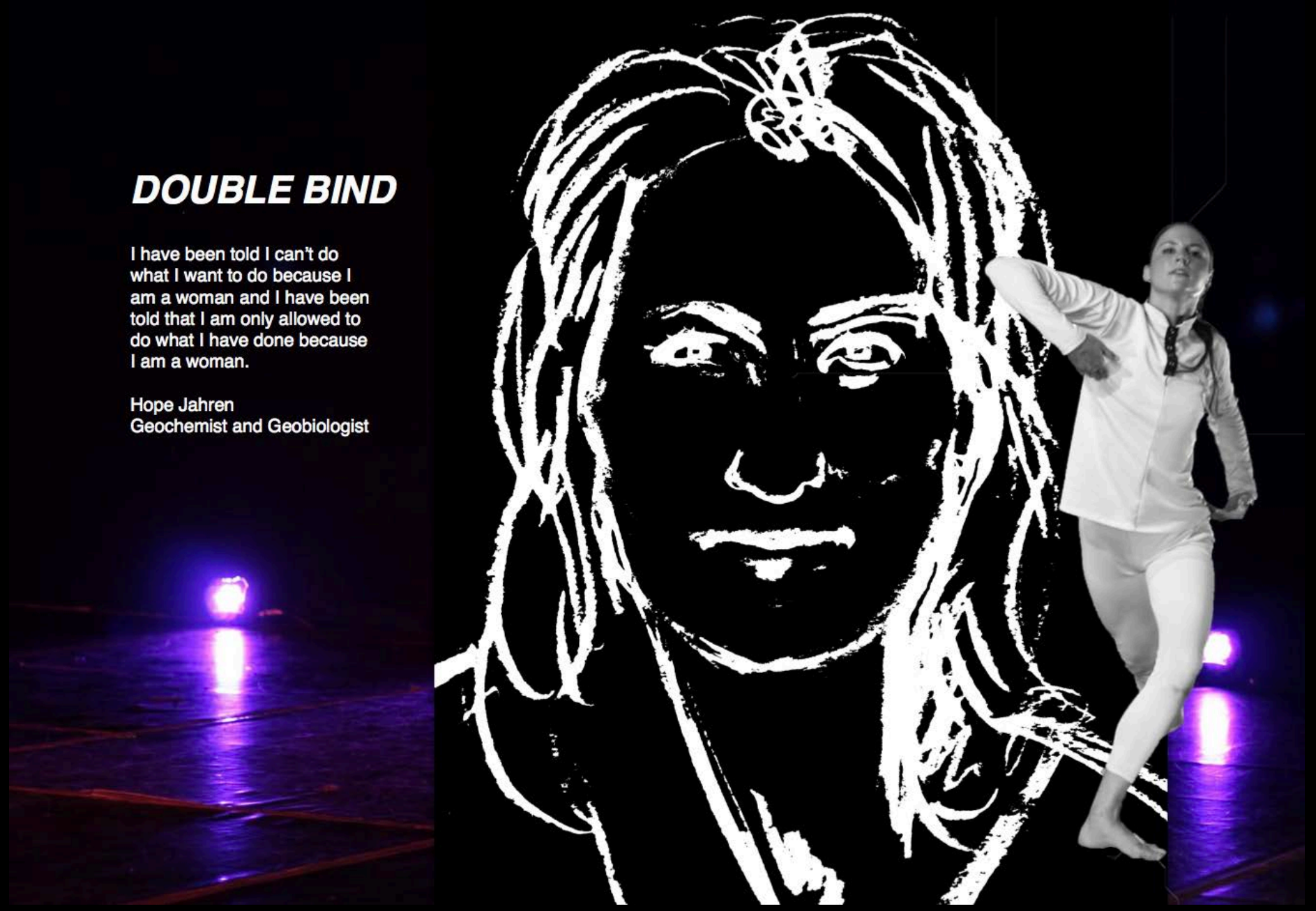
# Outside the Vortex

Meredith Tromble, Outside the Vortex, 2017

# *DOUBLE BIND*

I have been told I can't do what I want to do because I am a woman and I have been told that I am only allowed to do what I have done because I am a woman.

Hope Jahren
Geochemist and Geobiologist



## AFRAID

When I was an undergraduate in astronomy, my advisor was an internationally known scientist. I was grateful when he took time to talk to me about my career. But then he started talking about having sex outdoors with a woman he used to date. I stopped meeting with him after he gave me a ride home, parked, and started touching me, rubbing the back of my neck as I tried to get out of the car. I was afraid to report him because it might hurt my chances of going to graduate school.

Sarah Ballard, Astronomer

## RIDICULOUS

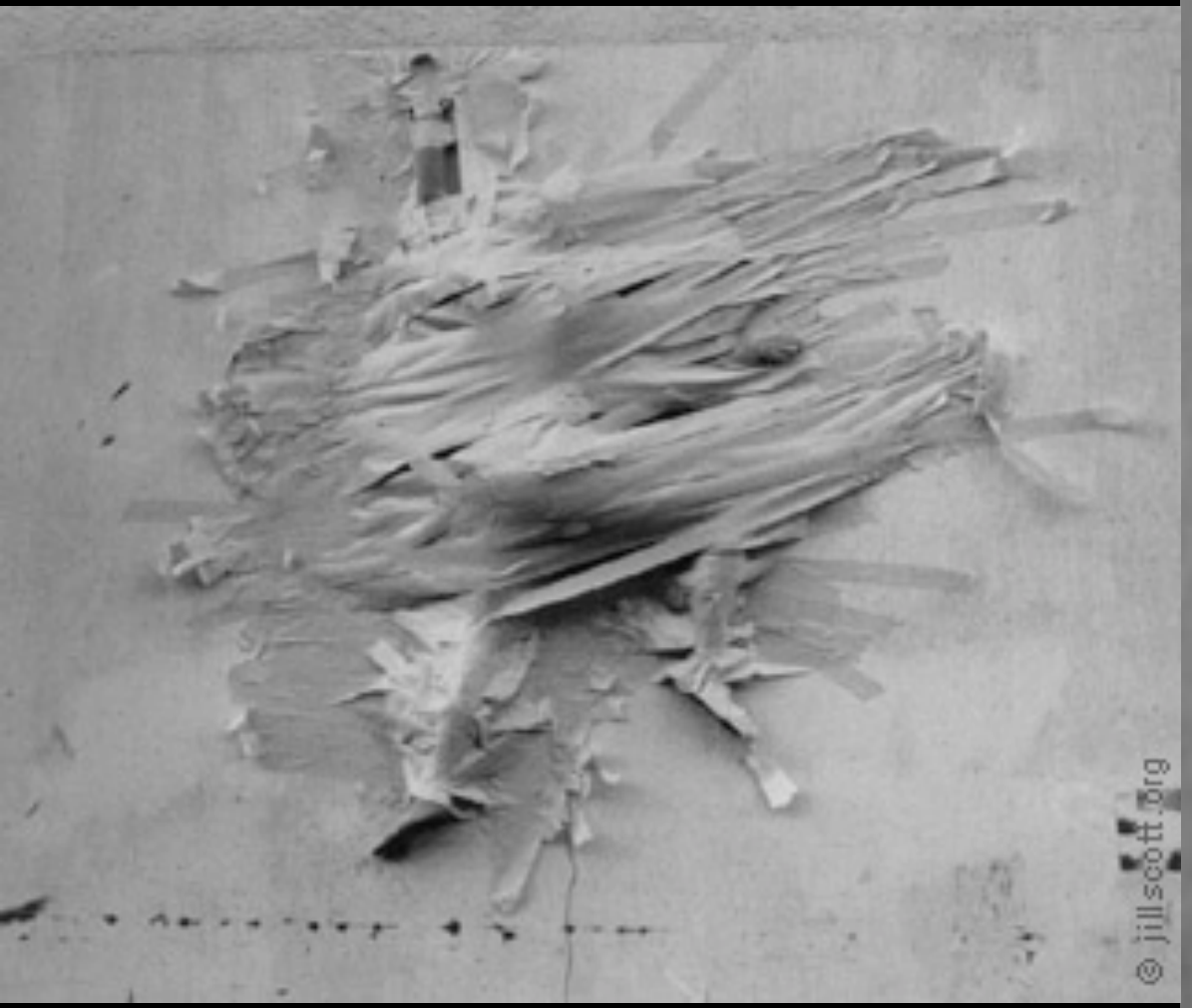
I was the only woman at the Russian base in Antarctica. My team had just come in from grueling weeks in the field where I had done a lot of the heavy lifting. The man who made announcements to the entire base kept referring to me over the loudspeaker as "Princess."

Dawn Sumner, Geobiologist

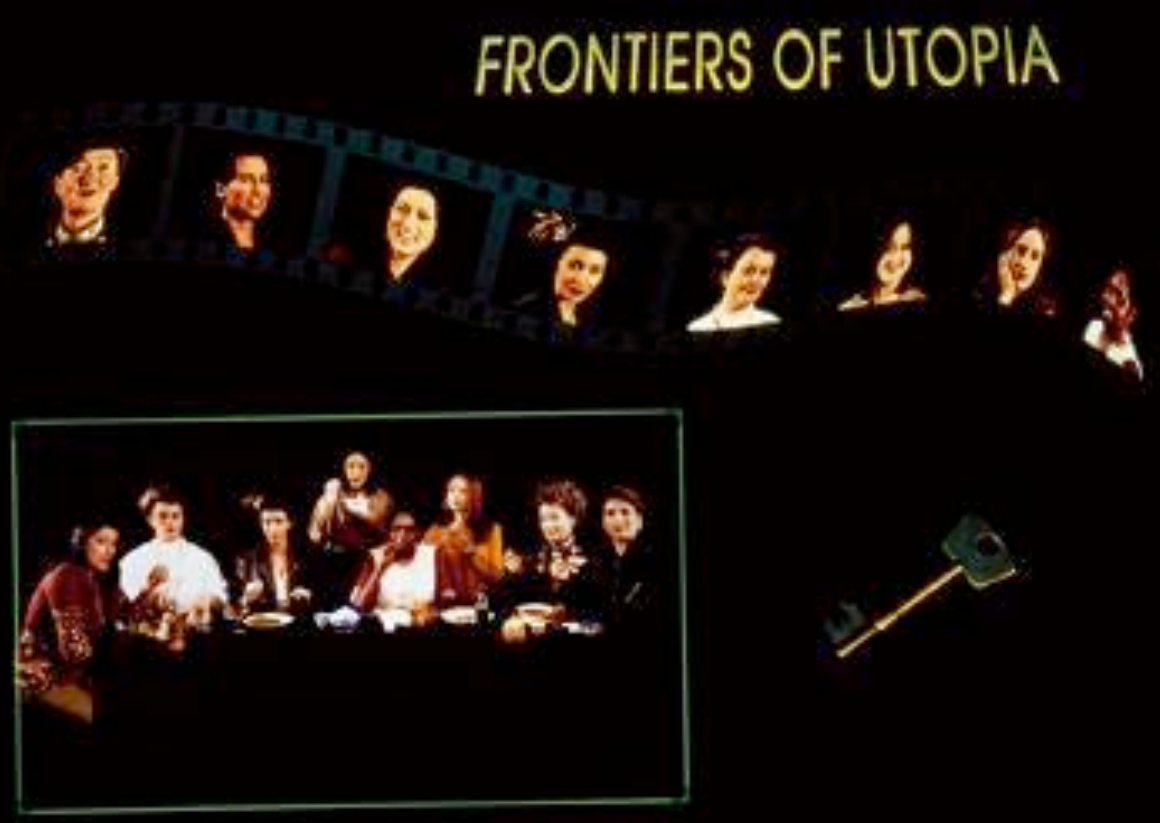
Jill Scott, Taped, 1975

Jill Scott is a video, sculpture and performance artist. Her artwork is focused on the human body and neuroscience

In “Taped,” the figure stood on the tops of two twenty-foot ladders, one foot on each ladder and leaned against the outside wall of a warehouse. Two assistants took ten rolls of two-inch making tape and stuck the figure to the wall, defying gravity, until sundown.



https://vimeo.com/111163586




Jill Scott, Frontiers of Utopia, 1995

In the installation Frontiers of Utopia the visitor is confronted with eight virtual female characters, based on the histories of real women who were born in different periods: 1900, 1930, 1960 and 1990. All eight characters dream of the way in which they will change their own lives as well as the world around them. In formulating their ideal future they also paint a picture of their own history and the way in which they view their world. The network of stories and references shows a rich variation in ideas, attitudes and historical perspectives with regard to the subjects that are being discussed. Although they all strive for their own ideals in their own time, they share common worries about happiness and health, reflecting also their worries about the future.

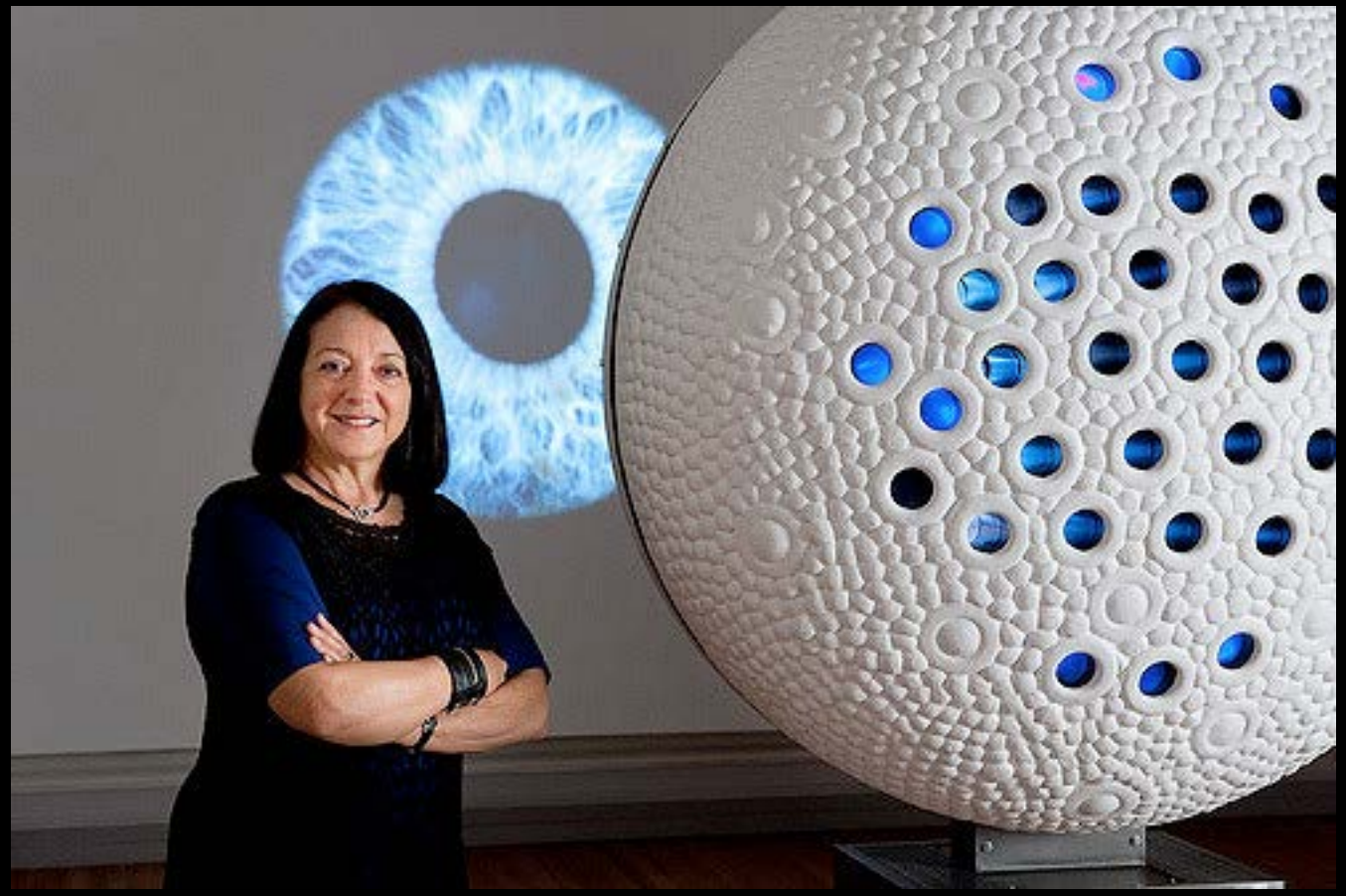
The viewer was able to construct a collage of sounds and images from 1900, 1930, 1960, 1990 by moving through both real and virtual space, their movement triggering sounds or by using icons on a touch sensitive screen. In this way they became time travellers, making interesting associations as well as learning about history in a new way.

In the installation the viewers can move interactively through the four time zone layers of «Frontiers of Utopia,» via touching icons and objects in the space as if they were time travellers. In another part of the installation they can attend a virtual dinner party where all the characters and their personal objects are available for comparison.
http://www.videoartchive.org.au/jscott/frontiers.html

# VISUALIZATION AND AESTHETICS

# BETWEEN ART AND SCIENCE

Jill Scott, The Electric Retina, 2008
https://vimeo.com/1387705



***The Electric Retina*** is a "neuromedia" sculpture which combines retinal research with interactive media art and metaphorical associations in order to explore the complexity of visual perception.