University of Texas at Dallas
Arts & Humanities
Fall 2018

Contemporary Art History
AHST 3318-501
(87353)
Dr. Charissa N. Terranova
W 7:00-9:45 pm
ATC 1.305

10/17/18
Perception in Motion: Op, New Tendencies and GRAV (review)
The Rise of the Digital Image in Art: Origins, Bell Labs, and E.A.T.
California Light and Space Movement

EXTRA CREDIT ASSIGNMENT #2: REVIEW OF *THE NATURE OF ARP* AT THE NASHER SCULPTURE CENTER

Using your knowledge of the critic's voice, please write a review of this exhibition. Your review might discuss the successes or failures of the exhibition according to the artist's work and its installation – how the Nasher Sculpture Center has worked to install works of art in the exhibition space. You must visit the art space for this assignment and include a selfie with one work of art in your review. No flashes in the gallery space.

This writing exercise will boost your mid-term exam grade one full letter grade.

- Length: 600 words
- double space
- 10 or 12 pt font
- title of your review underlined and located underneath course heading
- selfie with a work of art
- Please avoid personal statements in the first person, that is, using "I", such as "I think the show was beautiful."
- Please avoid artspeak, exaggeration, and clichés, such as "The artist [or critic] is a genius."
- Please be certain to identify the artist and his connection to Dada
- **Due: Wednesday November 7**

IMPORTANT DATES

OCTOBER 17: Extra Credit #1 Due -- Attend *György Kepes's Vision + Values Series and the Origins of Cybernetic Art* and submit a 300-word summary and boost your lowest grade one full letter grade.

OCTOBER 24: Assignment #2: Review of *Ian Davenport* at the Dallas Contemporary, 161 Glass St., Dallas, TX 75207

NOVEMBER 7: Extra Credit Assignment #2 Due – Review of The Nature of Arp at the Nasher Sculpture Center

NOVEMBER 14: Distribution of Final Exam Review Sheet

DECEMBER 5: Assignment #3: Review of *Günther Förg: A Fragile Beauty* at the Dallas Museum of Art, 1717 North Harwood, Dallas, TX 75201

DECEMBER 12: 8:00 pm Final Exam

Geometric Abstraction Mid 20th Century

French *Groupe de Recherche d'Art Visuel* [GRAV], Italian Gruppo N and Gruppo T, German Zero Group, Spanish Equipo 57, Dutch NUL, and the American Anonima

Op Art
Responsive Eye
New Tendencies
Neo-Constructivism

Perception
Gestalt
Movement
Process
Information

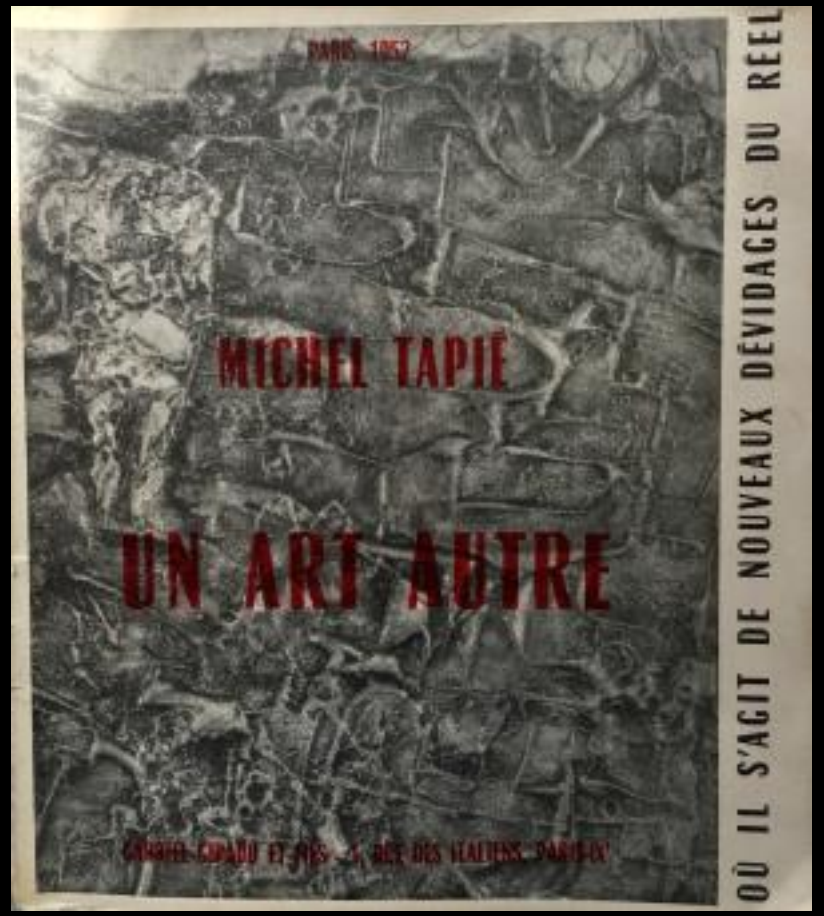
Nouvelle Tendance/New Tendency: (Neo)Constructivism and Kinetic Art

Founded in Zagreb (today Croatia, in 1961 Yugoslavia)

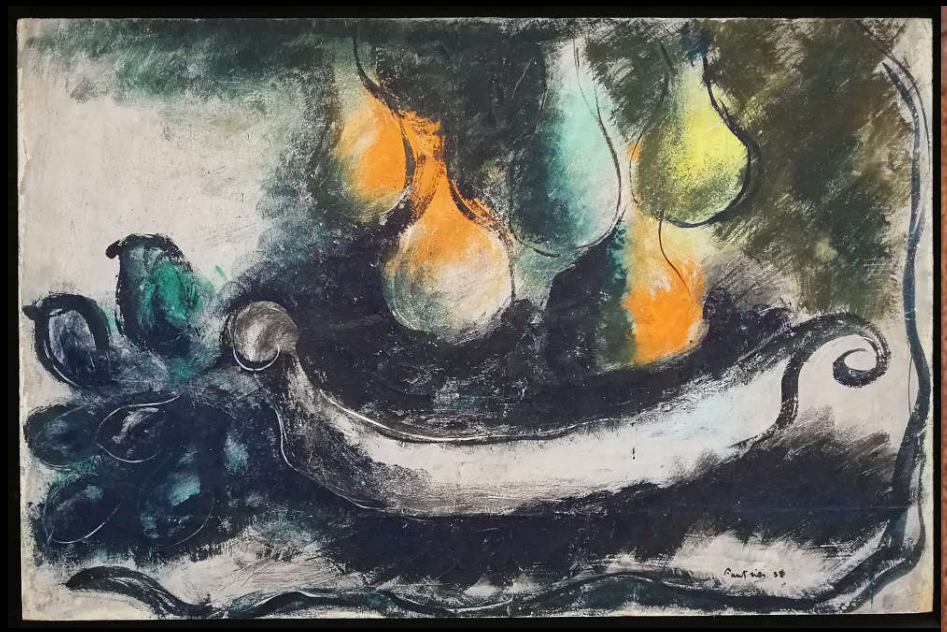
New Tendencies = Post Art Informel

Tachisme/Art Informel/Lyrical Abstraction

Michel Tapié, *Un Art autre* (1952), or "Art of Another Kind"



Also known as art informel, art autre translates as 'art of another kind' and was used to describe the dominant trend of abstract art in the 1940s and 1950s characterized by an improvisatory approach and highly gestural technique.



Jean Fautrier, Poirets dans uns vasque, 1938

Fautrier was a leading practitioner of Art Informel. Prior to WWII he painted in a figural vocabulary. The turning point was the war and a series of small abstract works he called Hostages.

Jean Fautrier, Head of a Hostage no 14, 1944

Hans Hartung, T1963-R6, 1963

Pierre Soulages, Painting, 23 May 1953, 1953

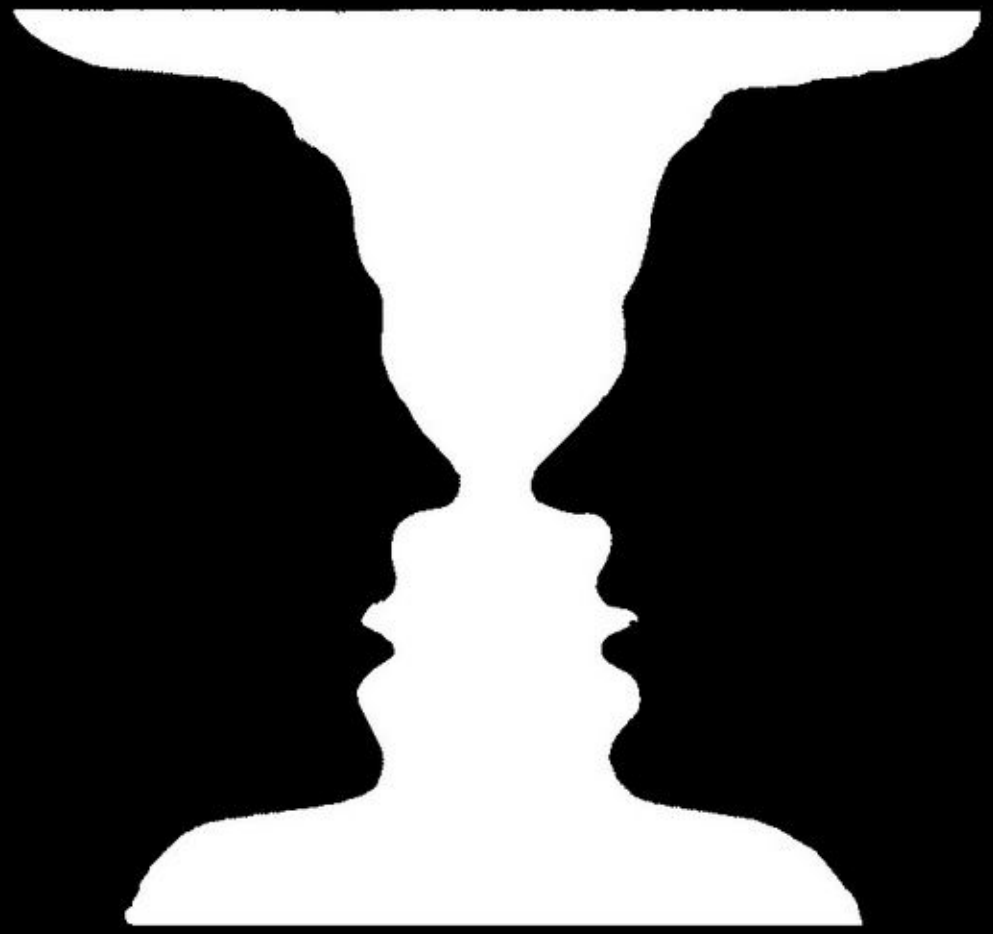
New Tendencies = Post Art Informel

New Tendencies = a dynamic movement dedicated to visual research

Art as visual research.

Computers and visual research.

New Tendencies

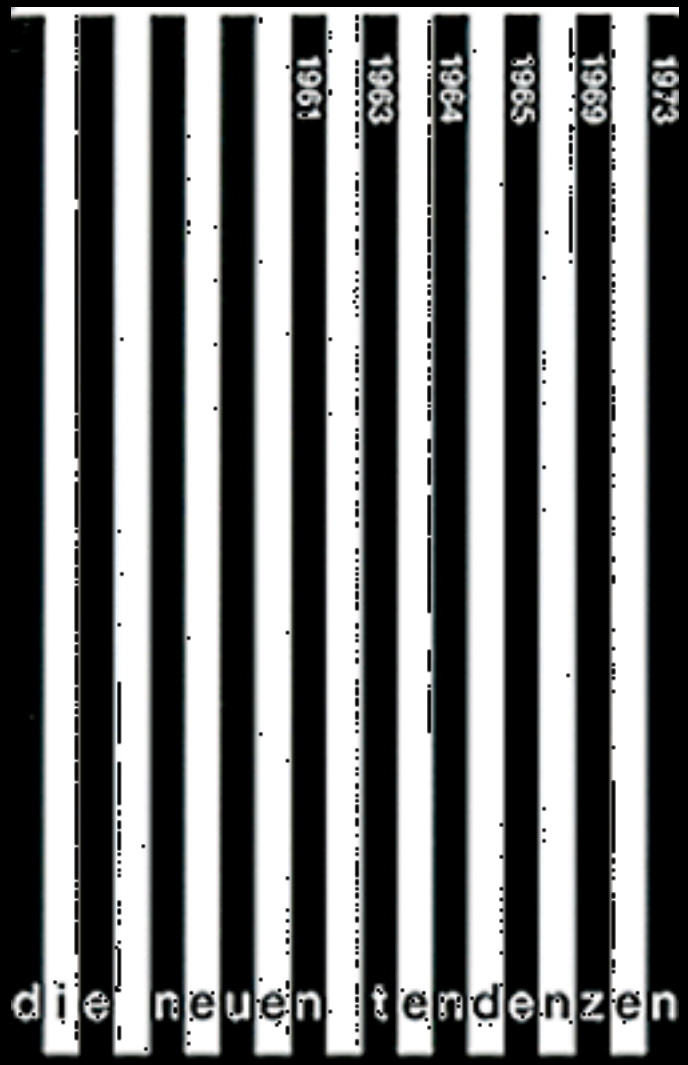


Gestalt – an organized whole that is perceived as more than the sum of its parts.

Figure and Ground = Whole

Gestaltung – organization, configuration, composition

Gestalt as perceptual whole; gestalt as social collective

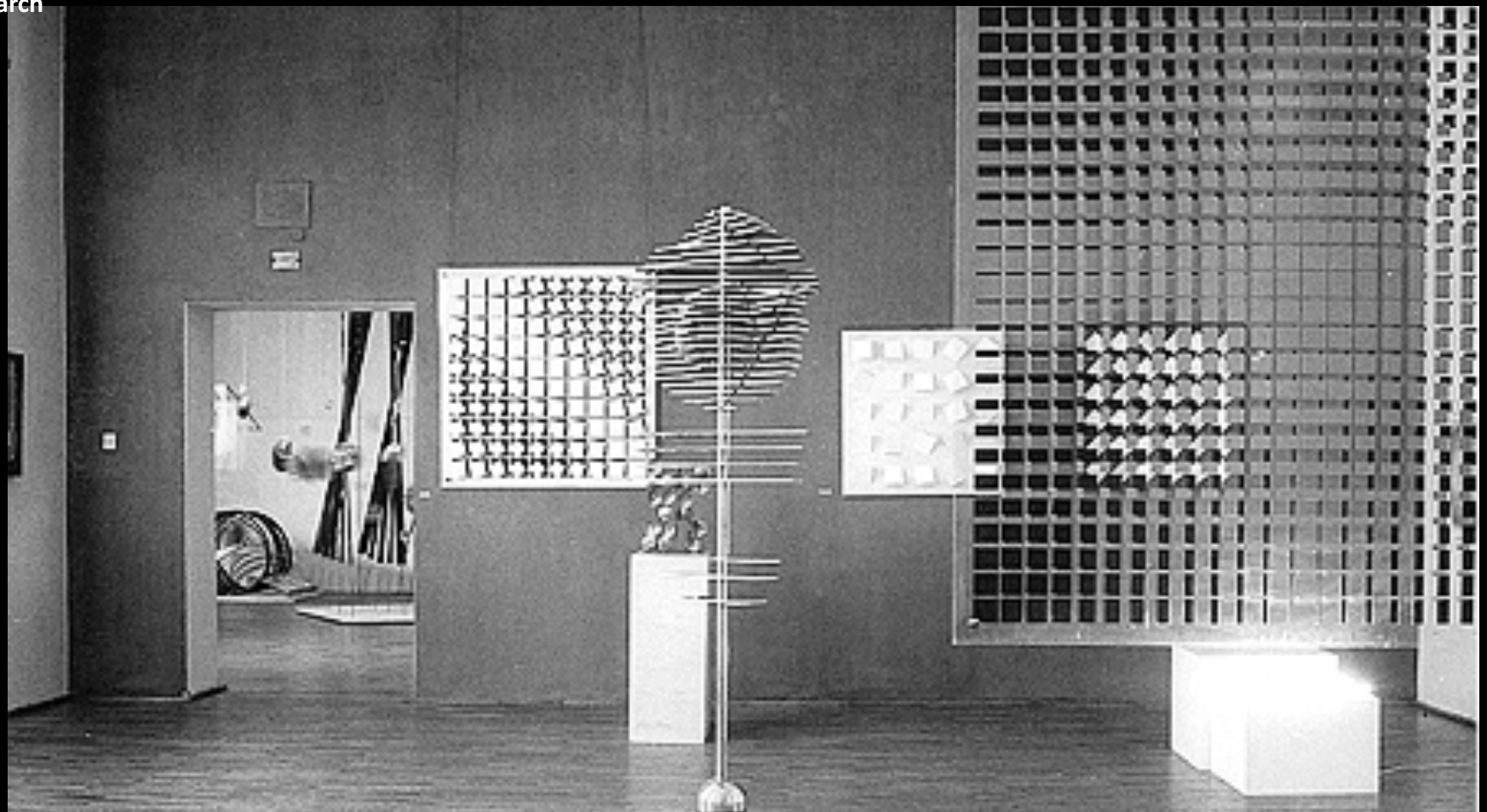

1961
1963
1964
1965
1969
1973
die neuen tendenzen

nove tendencije 2
galerija suvremene umjetnosti, zagreb, katarinin trg 2 1. august - 15. septembar 1963

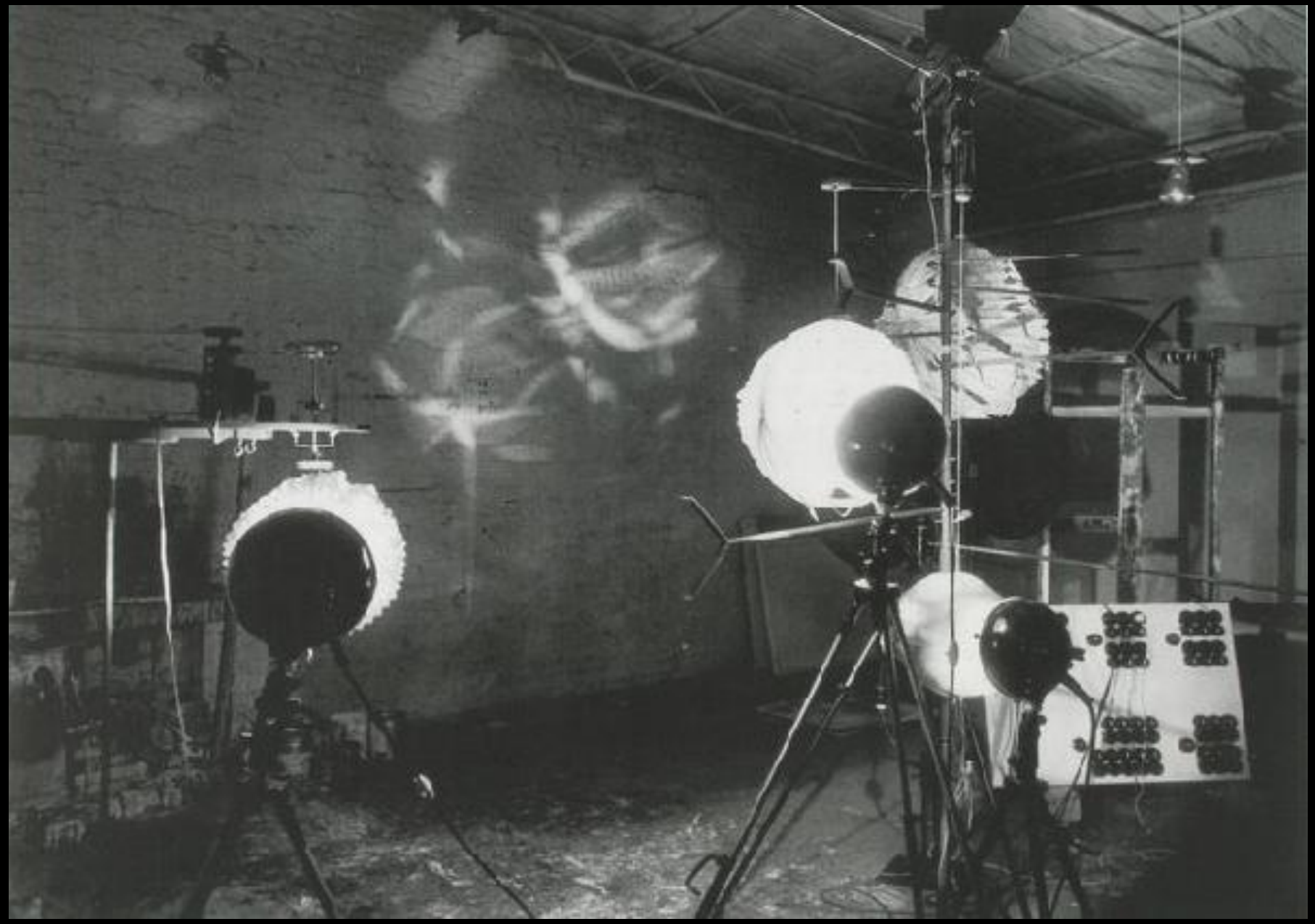
New Tendencies Exhibitions:
1961
New Tendencies
1963
New Tendencies 2
1965
New Tendency 3
1968-1969
Tendencies 4 (1968-1969) Computers and Visual Research
1973
Tendencies 5 Section: Computer and Visual Research

New Tendencies Colloquia and Symposia:
1962
Meeting of the Nouvelle Tendance (New Tendency)
1965
Working Meeting of the Participants in NT3
1968-1969
New Tendencies 4 (1968-1969) Computers and Visual Research
1971
Art and Computers 71. Colloquium
1973
Tendencies 5 (1973), The Rational and Irrational in Visual Research Today. Symposium, Match of ideas
1978
Tendencies 6 (1978), Art and Society International Symposium

New Tendencies Publications:
bit international (Magazine)

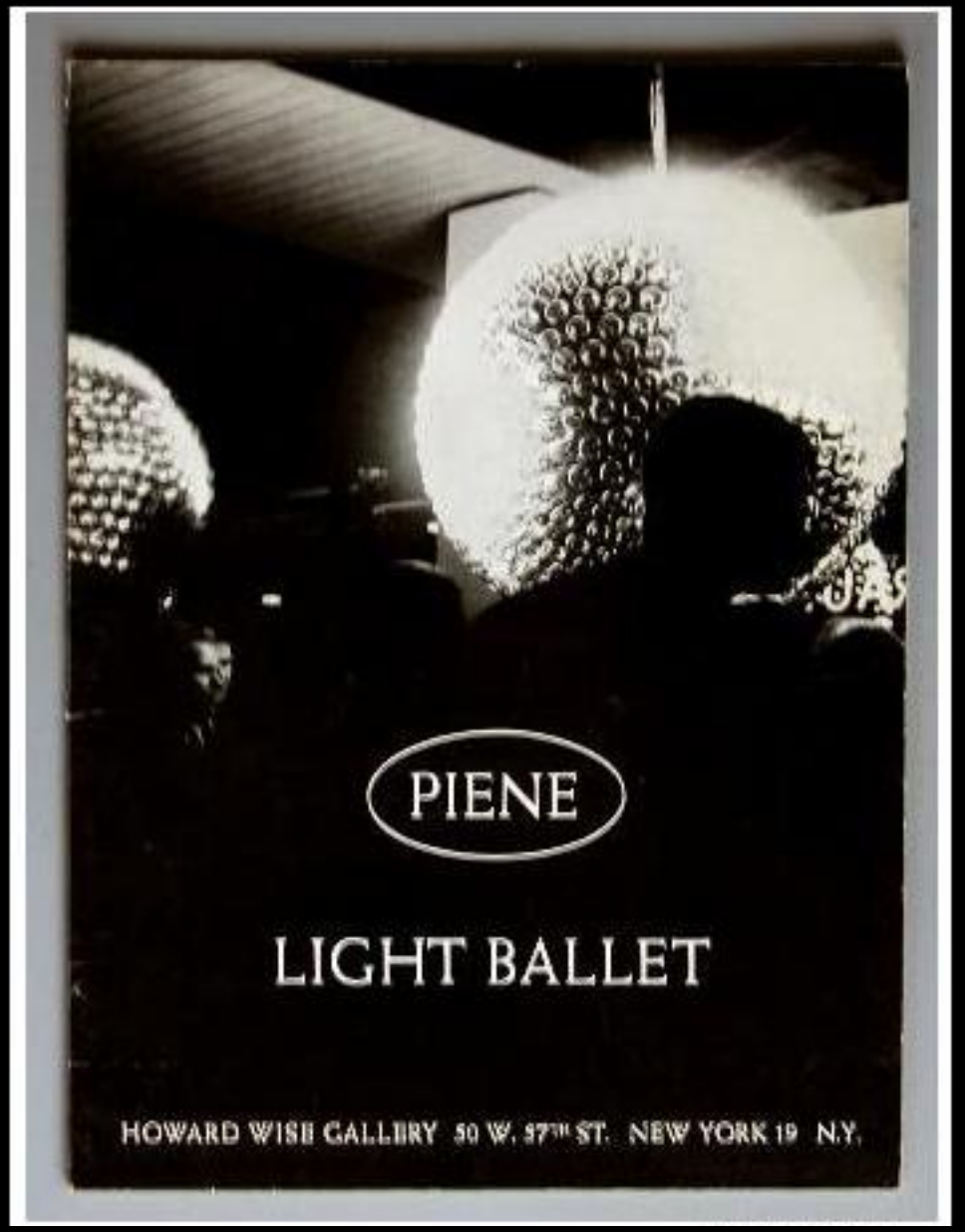


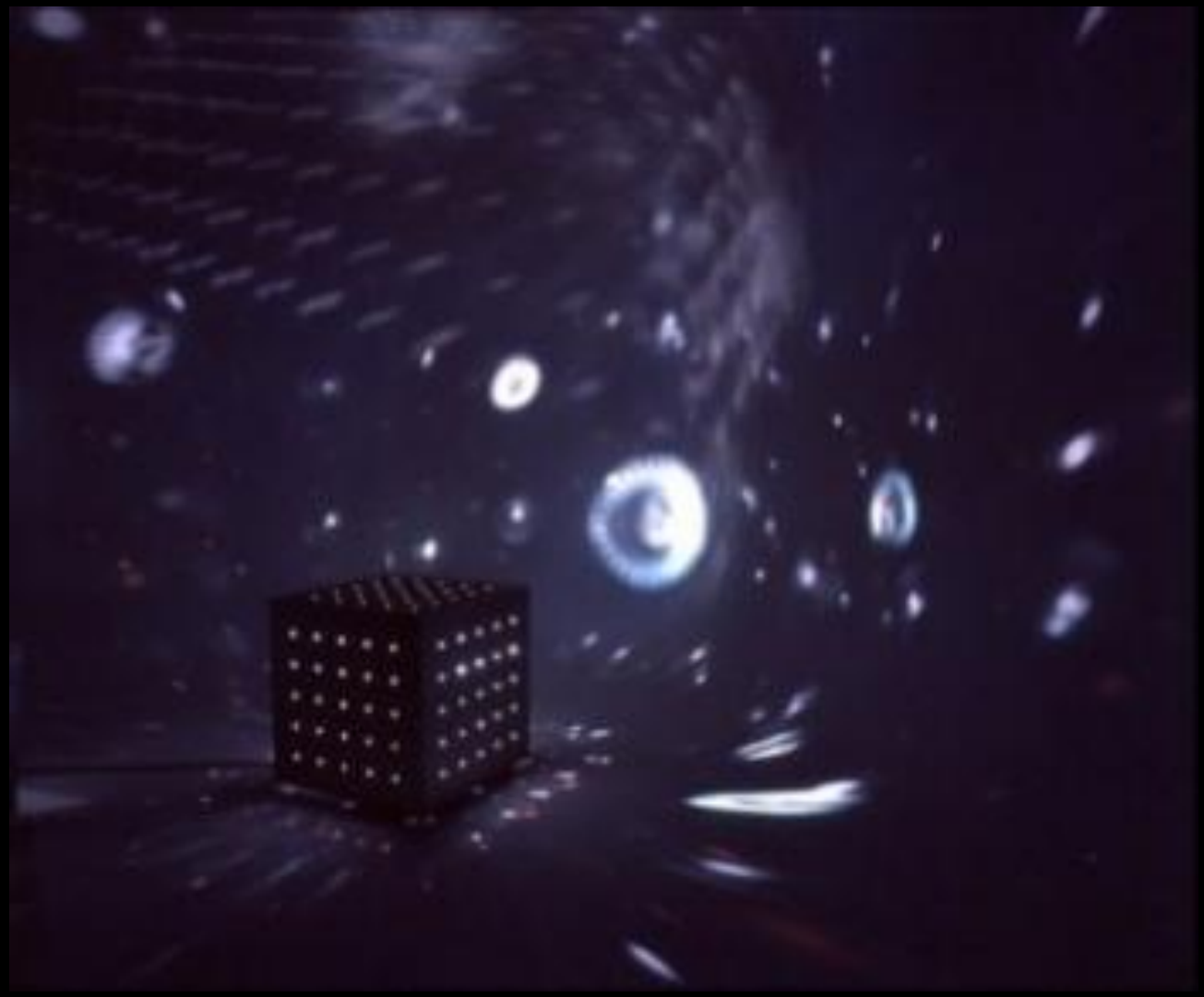
Zero Group



Otto Piene, Light Ballet, Galerie Schmela, Düsseldorf, 1959-61

Otto Piene, Electric Rose, 1965

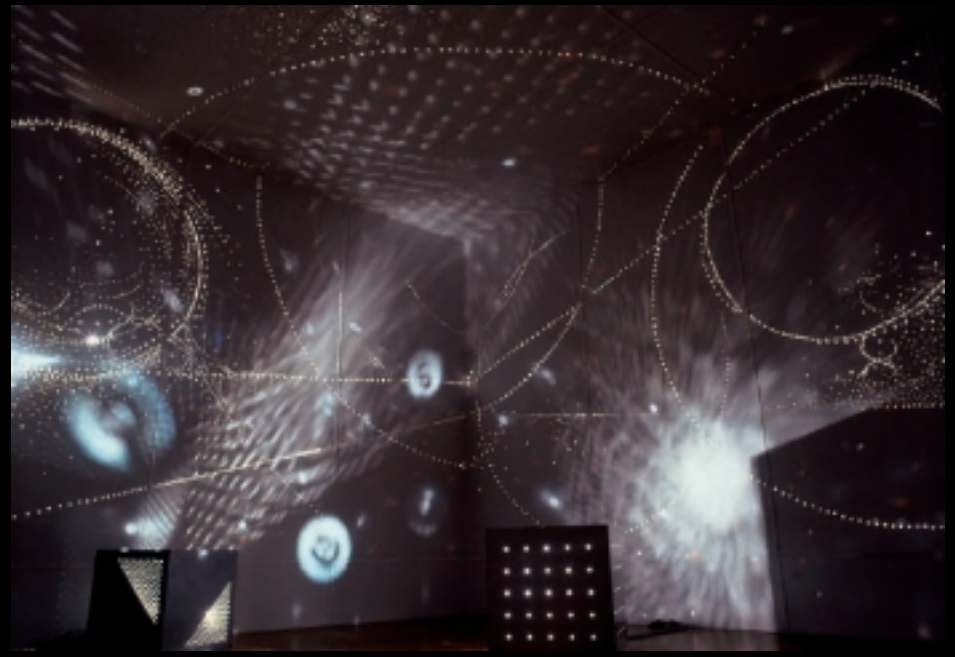


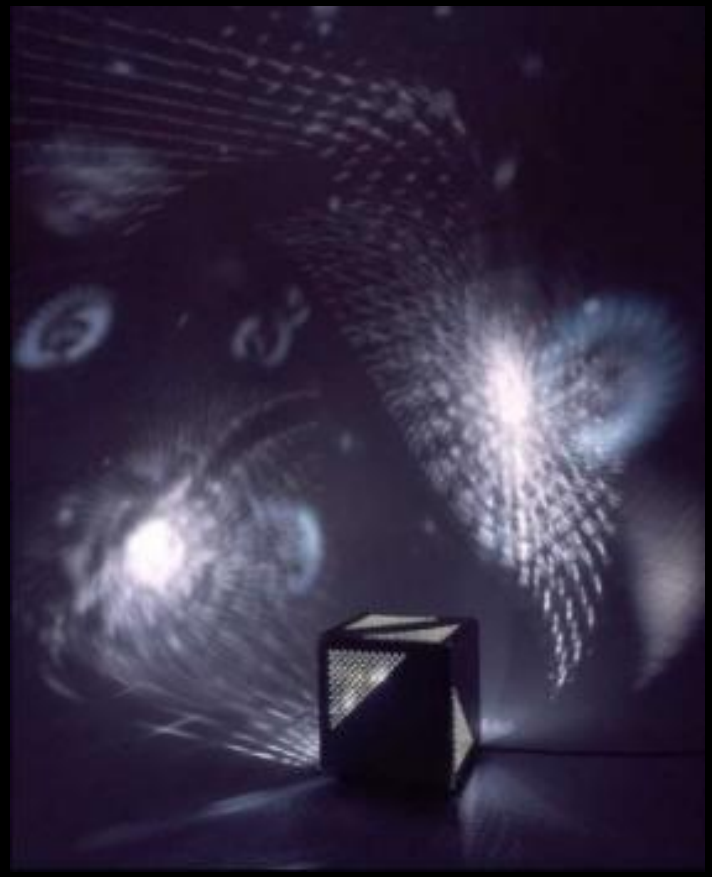


Otto Piene, Light Space, 1960

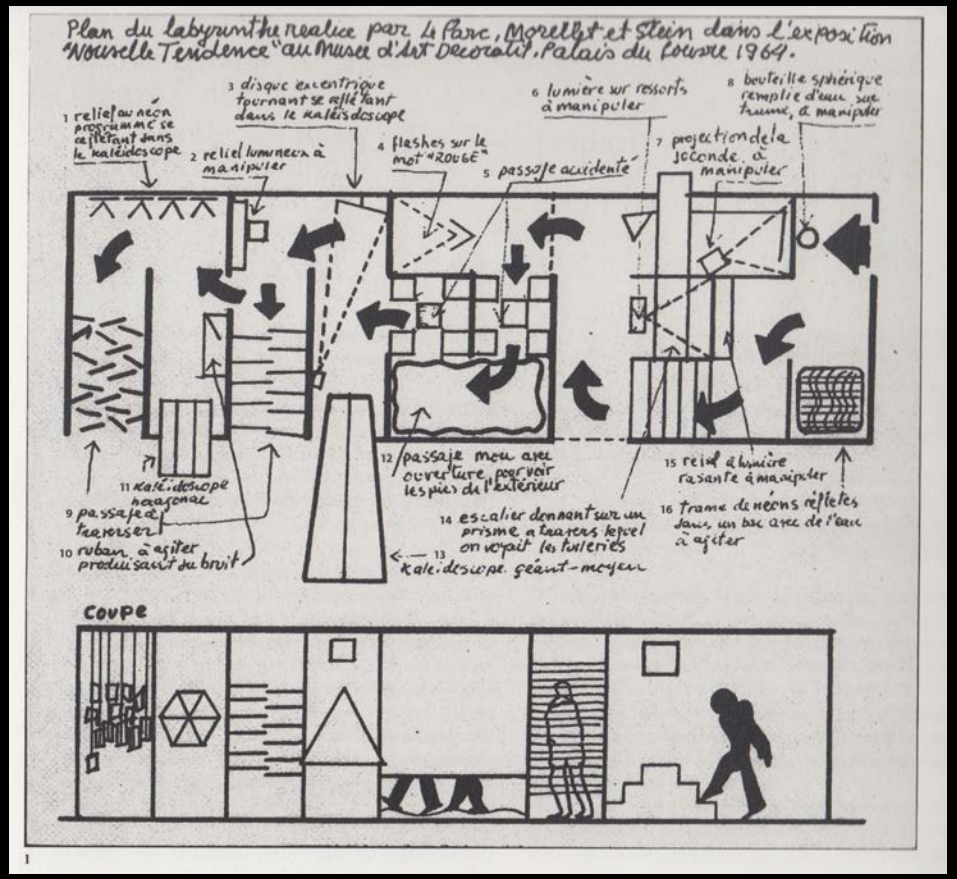
In describing the meaning and significance of the name “Zero,” Otto Piene wrote:

“From the beginning we looked upon the term [Zero] not as an expression of nihilism – or as a dada-like gag, but as a word indicating a zone of silence and of pure possibilities for a new beginning as the count-down when rockets take off – ZERO is the incommensurable zone in which the old state turns into the new.”



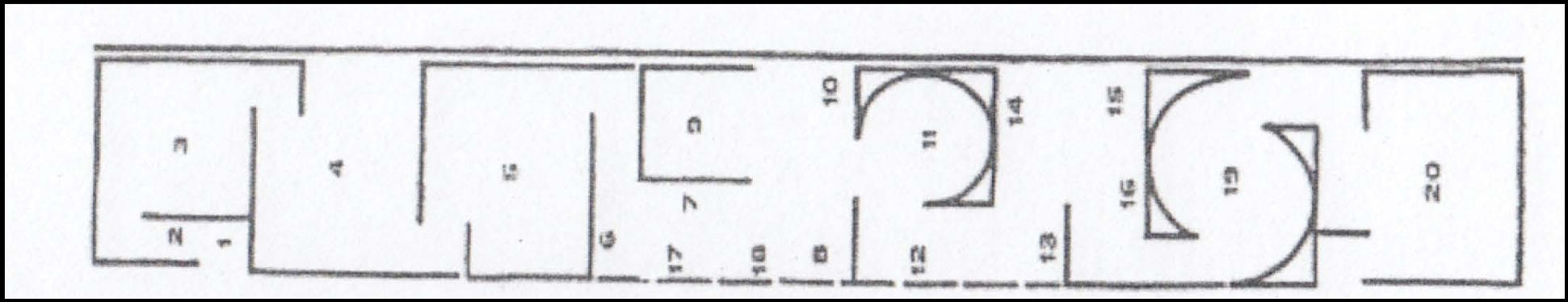


Groupe de Recherche d'Art Visuel
[GRAV]



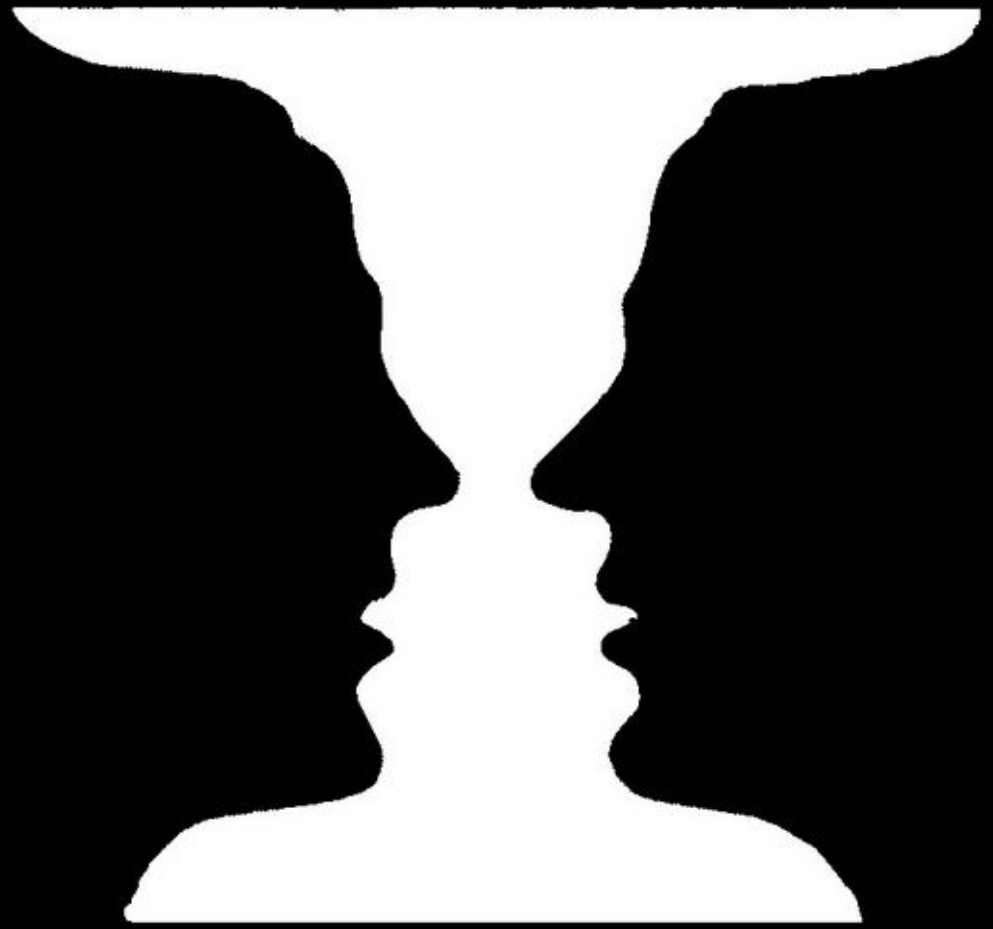
Plan and diagram of Julio Le Parc with members of GRAV, "Labyrinthe," 1964-65. Left, plan at the Musée d'Art Modern de la Ville de Paris in the context of the 1963 Biennale de Paris, 1963. Below, diagram for New Tendency exhibition at the Musée d'Art Décoratif, Palais du Louvre, 1964.

The original space was a winding corridor roughly nine feet wide, sixty-five feet long, and eight feet high. Artists installed a series of interactive props, sets, and landscapes in miniature in the warren of rooms with a greater concern for making material the full-body perception of the abstractions of space and time.



In 1963, GRAV and New Tendencies artist Julio Le Parc gave conceptual form to this translation of the Gestalt in words and form, a text titled “Proposal for a Place of Action” and the team-driven total environment of “Labyrinth,” the first purely collective artwork of GRAV. Le Parc explained the goal of the collective work:

The tendency we are advocating strives to open up the work, and to alter the work-spectator relationship. It asks the spectator to play a more active part…The end purpose of our work is to free people from their dependence – passivity – and from their usually individual leisure activities, and involve them in an activity that will trigger their positive qualities in a climate of communication and interaction.



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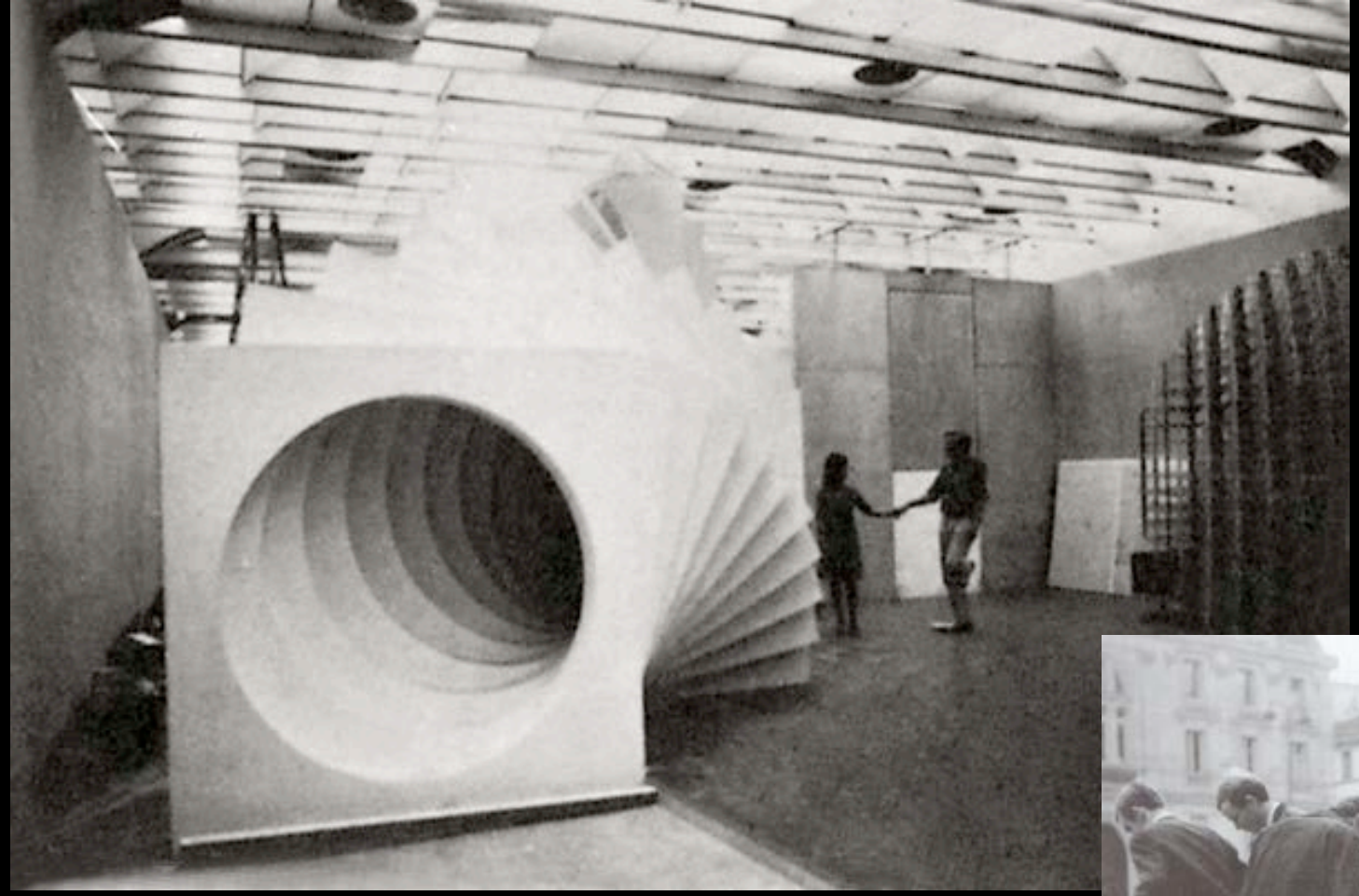


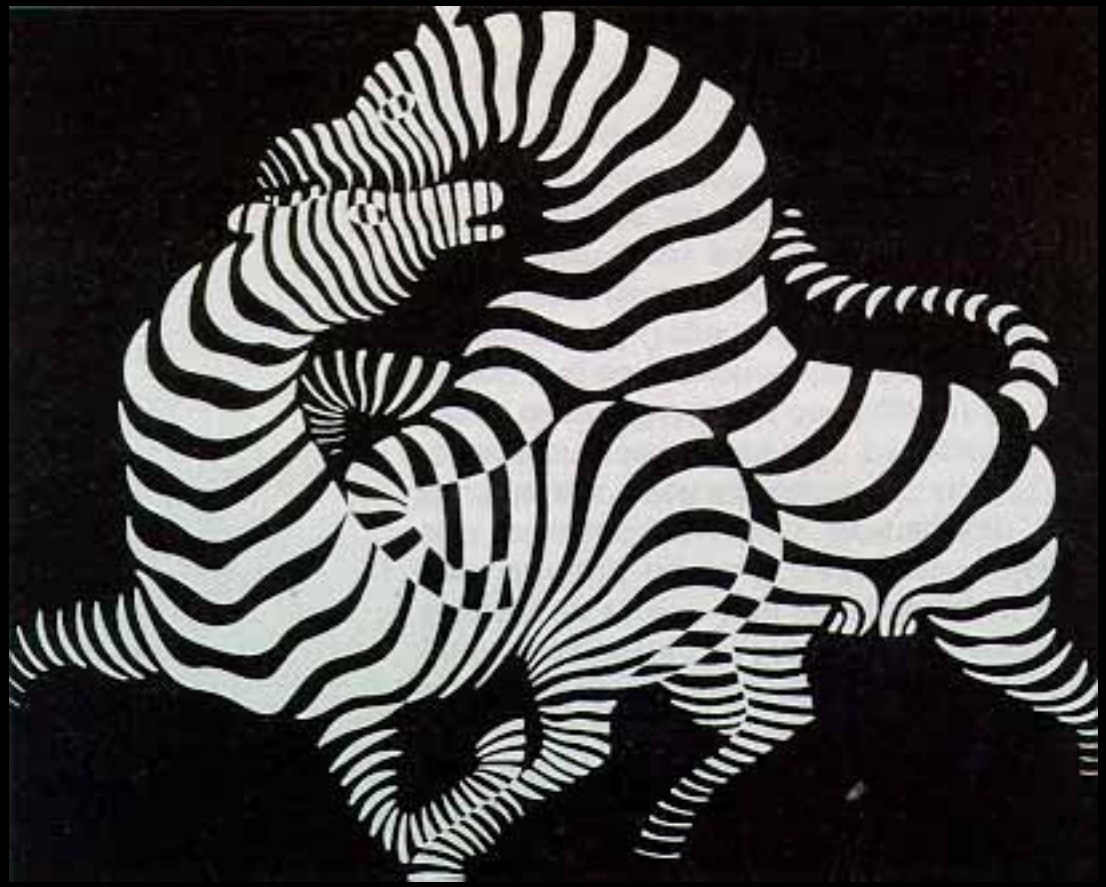
https://www.youtube.com/watch?v=C3PH-u9Zsgo

Paris Biennale 1963

GRAV

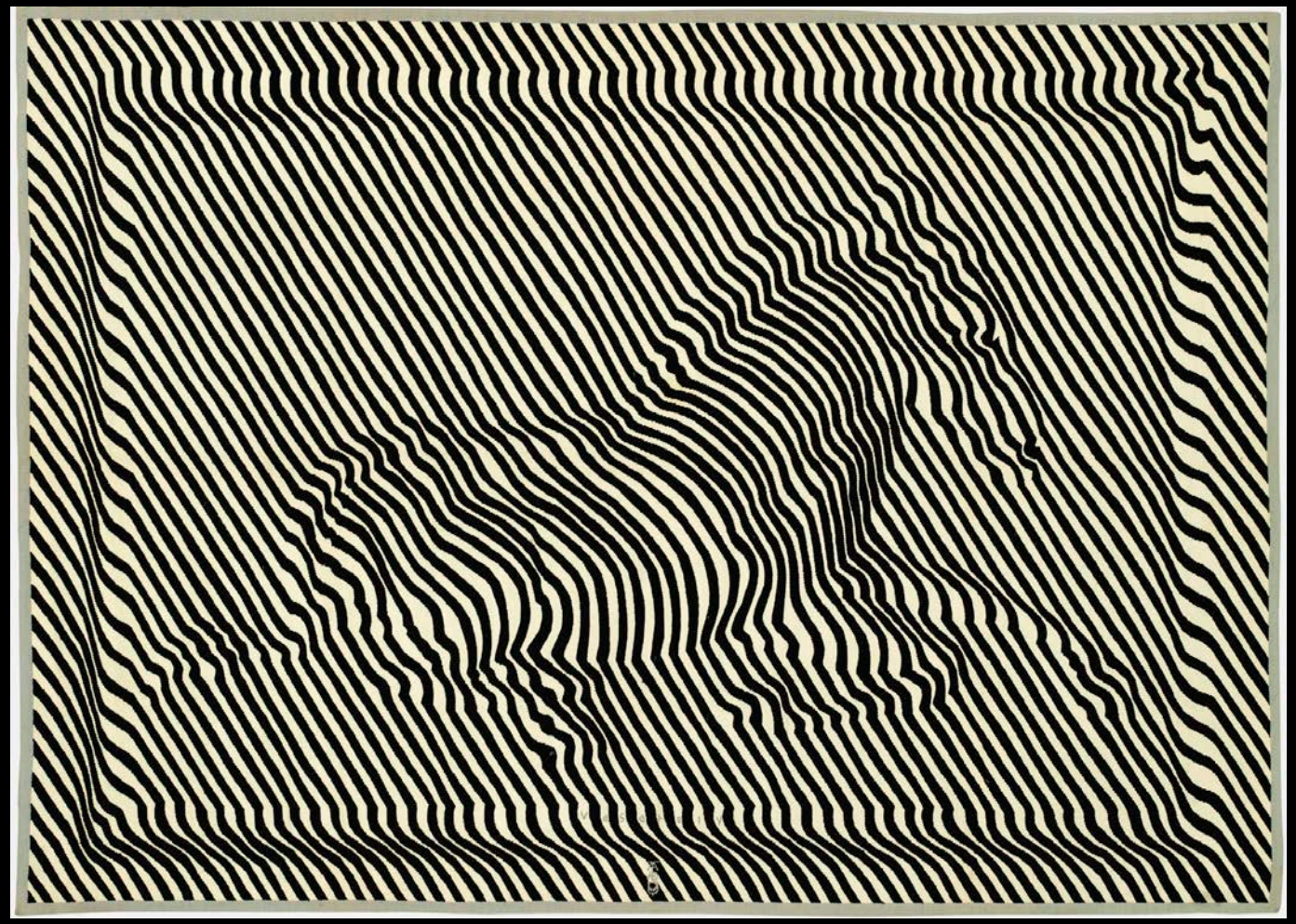
Op Art

Victor Vasarely
[1906-1997]



Vasarely, Zebra, 1937

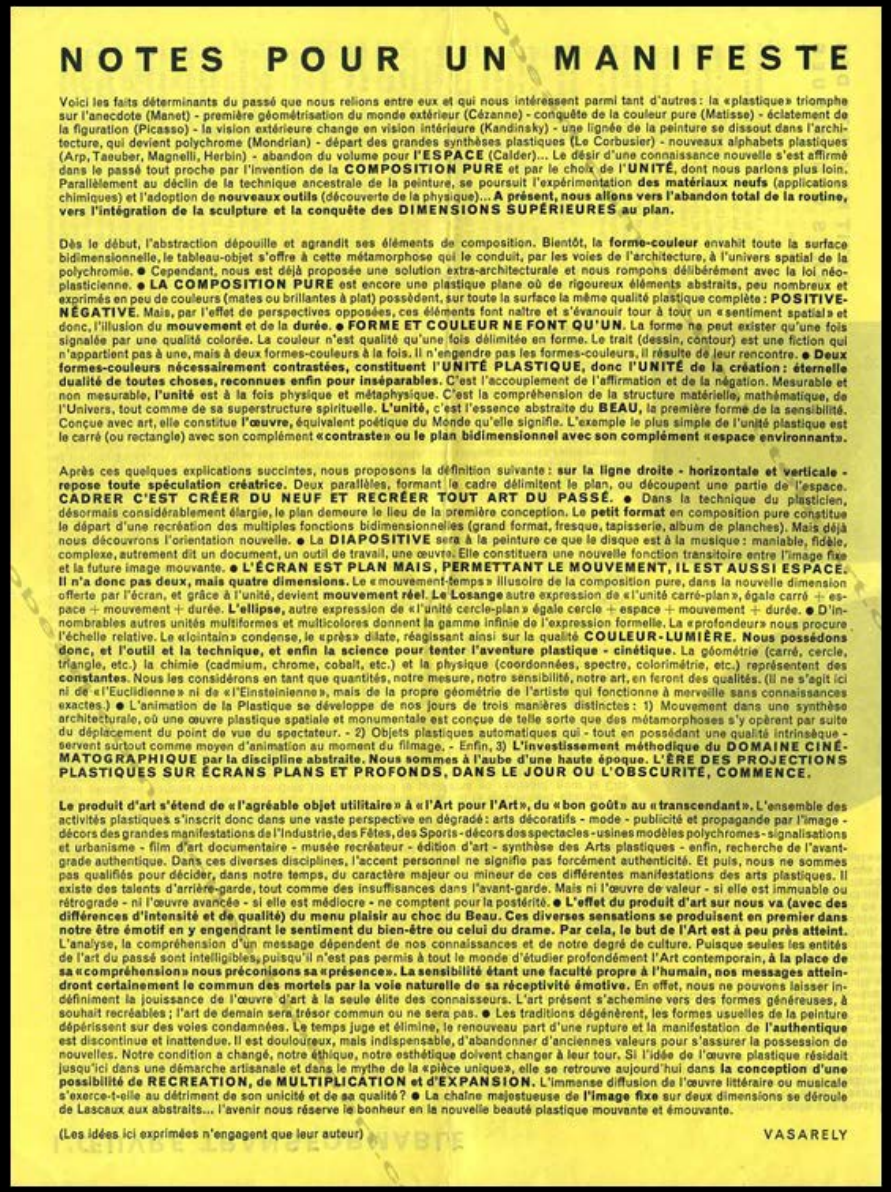
Vasarely, Zebra, 1938



Vasarely, Zebra Tapestry , 1950
wool
Woven with signature *Vasarely* and the Tabard
Frères & Soeurs *TABARD* monogram

Vasarely, Zebras, 1959
Cotton and wool, slit and double interlocking tapestry weave

Le Mouvement, Galerie Denise René, 1955, Paris



NOTES POUR UN MANIFESTE

Voici les faits déterminants du passé que nous relions entre eux et qui nous intéressent parmi tant d'autres : la «plastique» triomphe sur l'anecdote (Manet) - première géométrisation du monde extérieur (Cézanne) - conquête de la couleur pure (Matisse) - éclatement de la figuration (Picasso) - la vision extérieure change en vision intérieure (Kandinsky) - une lignée de la peinture se dissout dans l'architecture, qui devient polychrome (Mondrian) - départ des grandes synthèses plastiques (Le Corbusier) - nouveaux alphabets plastiques (Arp, Taeuber, Magnelli, Herbin) - abandon du volume pour **l'ESPACE** (Calder)... Le désir d'une connaissance nouvelle s'est affirmé dans le passé tout proche par l'invention de la **COMPOSITION PURE** et par le choix de l'**UNITÉ**, dont nous parlons plus loin. Parallèlement au déclin de la technique ancestrale de la peinture, se poursuit l'expérimentation **des matériaux neufs** (applications chimiques) et l'adoption de **nouveaux outils** (découverte de la physique)... **A présent, nous allons vers l'abandon total de la routine, vers l'intégration de la sculpture et la conquête des DIMENSIONS SUPÉRIEURES au plan.**

Dès le début, l'abstraction dépouille et agrandit ses éléments de composition. Bientôt, la **forme-couleur** envahit toute la surface bidimensionnelle, le tableau-objet s'offre à cette métamorphose qui le conduit, par les voies de l'architecture, à l'univers spatial de la polychromie. ● Cependant, nous est déjà proposée une solution extra-architecturale et nous rompons délibérément avec la loi néo-plasticienne. ● **LA COMPOSITION PURE** est encore une plastique plane où de rigoureux éléments abstraits, peu nombreux et exprimés en peu de couleurs (mates ou brillantes à plat) possèdent, sur toute la surface la même qualité plastique complète : **POSITIVE-NÉGATIVE.** Mais, par l'effet de perspectives opposées, ces éléments font naître et s'évanouir tour à tour un «sentiment spatial» et donc, l'illusion du **mouvement** et de la **durée.** ● **FORME ET COULEUR NE FONT QU'UN.** La forme ne peut exister qu'une fois signalée par une qualité colorée. La couleur n'est qualité qu'une fois délimitée en forme. Le trait (dessin, contour) est une fiction qui n'appartient pas à une, mais à deux formes-couleurs à la fois. Il n'engendre pas les formes-couleurs, il résulte de leur rencontre. ● **Deux formes-couleurs nécessairement contrastées, constituent l'UNITÉ PLASTIQUE, donc l'UNITÉ de la création : éternelle dualité de toutes choses, reconnues enfin pour inséparables.** C'est l'accouplement de l'affirmation et de la négation. Mesurable et non mesurable, **l'unité** est à la fois physique et métaphysique. C'est la compréhension de la structure matérielle, mathématique, de l'Univers, tout comme de sa superstructure spirituelle. **L'unité,** c'est l'essence abstraite du **BEAU,** la première forme de la sensibilité. Conçue avec art, elle constitue **l'œuvre,** équivalent poétique du Monde qu'elle signifie. L'exemple le plus simple de l'unité plastique est le carré (ou rectangle) avec son complément **«contraste» ou le plan bidimensionnel avec son complément «espace environnant».**

Après ces quelques explications succintes, nous proposons la définition suivante : **sur la ligne droite - horizontale et verticale - repose toute spéculation créatrice.** Deux parallèles, formant le cadre délimitent le plan, ou découpent une partie de l'espace. **CADRER C'EST CRÉER DU NEUF ET RECRÉER TOUT ART DU PASSÉ.** ● Dans la technique du plasticien, désormais considérablement élargie, le plan demeure le lieu de la première conception. **Le petit format** en composition pure constitue le départ d'une recréation des multiples fonctions bidimensionnelles (grand format, fresque, tapisserie, album de planches). Mais déjà nous découvrons l'orientation nouvelle. ● La **DIAPOSITIVE** sera à la peinture ce que le disque est à la musique : maniable, fidèle, complexe, autrement dit un document, un outil de travail, une œuvre. Elle constituera une nouvelle fonction transitoire entre l'image fixe et la future image mouvante. ● **L'ÉCRAN EST PLAN MAIS, PERMETTANT LE MOUVEMENT, IL EST AUSSI ESPACE. Il n'a donc pas deux, mais quatre dimensions.** Le «mouvement-temps» illusoire de la composition pure, dans la nouvelle dimension offerte par l'écran, et grâce à l'unité, devient **mouvement réel. Le Losange** autre expression de «l'unité carré-plan», égale carré + espace + mouvement + durée. **L'ellipse,** autre expression de «l'unité cercle-plan» égale cercle + espace + mouvement + durée. ● D'innombrables autres unités multiformes et multicolores donnent la gamme infinie de l'expression formelle. La «profondeur» nous procure l'échelle relative. Le «lointain» condense, le «près» dilate, réagissant ainsi sur la qualité **COULEUR-LUMIÈRE. Nous possédons donc, et l'outil et la technique, et enfin la science pour tenter l'aventure plastique - cinétique.** La géométrie (carré, cercle, triangle, etc.) la chimie (cadmium, chrome, cobalt, etc.) et la physique (coordonnées, spectre, colorimétrie, etc.) représentent des **constantes.** Nous les considérons en tant que quantités, notre mesure, notre sensibilité, notre art, en feront des qualités. (Il ne s'agit ici ni de «l'Euclidienne» ni de «l'Einsteinienne», mais de la propre géométrie de l'artiste qui fonctionne à merveille sans connaissances exactes.) ● L'animation de la Plastique se développe de nos jours de trois manières distinctes : 1) Mouvement dans une synthèse architecturale, où une œuvre plastique spatiale et monumentale est conçue de telle sorte que des métamorphoses s'y opèrent par suite du déplacement du point de vue du spectateur. - 2) Objets plastiques automatiques qui - tout en possédant une qualité intrinsèque - servent surtout comme moyen d'animation au moment du filmage. - Enfin, 3) **L'investissement méthodique du DOMAINE CINÉMATOGRAPHIQUE par la discipline abstraite. Nous sommes à l'aube d'une haute époque. L'ÈRE DES PROJECTIONS PLASTIQUES SUR ÉCRANS PLANS ET PROFONDS, DANS LE JOUR OU L'OBSCURITÉ, COMMENCE.**

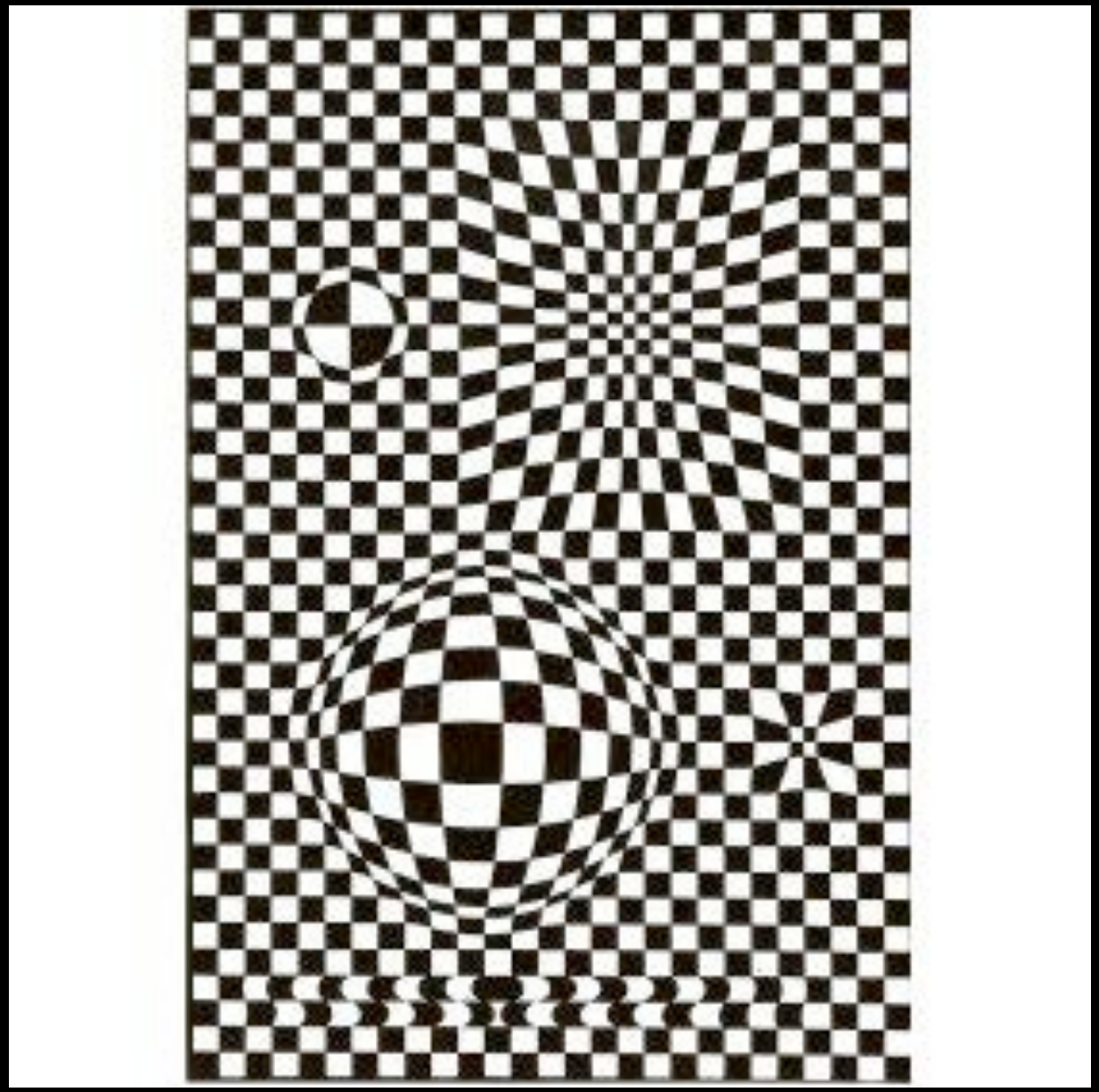
Le produit d'art s'étend de «l'agréable objet utilitaire» à «l'Art pour l'Art», du «bon goût» au «transcendant». L'ensemble des activités plastiques s'inscrit donc dans une vaste perspective en dégradé : arts décoratifs - mode - publicité et propagande par l'image - décors des grandes manifestations de l'Industrie, des Fêtes, des Sports - décors des spectacles - usines modèles polychromes - signalisations et urbanisme - film d'art documentaire - musée recréateur - édition d'art - synthèse des Arts plastiques - enfin, recherche de l'avant-grade authentique. Dans ces diverses disciplines, l'accent personnel ne signifie pas forcément authenticité. Et puis, nous ne sommes pas qualifiés pour décider, dans notre temps, du caractère majeur ou mineur de ces différentes manifestations des arts plastiques. Il existe des talents d'arrière-garde, tout comme des insuffisances dans l'avant-garde. Mais ni l'œuvre de valeur - si elle est immuable ou rétrograde - ni l'œuvre avancée - si elle est médiocre - ne comptent pour la postérité. ● **L'effet du produit d'art sur nous va (avec des différences d'intensité et de qualité) du menu plaisir au choc du Beau. Ces diverses sensations se produisent en premier dans notre être émotif en y engendrant le sentiment du bien-être ou celui du drame. Par cela, le but de l'Art est à peu près atteint.** L'analyse, la compréhension d'un message dépendent de nos connaissances et de notre degré de culture. Puisque seules les entités de l'art du passé sont intelligibles, puisqu'il n'est pas permis à tout le monde d'étudier profondément l'Art contemporain, **à la place de sa «compréhension» nous préconisons sa «présence». La sensibilité étant une faculté propre à l'humain, nos messages atteindront certainement le commun des mortels par la voie naturelle de sa réceptivité émotive.** En effet, nous ne pouvons laisser indéfiniment la jouissance de l'œuvre d'art à la seule élite des connaisseurs. L'art présent s'achemine vers des formes généreuses, à souhait recréables ; l'art de demain sera trésor commun ou ne sera pas. ● Les traditions dégénèrent, les formes usuelles de la peinture dépérissent sur des voies condamnées. Le temps juge et élimine, le renouveau part d'une rupture et la manifestation de **l'authentique** est discontinue et inattendue. Il est douloureux, mais indispensable, d'abandonner d'anciennes valeurs pour s'assurer la possession de nouvelles. Notre condition a changé, notre éthique, notre esthétique doivent changer à leur tour. Si l'idée de l'œuvre plastique résidait jusqu'ici dans une démarche artisanale et dans le mythe de la «pièce unique», elle se retrouve aujourd'hui dans **la conception d'une possibilité de RECREATION, de MULTIPLICATION et d'EXPANSION.** L'immense diffusion de l'œuvre littéraire ou musicale s'exerce-t-elle au détriment de son unicité et de sa qualité ? ● La chaîne majestueuse de **l'image fixe** sur deux dimensions se déroule de Lascaux aux abstraits... l'avenir nous réserve le bonheur en la nouvelle beauté plastique mouvante et émouvante.

(Les idées ici exprimées n'engagent que leur auteur)

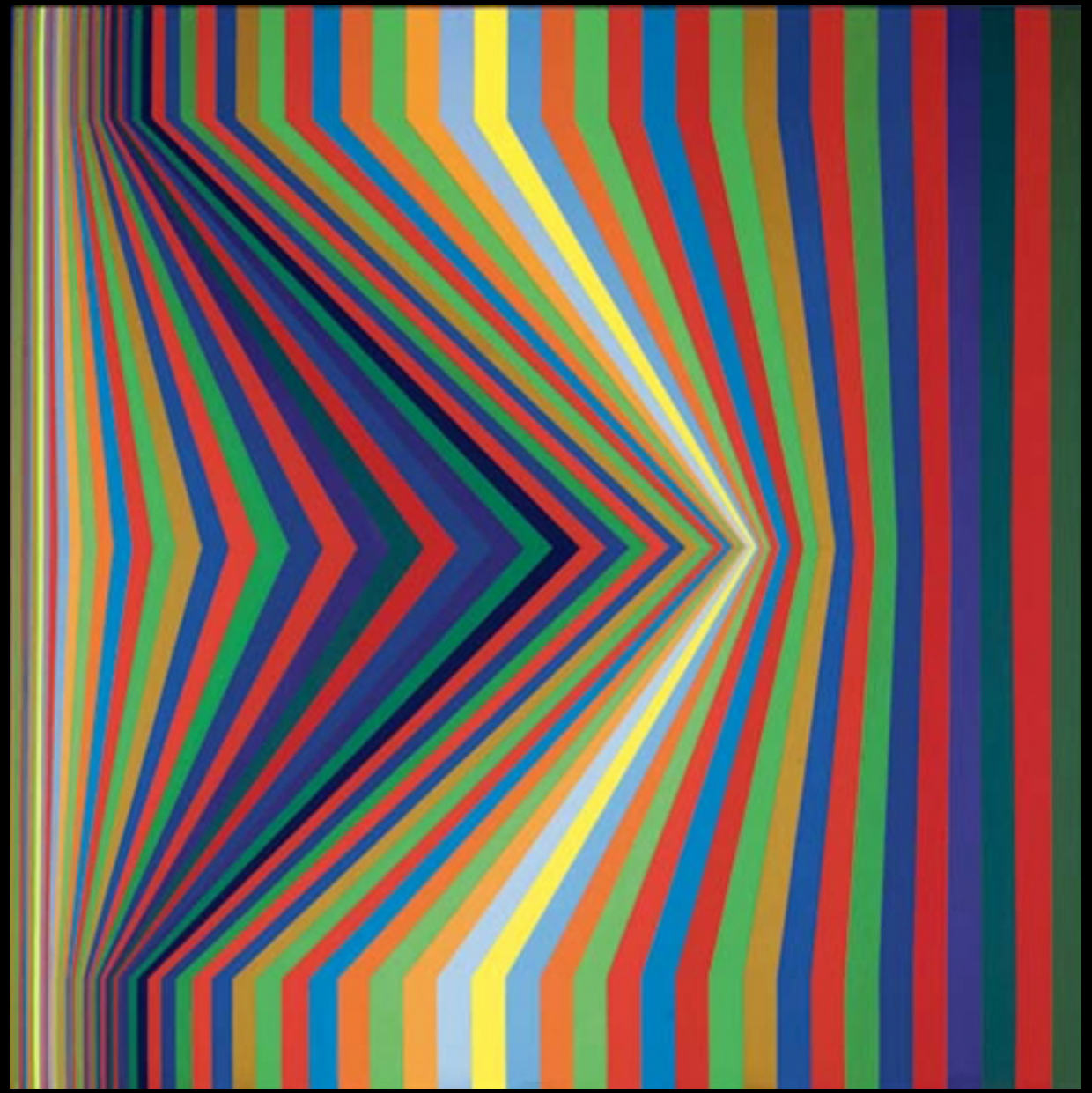
VASARELY

Plastic Kinetics

For the artist “painting and sculpture become anachronistic terms: it’s more exact to speak of bi-, tri- and multidimensional plastic art. We no longer have distinct manifestations of a creative sensibility, but the development of a single plastic sensibility in different spaces.” Vasarely continues, “Movement does not rely on composition nor a specific subject, but on the apprehension of the act of looking, which by itself is considered as the only creator.”



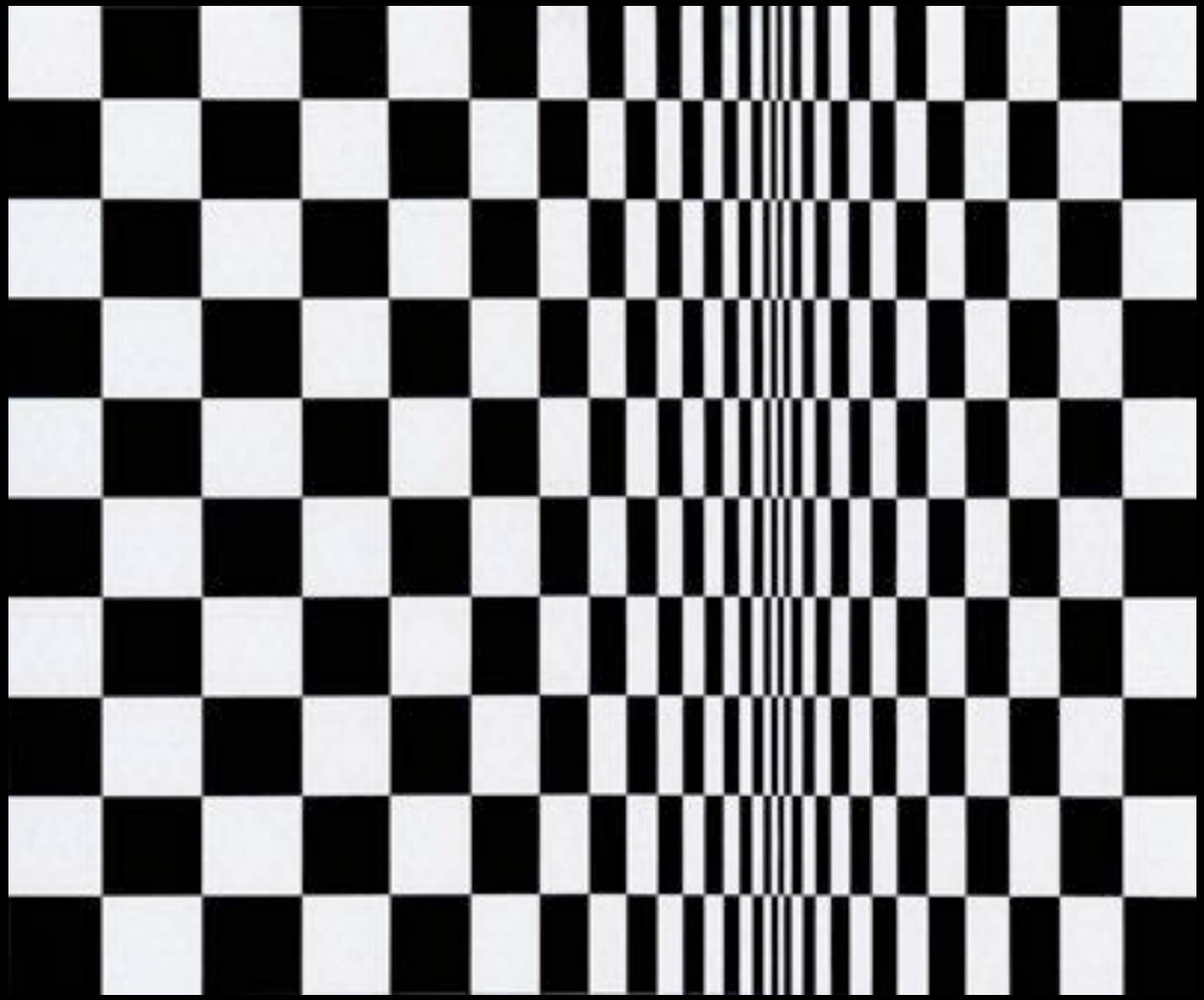
Victor Vasarely, Vega, 1957



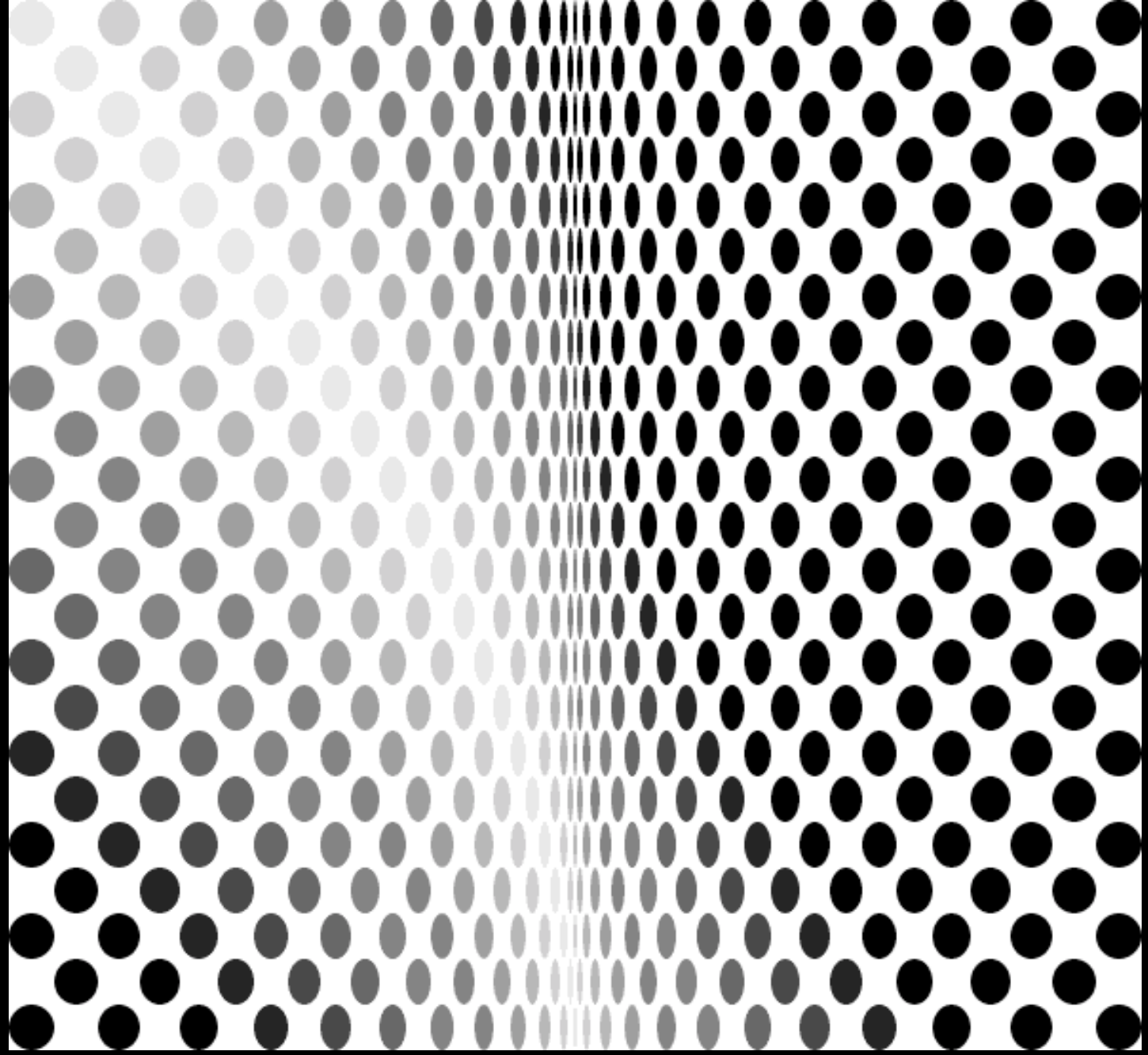
Victor Vasarely, *Berc*, 1967

Vasarely, Kroa A, 1968

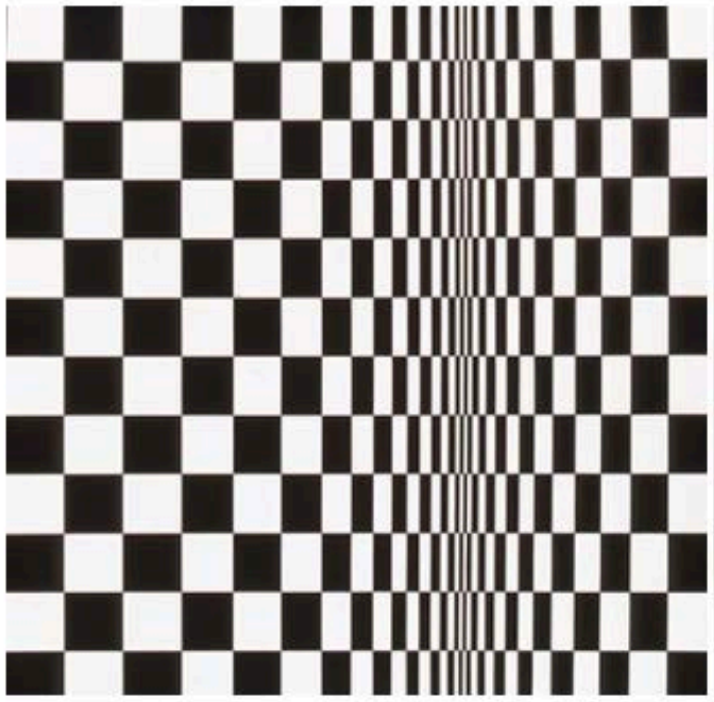
Bridget Riley (b. 1931-)



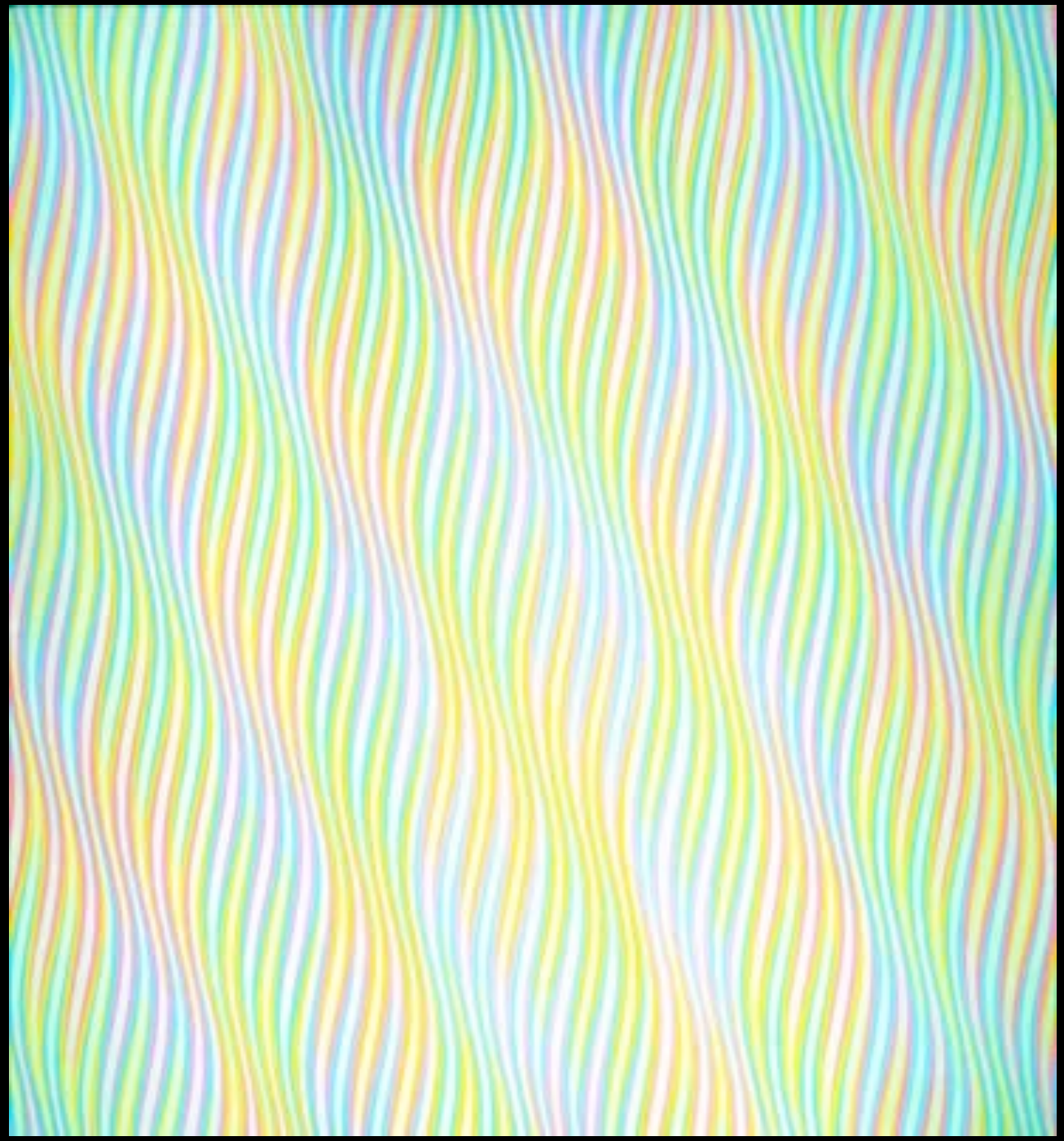
Bridget Riley, Movement in Squares, 1961



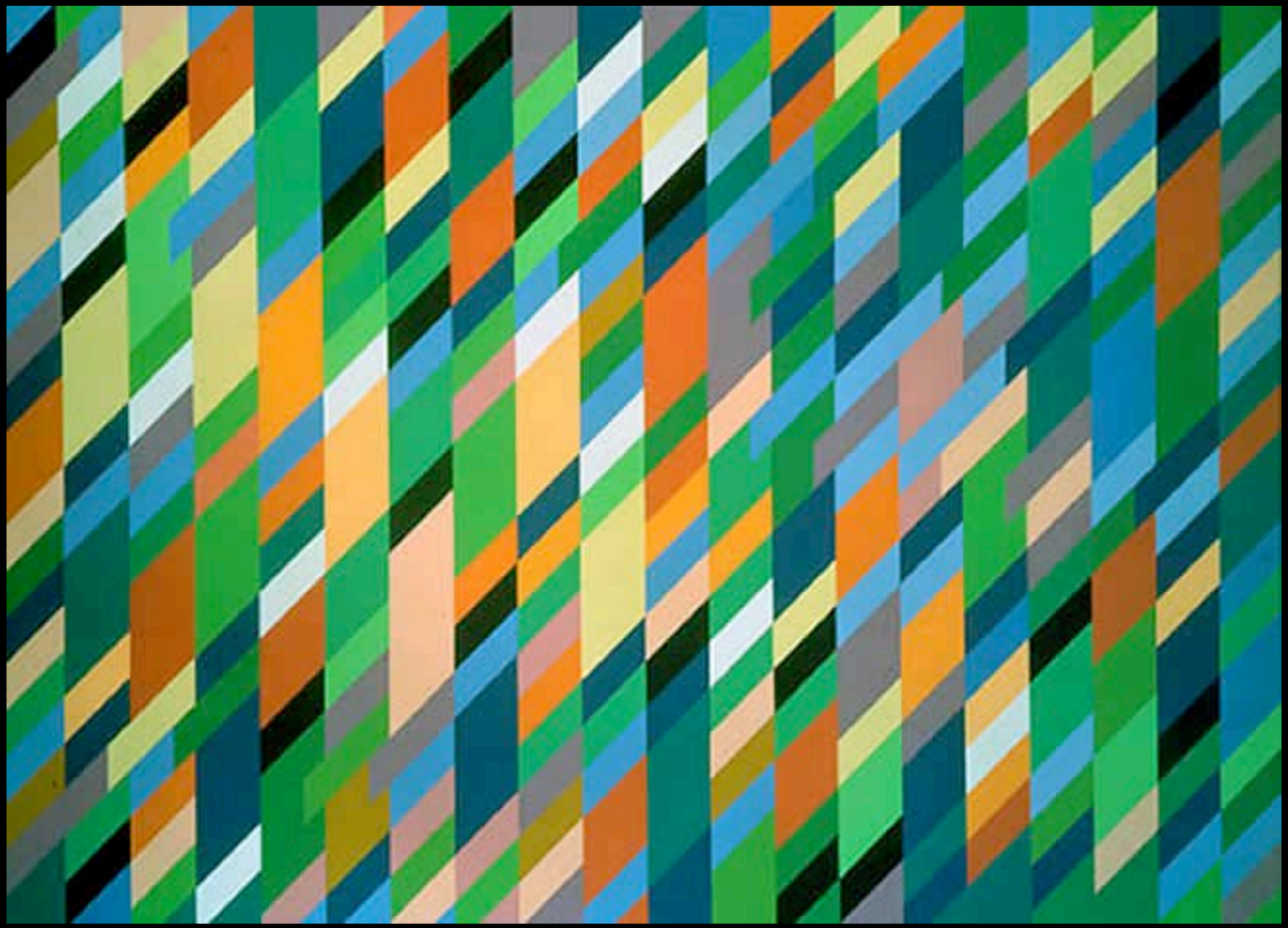
Bridget Riley, Loss, 1964



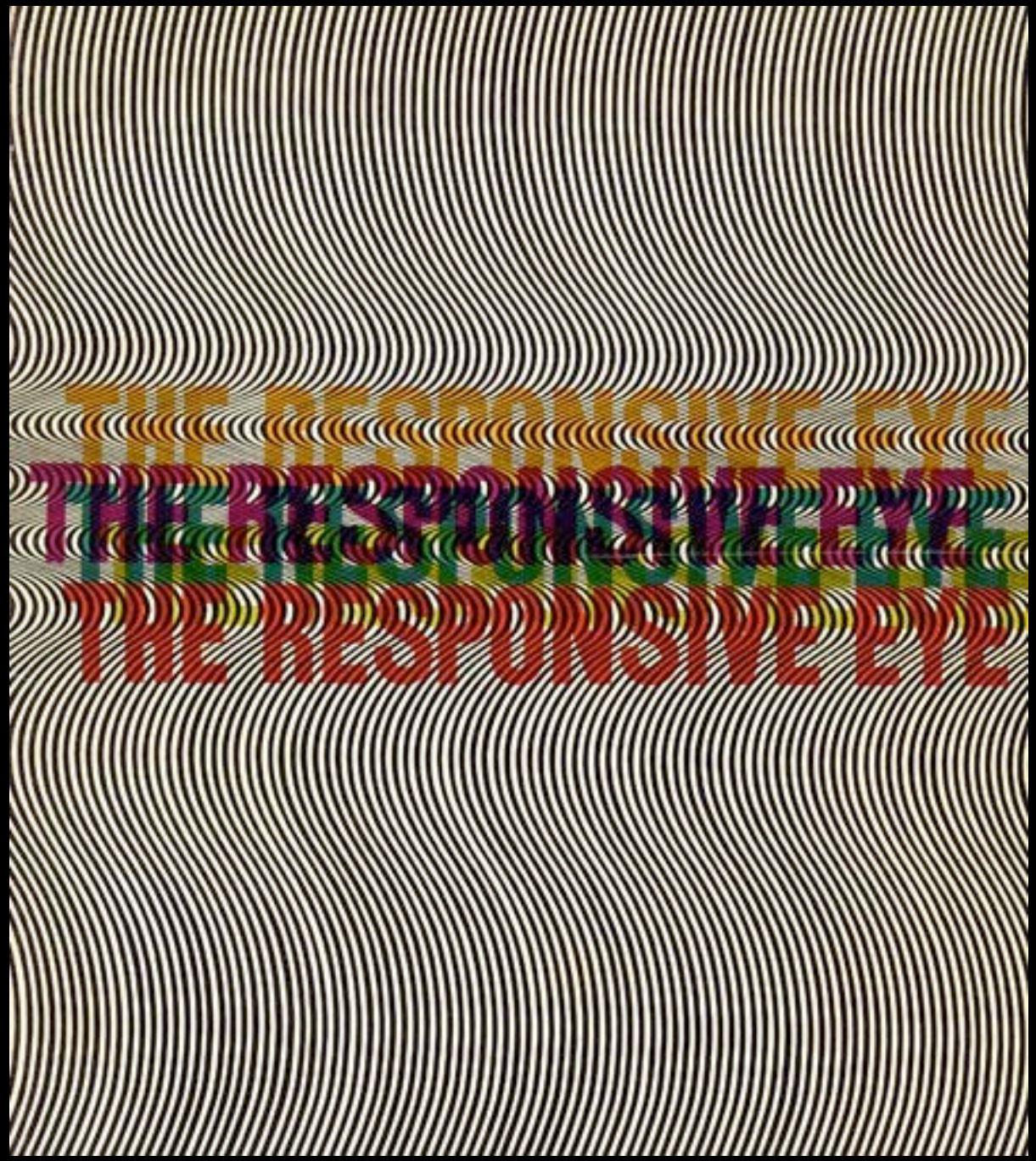
ANTIVERT*
MECLIZINE and NIACIN
STOPS VERTIGO



Bridget Riley, Aurulum, 1978



Bridget Riley, ***High Sky 2,*** 1992



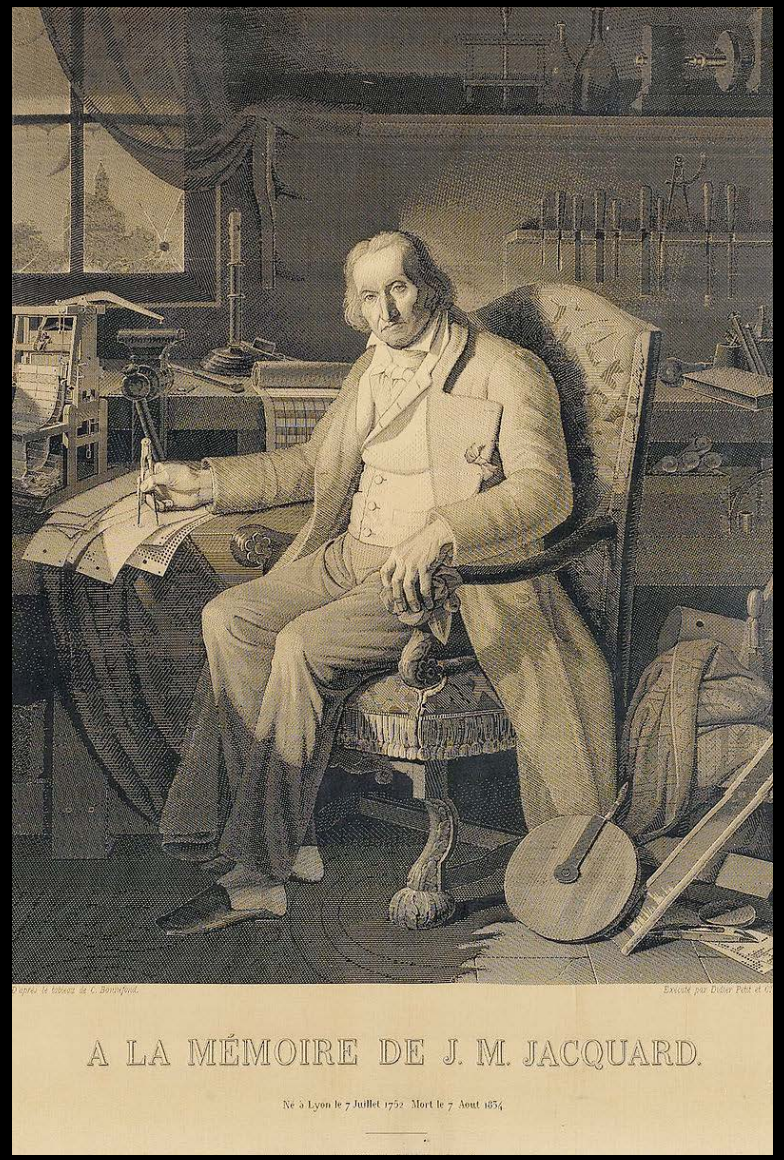
MoMA, William C. Seitz

February 1965

http://www.youtube.com/watch?v=GxgqN2Gf-Do

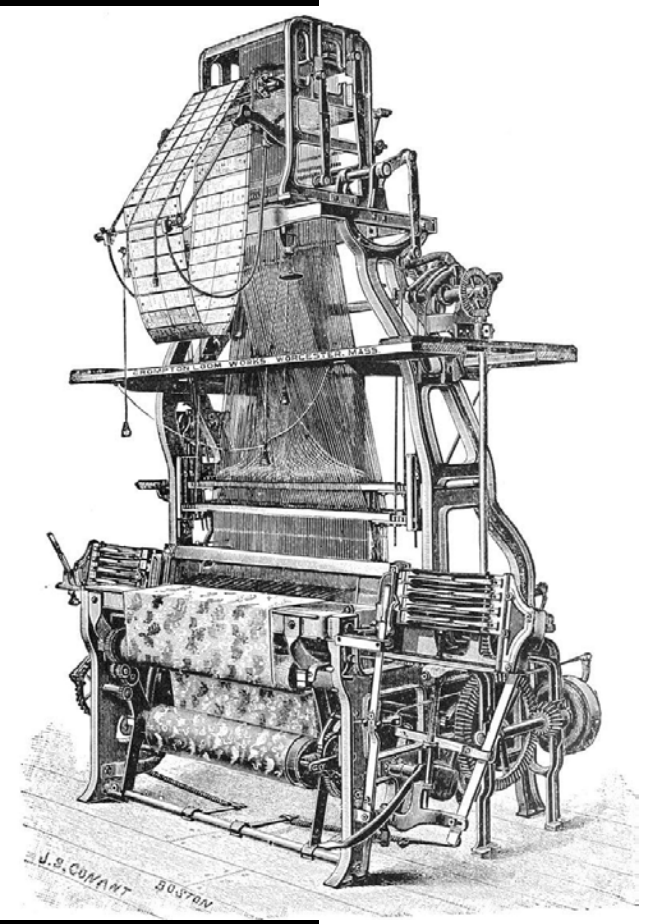
http://www.youtube.com/watch?v=vaUme6DY8Lk

The Rise of the Digital Image in Art: Origins, Bell Labs and E.A.T.

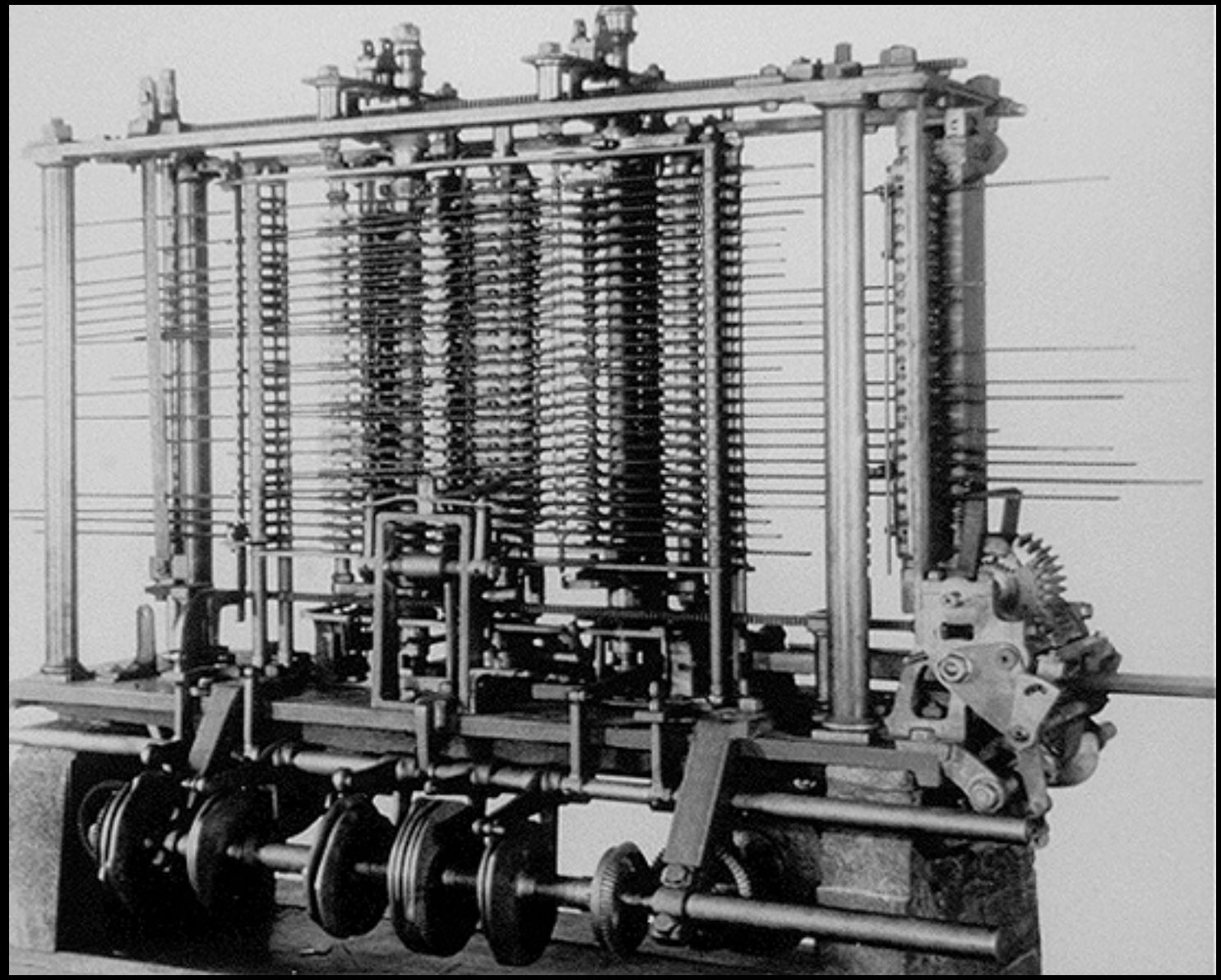


Joseph Marie Jacquard [1752-1834] portrait of Jacquard was woven in silk on a Jacquard loom and required 24,000 punched cards to create (1839).

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]

Ada Lovelace (1815-1852)

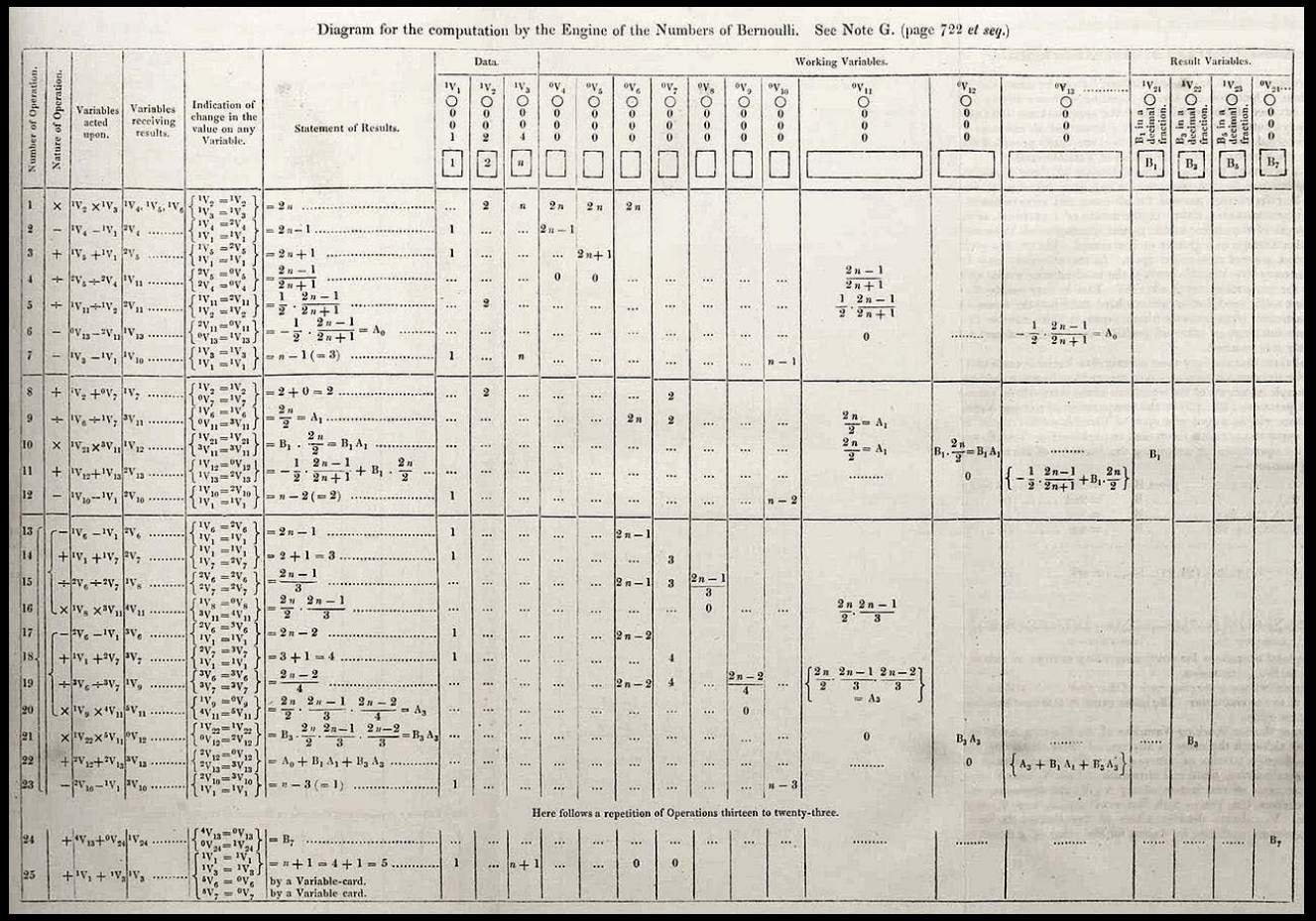


Diagram for the computation by the Engine of the Numbers of Bernoulli. See Note G. (page 722 *et seq.*)

Number of Operation.	Nature of Operation.	Variables acted upon.	Variables receiving results.	Indication of change in the value on any Variable.	Statement of Results.	Data.			Working Variables.									Result Variables.			
						$^1V_1$ 0 0 0 1	$^1V_2$ 0 0 0 2	$^1V_3$ 0 0 0 4	$^0V_4$ 0 0 0 0	$^0V_5$ 0 0 0 0	$^0V_6$ 0 0 0 0	$^0V_7$ 0 0 0 0	$^0V_8$ 0 0 0 0	$^0V_9$ 0 0 0 0	$^0V_{10}$ 0 0 0 0	$^0V_{11}$ 0 0 0 0	$^0V_{12}$ 0 0 0 0	$^0V_{13}$ 0 0 0 0	$^1V_{21}$ B_1 in a decimal fraction.	$^1V_{22}$ B_2 in a decimal fraction.	$^1V_{23}$ B_3 in a decimal fraction.	$^0V_{24}$... 0 0 0 0
						1	2	n												B_1	B_2	B_3	B_7
1	×	$^1V_2 \times {}^1V_3$	$^1V_4, {}^1V_5, {}^1V_6$		$= 2n$	...	2	n	$2n$	$2n$	$2n$												
2	−	$^1V_4 - {}^1V_1$	$^2V_4$		$= 2n-1$	1	...	...	$2n-1$														
3	+	$^1V_5 + {}^1V_1$	$^2V_5$		$= 2n+1$	1	...	...	...	$2n+1$													
4	+	$^2V_5 \div {}^2V_4$	$^1V_{11}$		$= \frac{2n-1}{2n+1}$	...	...	...	0	0	...	...	...	...	...	$\frac{2n-1}{2n+1}$							
5	+	$^1V_{11} \div {}^1V_2$	$^2V_{11}$		$= \frac{1}{2} \cdot \frac{2n-1}{2n+1}$	...	2	...	...	...	...	...	...	...	...	$\frac{1}{2} \cdot \frac{2n-1}{2n+1}$							
6	−	$^0V_{13} - {}^2V_{11}$	$^1V_{12}$	$\begin{cases} {}^2V_{11} = {}^0V_{11} \\ {}^0V_{13} = {}^1V_{12} \end{cases}$	$= -\frac{1}{2} \cdot \frac{2n-1}{2n+1} = A_0$	...	...	...	...	...	...	...	...	...	...	0	.....	$-\frac{1}{2} \cdot \frac{2n-1}{2n+1} = A_0$					
7	−	$^1V_3 - {}^1V_1$	$^1V_{10}$	$\begin{cases} {}^1V_3 = {}^1V_3 \\ {}^1V_1 = {}^1V_1 \end{cases}$	$= n-1\ (=3)$	1	...	n	...	...	...	...	...	...	$n-1$								
8	+	$^1V_2 + {}^0V_7$	$^1V_7$	$\begin{cases} {}^1V_2 = {}^1V_2 \\ {}^0V_7 = {}^1V_7 \end{cases}$	$= 2+0=2$	...	2	...	...	...	...	2											
9	+	$^1V_6 \div {}^1V_7$	$^2V_{11}$	$\begin{cases} {}^1V_6 = {}^1V_6 \\ {}^0V_{11} = {}^2V_{11} \end{cases}$	$= \frac{2n}{2} = A_1$	...	...	...	...	...	$2n$	2	...	...	...	$\frac{2n}{2} = A_1$							
10	×	$^1V_{21} \times {}^2V_{11}$	$^1V_{12}$	$\begin{cases} {}^1V_{21} = {}^1V_{21} \\ {}^2V_{11} = {}^2V_{12} \end{cases}$	$= B_1 \cdot \frac{2n}{2} = B_1 A_1$	...	...	...	...	...	...	...	...	...	...	$\frac{2n}{2} = A_1$	$B_1 \cdot \frac{2n}{2} = B_1 A_1$	.....	B_1			
11	+	$^1V_{12} + {}^1V_{13}$	$^2V_{13}$	$\begin{cases} {}^1V_{12} = {}^0V_{12} \\ {}^1V_{13} = {}^2V_{13} \end{cases}$	$= -\frac{1}{2} \cdot \frac{2n-1}{2n+1} + B_1 \cdot \frac{2n}{2}$ ...	...	...	...	...	...	...	...	...	...	...	.....	0	$\left\{-\frac{1}{2} \cdot \frac{2n-1}{2n+1} + B_1 \cdot \frac{2n}{2}\right\}$				
12	−	$^1V_{10} - {}^1V_1$	$^2V_{10}$	$\begin{cases} {}^1V_{10} = {}^2V_{10} \\ {}^1V_1 = {}^1V_1 \end{cases}$	$= n-2\ (=2)$	1	...	...	...	...	...	...	...	...	$n-2$								
13	−	$^1V_6 - {}^1V_1$	$^2V_6$	$\begin{cases} {}^1V_6 = {}^2V_6 \\ {}^1V_1 = {}^1V_1 \end{cases}$	$= 2n-1$	1	...	...	...	...	$2n-1$												
14	+	$^1V_1 + {}^1V_7$	$^2V_7$	$\begin{cases} {}^1V_1 = {}^1V_1 \\ {}^1V_7 = {}^2V_7 \end{cases}$	$= 2+1=3$	1	...	...	...	...	...	3											
15	÷	$^2V_6 \div {}^2V_7$	$^1V_8$	$\begin{cases} {}^2V_6 = {}^2V_6 \\ {}^2V_7 = {}^2V_7 \end{cases}$	$= \frac{2n-1}{3}$	...	...	...	...	...	$2n-1$	3	$\frac{2n-1}{3}$										
16	×	$^1V_8 \times {}^3V_{11}$	$^4V_{11}$	$\begin{cases} {}^1V_8 = {}^0V_8 \\ {}^3V_{11} = {}^4V_{11} \end{cases}$	$= \frac{2n}{2} \cdot \frac{2n-1}{3}$	...	...	...	...	...	...	...	0	...	...	$\frac{2n}{2} \cdot \frac{2n-1}{3}$							
17	−	$^2V_6 - {}^1V_1$	$^3V_6$	$\begin{cases} {}^2V_6 = {}^3V_6 \\ {}^1V_1 = {}^1V_1 \end{cases}$	$= 2n-2$	1	...	...	...	...	$2n-2$												
18	+	$^1V_1 + {}^3V_7$	$^3V_7$	$\begin{cases} {}^2V_7 = {}^3V_7 \\ {}^1V_1 = {}^1V_1 \end{cases}$	$= 3+1=4$	1	...	...	...	...	...	4											
19	÷	$^3V_6 \div {}^3V_7$	$^1V_9$	$\begin{cases} {}^3V_6 = {}^3V_6 \\ {}^3V_7 = {}^3V_7 \end{cases}$	$= \frac{2n-2}{4}$	...	...	...	...	...	$2n-2$	4	...	$\frac{2n-2}{4}$	...	$\left\{\frac{2n}{2} \cdot \frac{2n-1}{3} \cdot \frac{2n-2}{3}\right\} = A_2$							
20	×	$^1V_9 \times {}^4V_{11}$	$^5V_{11}$	$\begin{cases} {}^1V_9 = {}^0V_9 \\ {}^4V_{11} = {}^5V_{11} \end{cases}$	$= \frac{2n}{2} \cdot \frac{2n-1}{3} \cdot \frac{2n-2}{4} = A_3$ ...	...	...	...	...	...	...	...	...	0								
21	×	$^1V_{22} \times {}^5V_{11}$	$^0V_{12}$	$\begin{cases} {}^1V_{22} = {}^1V_{22} \\ {}^0V_{12} = {}^2V_{12} \end{cases}$	$= B_3 \cdot \frac{2n}{2} \cdot \frac{2n-1}{3} \cdot \frac{2n-2}{4} = B_3 A_3$	...	...	...	...	...	...	...	...	...	...	0	$B_3 A_3$	.....	.....		B_3	
22	+	$^2V_{12} + {}^2V_{13}$	$^3V_{13}$	$\begin{cases} {}^2V_{12} = {}^0V_{12} \\ {}^2V_{13} = {}^3V_{13} \end{cases}$	$= A_0 + B_1 A_1 + B_3 A_3$	...	...	...	...	...	...	...	...	...	...	.....	0	$\left\{A_2 + B_1 A_1 + B_3 A_3\right\}$				
23	−	$^2V_{10} - {}^1V_1$	$^3V_{10}$	$\begin{cases} {}^2V_{10} = {}^3V_{10} \\ {}^1V_1 = {}^1V_1 \end{cases}$	$= n-3\ (=1)$	1	...	...	...	...	...	...	...	...	$n-3$								
Here follows a repetition of Operations thirteen to twenty-three.																							
24	+	$^4V_{13} + {}^0V_{24}$	$^1V_{24}$	$\begin{cases} {}^4V_{13} = {}^0V_{13} \\ {}^0V_{24} = {}^1V_{24} \end{cases}$	$= B_7$	...	...	...	...	...	...	...	...	...	...	.....	.....	.....	.....		.....	.....	B_7
25	+	$^1V_1 + {}^1V_3$	$^1V_3$	$\begin{cases} {}^1V_1 = {}^1V_1 \\ {}^1V_3 = {}^1V_3 \\ {}^4V_7 = {}^0V_6 \\ {}^4V_7 = {}^0V_7 \end{cases}$	$= n+1 = 4+1 = 5$ ..... by a Variable-card. by a Variable card.	1	...	$n+1$	...	...	0	0											

Lovelace's Analytical Engine algorithm for the computation of Bernoulli numbers

Margaret Sarah Carpenter, Ada Lovelace, 1836

ADA LOVELACE

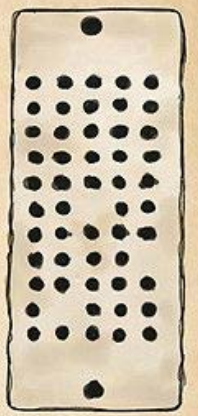
FIRST COMPUTER PROGRAMMER

The Analytical Engine

Lovelace's program turned a complex formula into simple calculations that could be encoded on punched cards and fed into Charles Babbage's Analytical Engine, a mechanical computer that he designed but never built. She published it in 1843, a century before the modern computer age.

"I want to put in something about Bernoulli's Number, in one of my Notes, as an example of how an explicit function may be worked out by the engine, without having been worked out by human head and hands first."

$$\frac{x}{e^x - 1} = \frac{1}{1 + \frac{x}{2} + \frac{x^2}{2 \cdot 3} + \frac{x^3}{2 \cdot 3 \cdot 4} + \&c.}$$



A Universal Computer

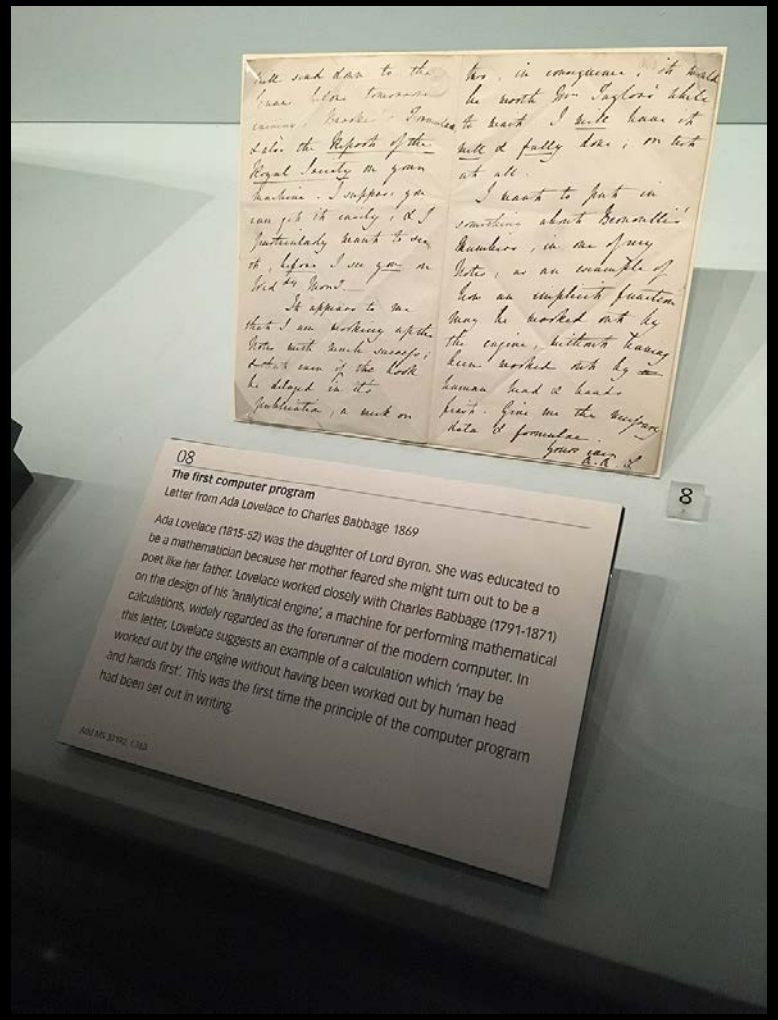
Lovelace did more than write the first computer program. She was also the first person to realise that a general purpose computer could do anything, given the right data and instructions.

"The Analytical Engine weaves algebraic patterns just as the Jacquard loom weaves flowers and leaves."

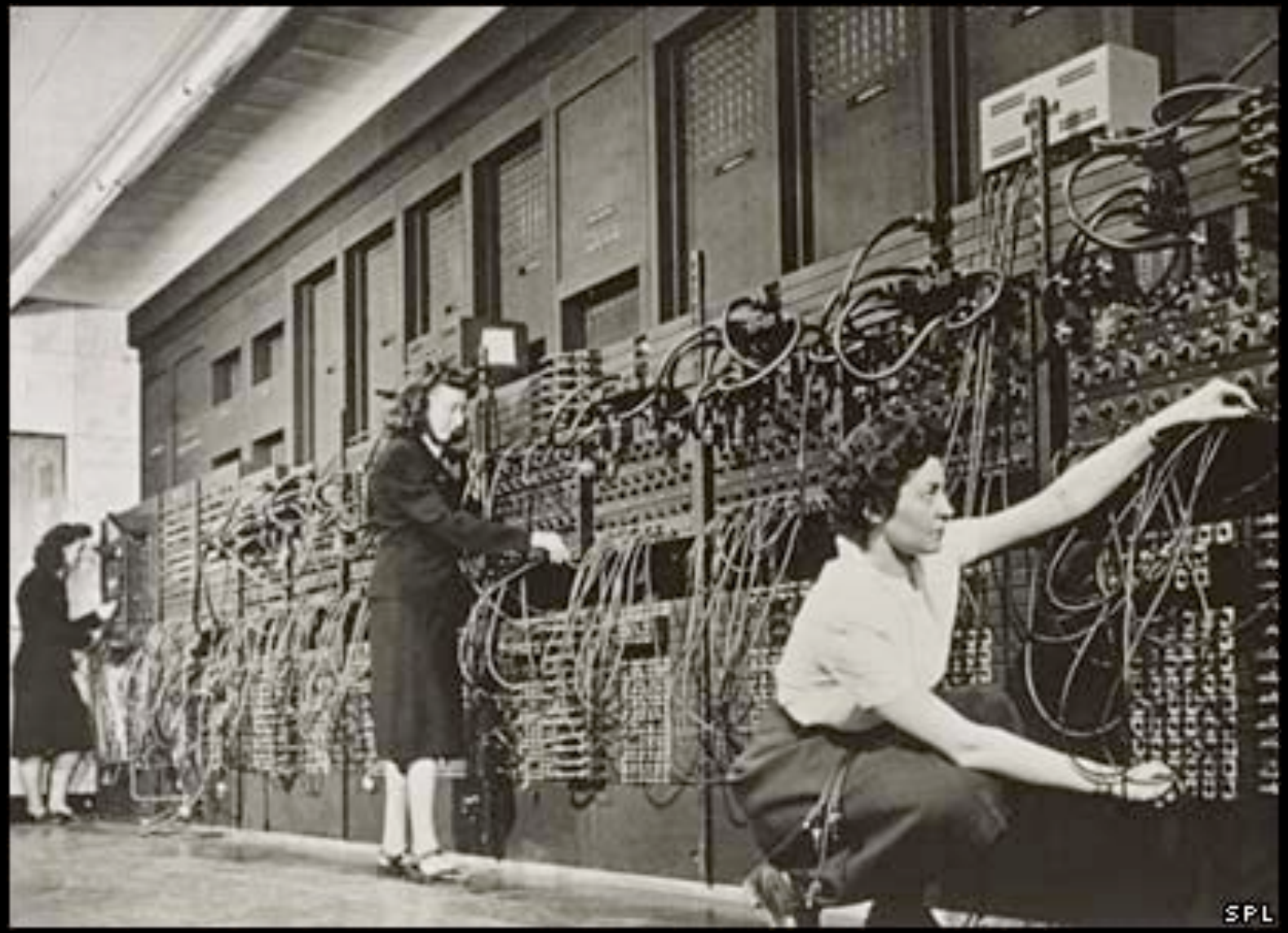
"Supposing, for instance, that the fundamental relations of pitched sounds in the science of harmony and of musical composition were susceptible of such expression and adaptations, the engine might compose elaborate and scientific pieces of music of any degree of complexity or extent."

Augusta Ada King,
Countess of Lovelace
Born: 10 December 1815
Died: 27 November 1852

Ada Lovelace Day
FindingAda.com

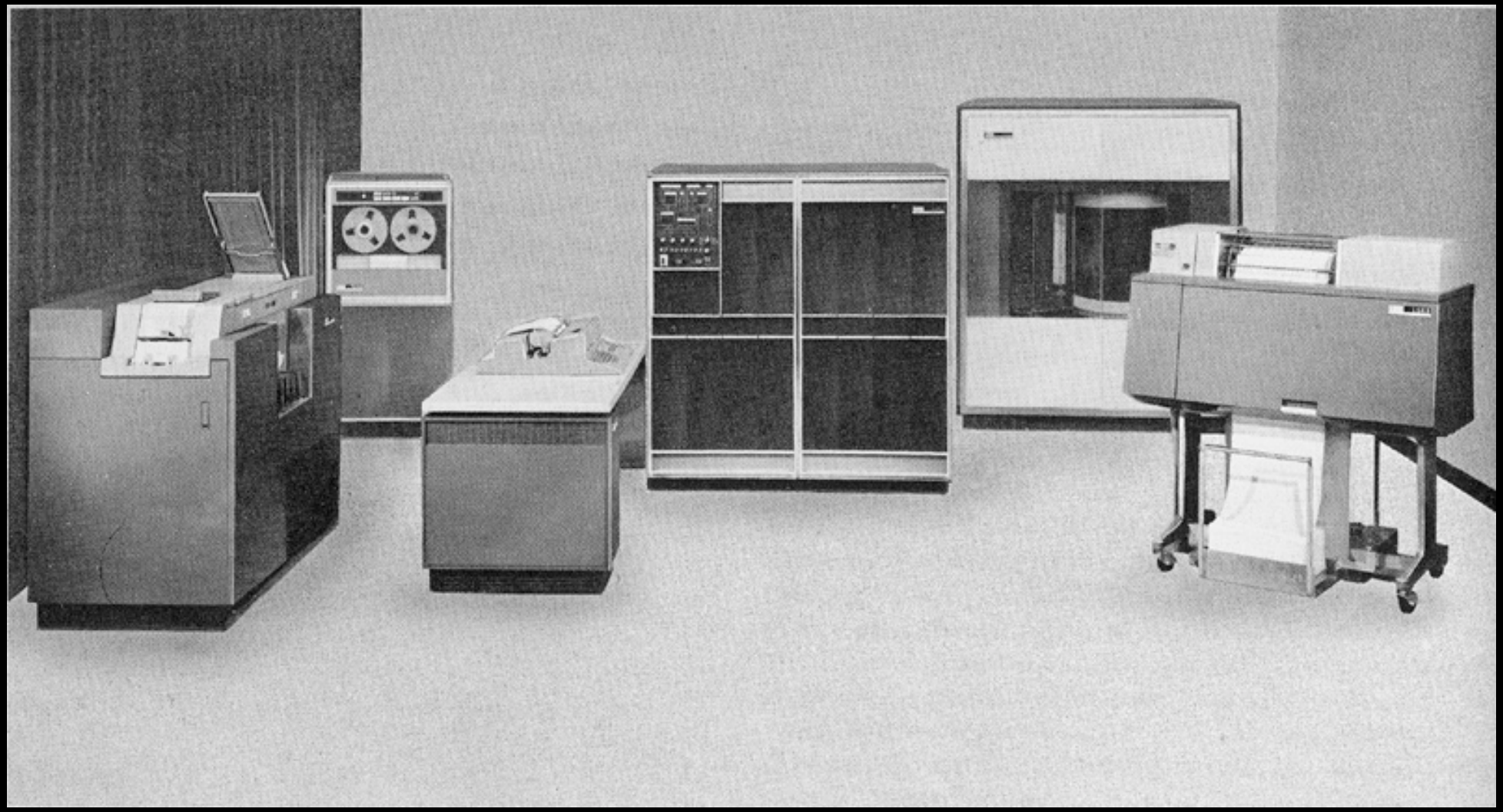


She speculated that the Engine "might act upon other things besides number... the Engine might compose elaborate and scientific pieces of music of any degree of complexity or extent."

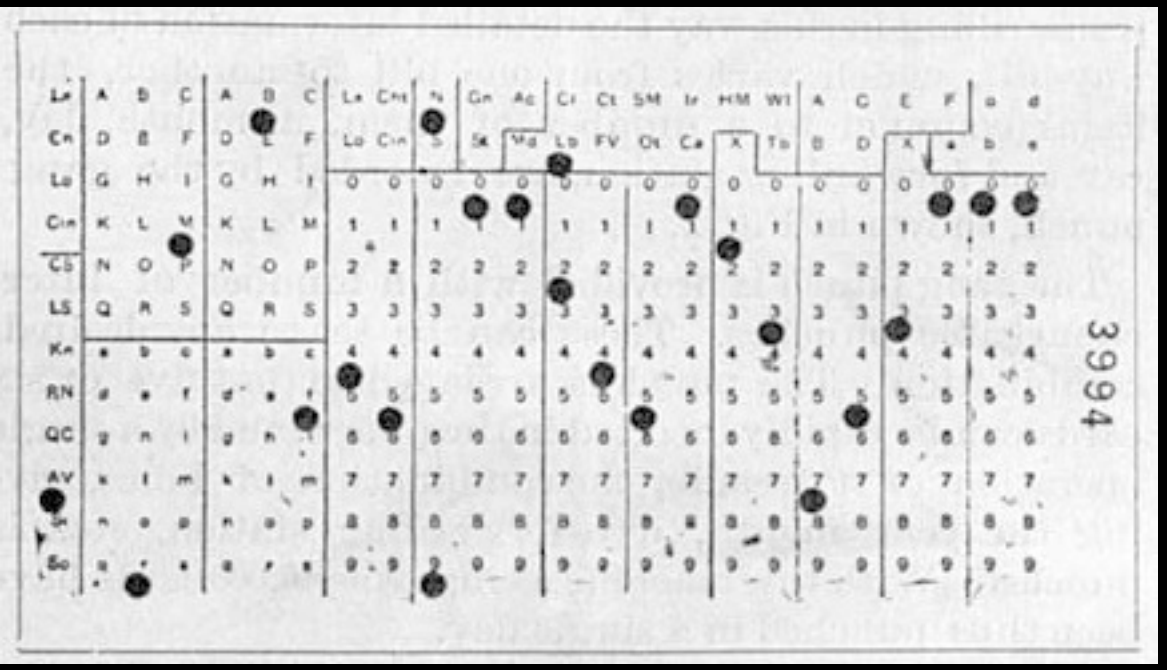


ENIAC [Electronic Numerical Integrator and Computer] Computer at the University of Pennsylvania, 1946, conceived by John Mauchly and J. Presper Eckert

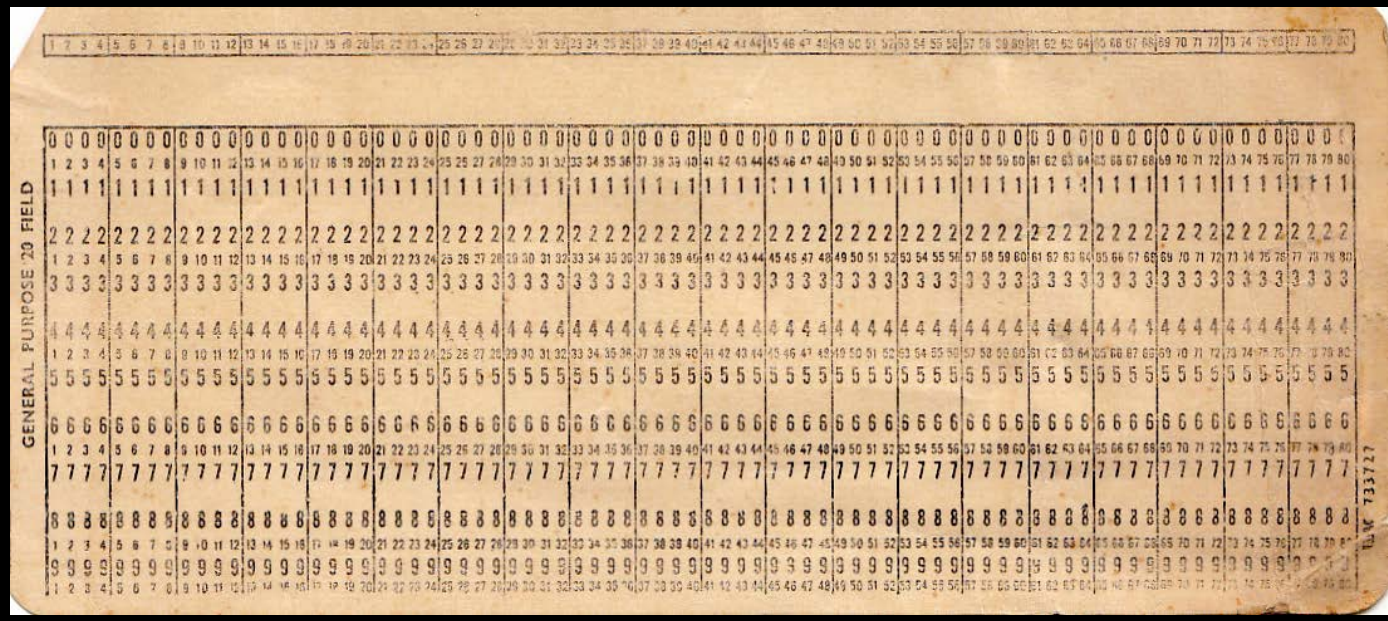
ENIAC vacuum tubes



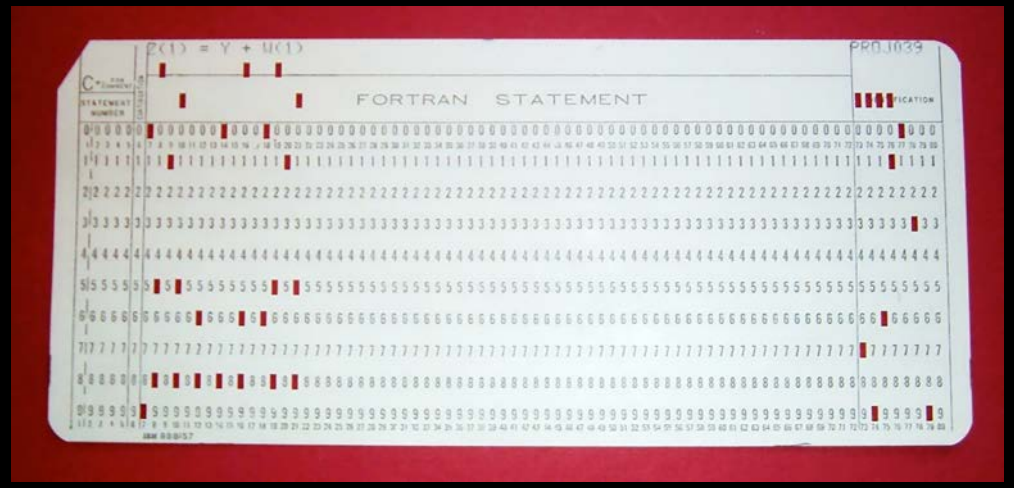
IBM 1401 Data Processing System, 1959



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



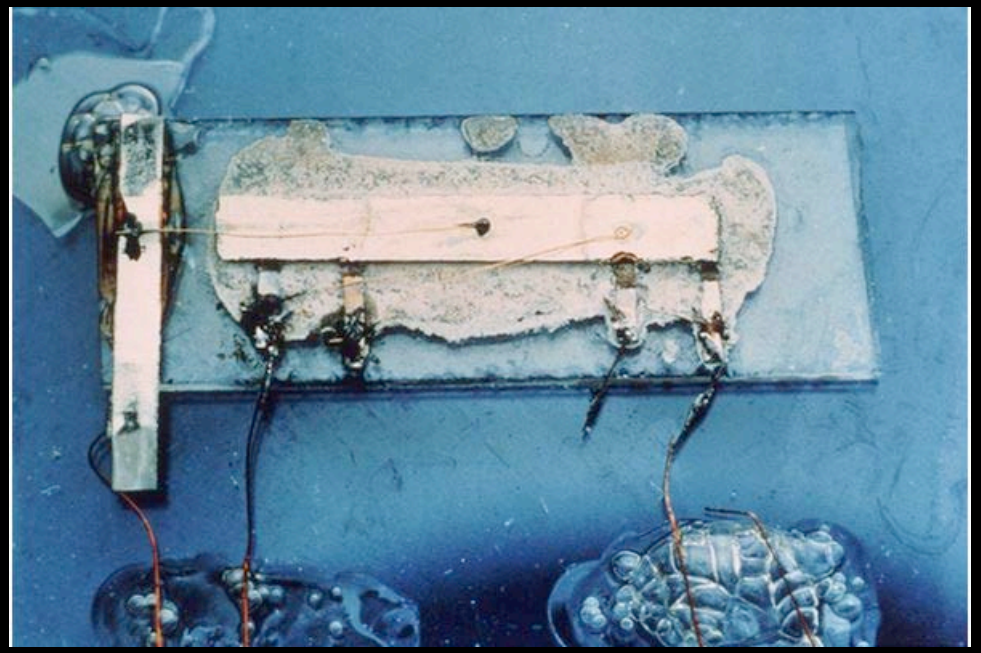
A general-purpose punched card from the mid twentieth century.



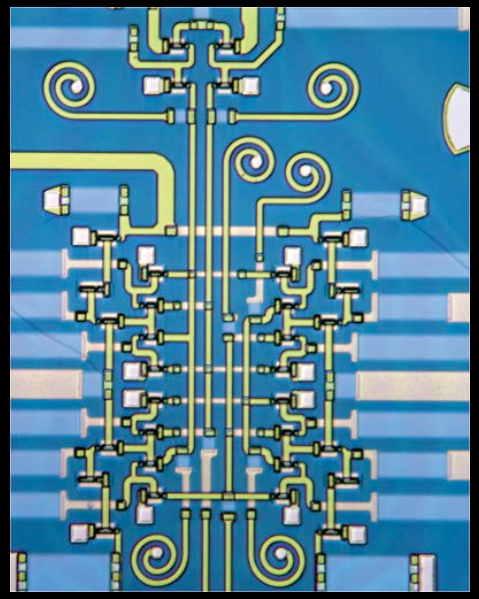
Card from a Fortran program: Z(1) = Y + W(1)

ENIAC vacuum tubes

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.

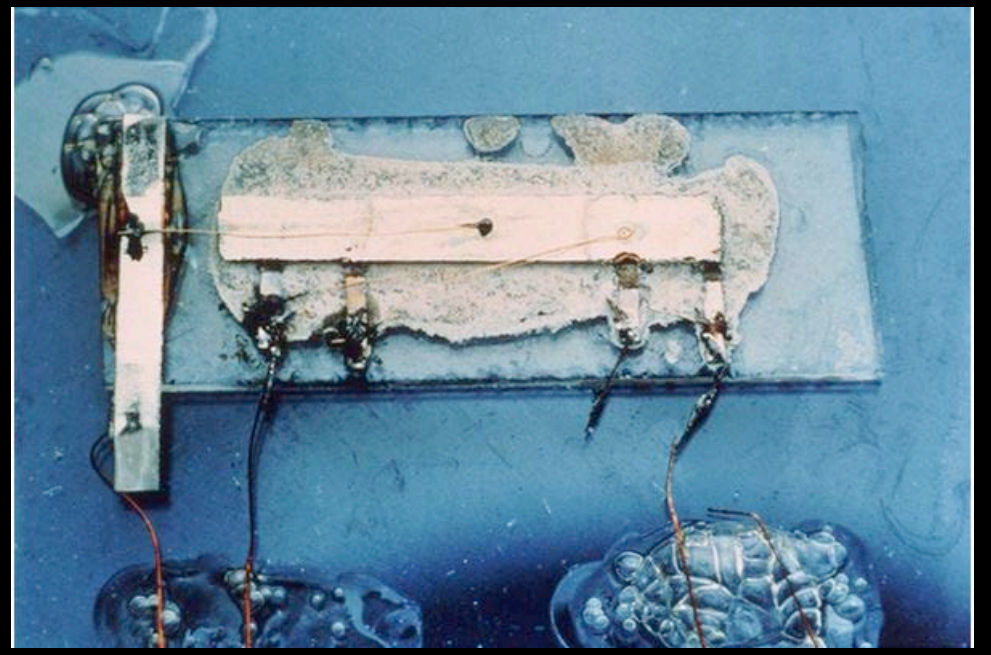


Jack Kilby's original integrated circuit, 1958

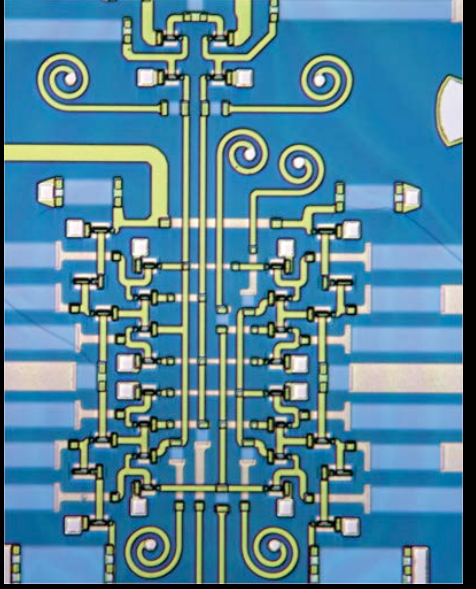


Integrated Circuit 1958

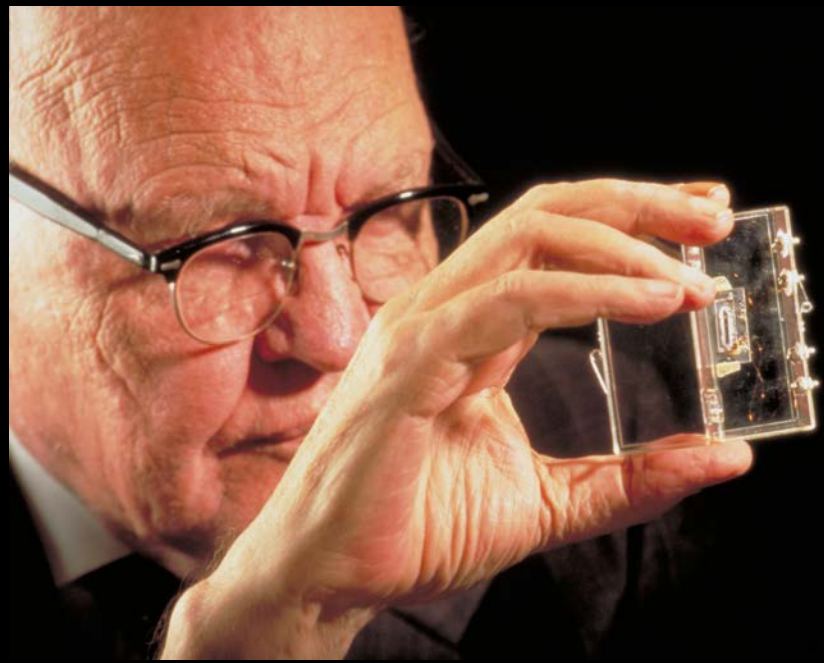
The Bell Labs team of John Bardeen, Walter Brattain and William Shockley won the 1956 Nobel Prize in Physics for their work in developing transistors.



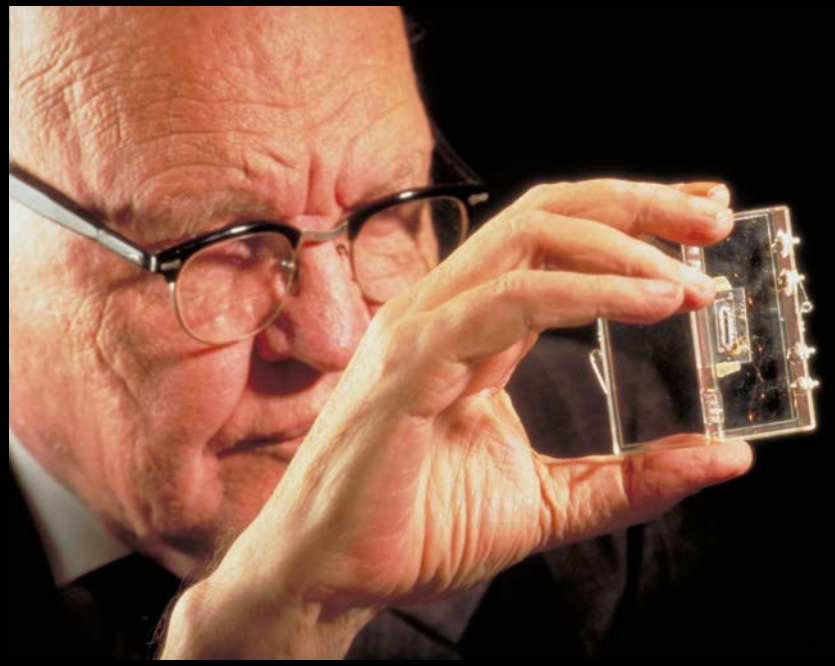
Jack Kilby's original integrated circuit created at Texas Instruments, 1958

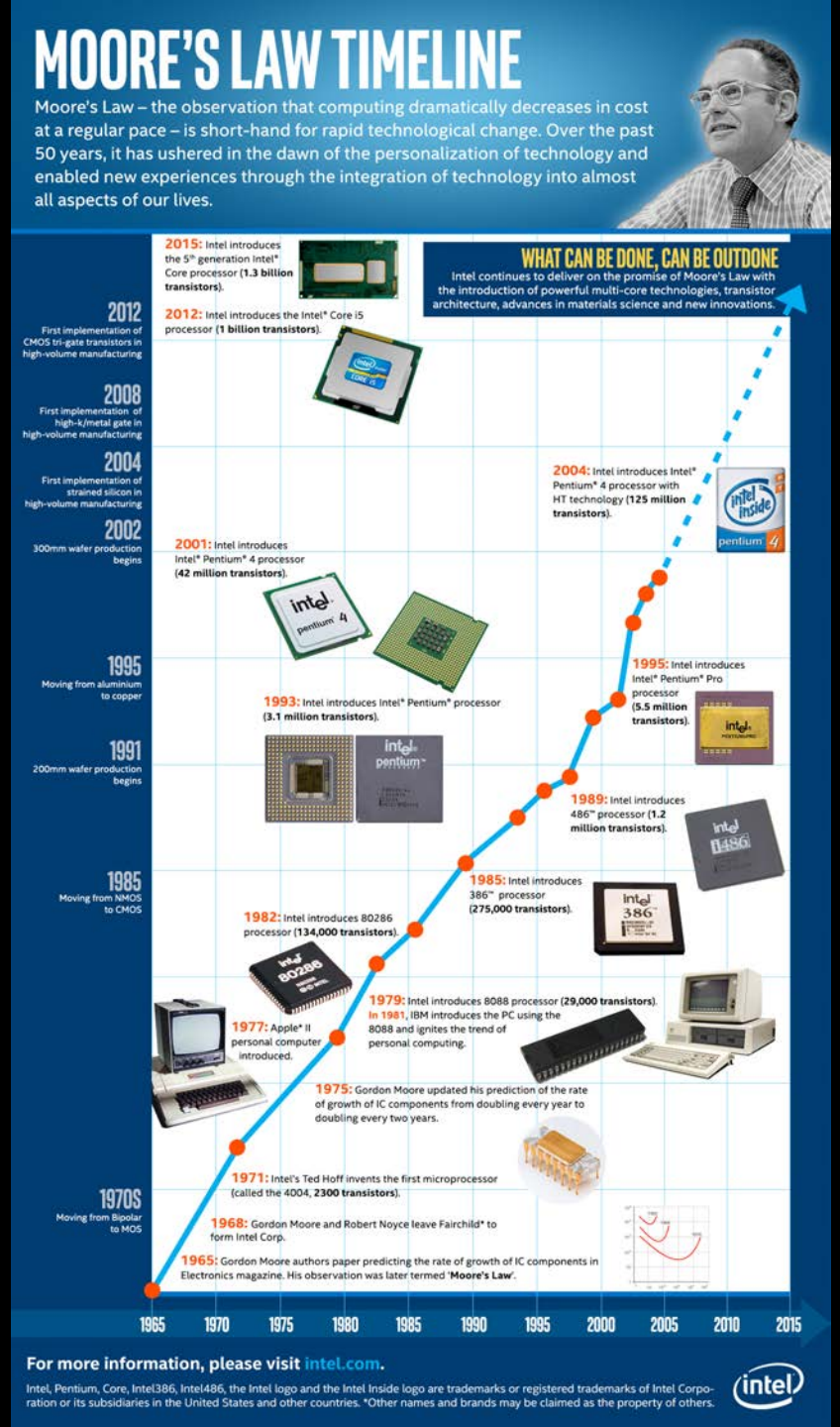


Integrated Circuit 1958



Untitled photographs by Jack Kilby, c. 1955





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

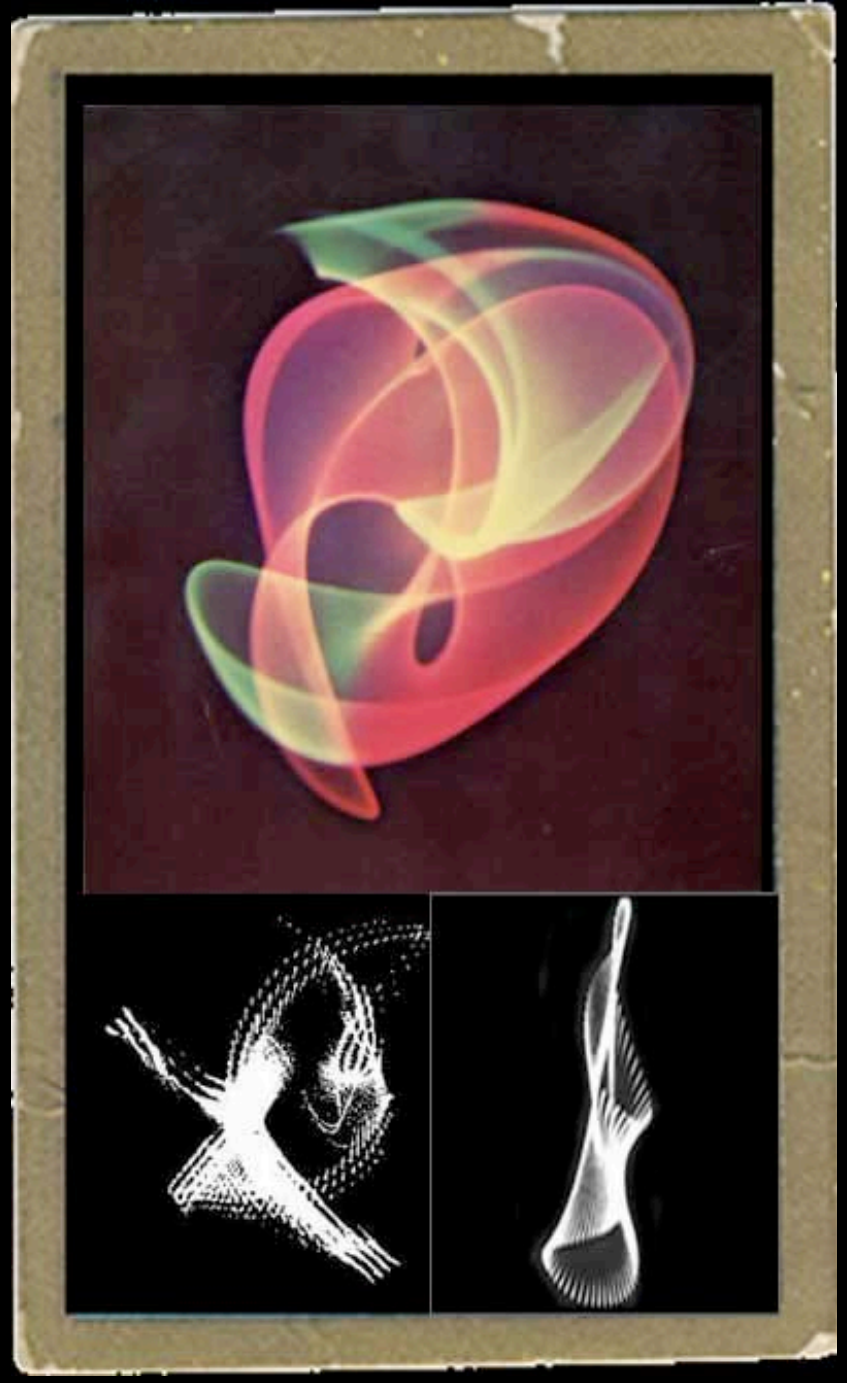
Hollerith Tabulator
IBM Tabulator
National Ellis 3000
Zuse 2
Zuse 3
ENIAC
BINAC
IBM SSEC
Whirlwind
EDVAC
Datamatic 1000
IBM 1620
DEC PDP-4
IBM 1130
DEC PDP-10
Data General Nova
Intellec-8
IBM PC
Compaq Deskpro 386
Pentium PC
Pentium II PC
Dell Dimension 8400
Mac Pro
Nvidia Tesla GPU & PC

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

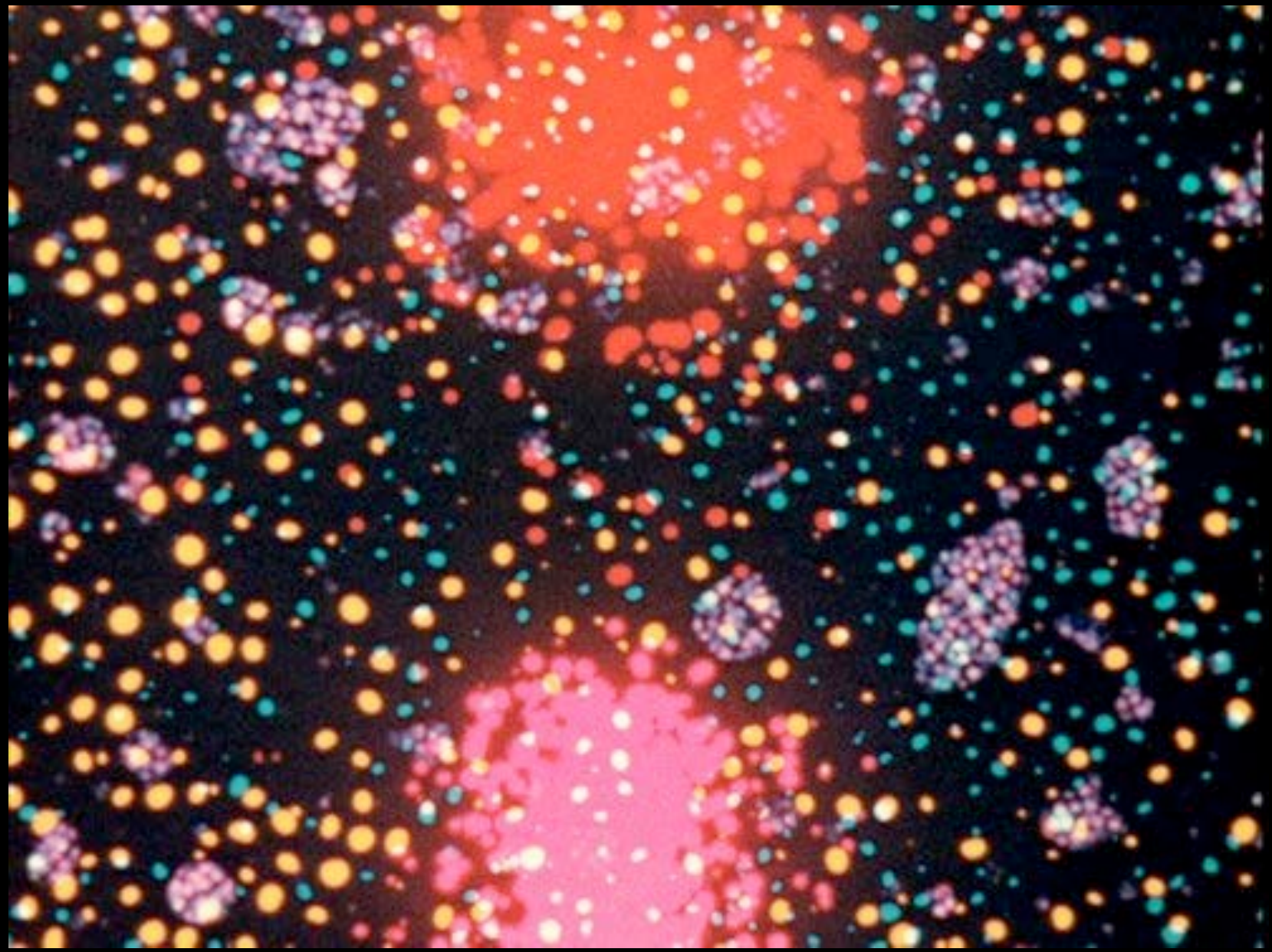
1900 1920 1940 1960 1980 2000 2011 2020 2045

Microprocessors and personal computers, 1970s

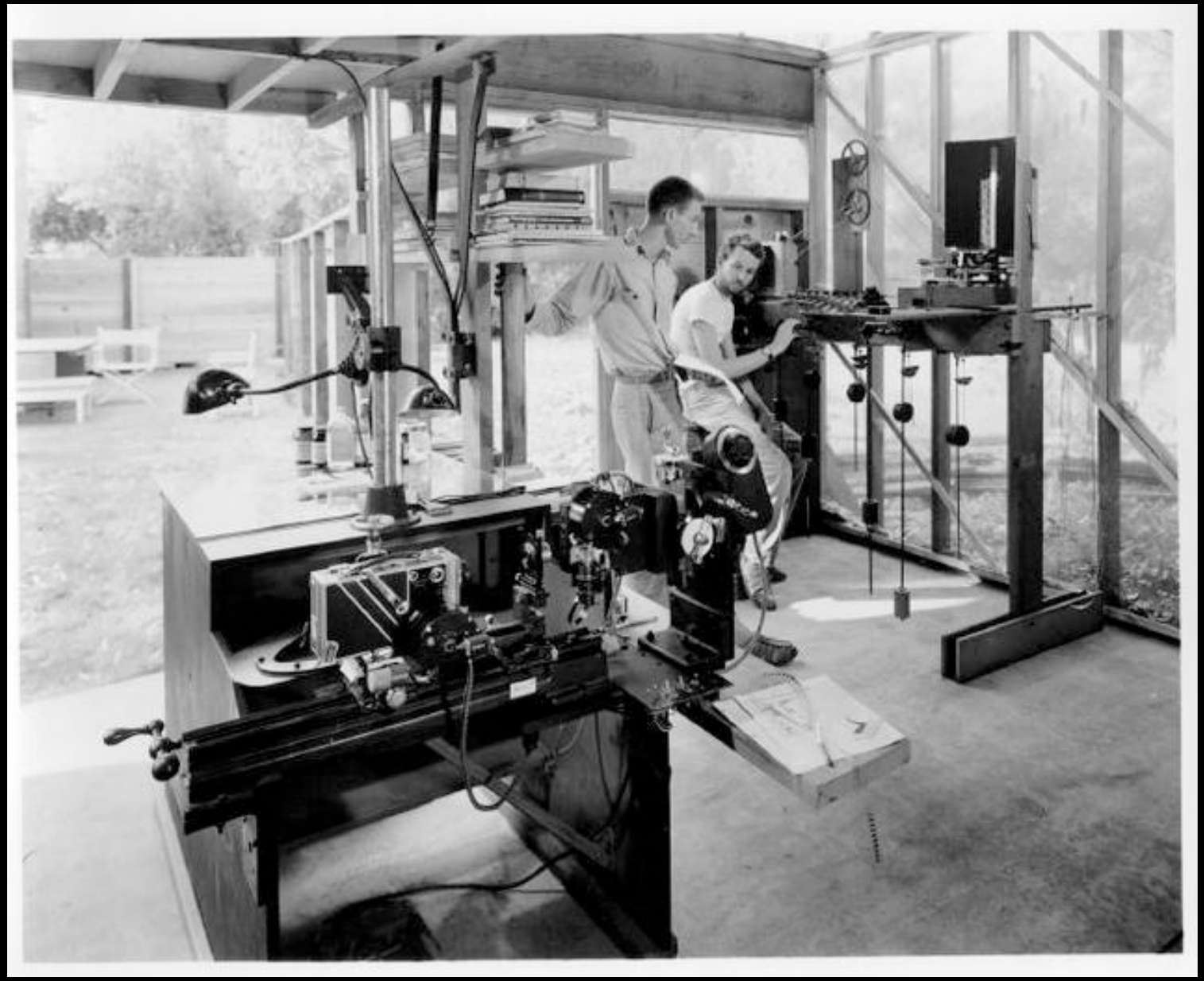
Ben F. Laposky with
oscilloscope, 1956



Ben Laposky, Oscillons, 1956

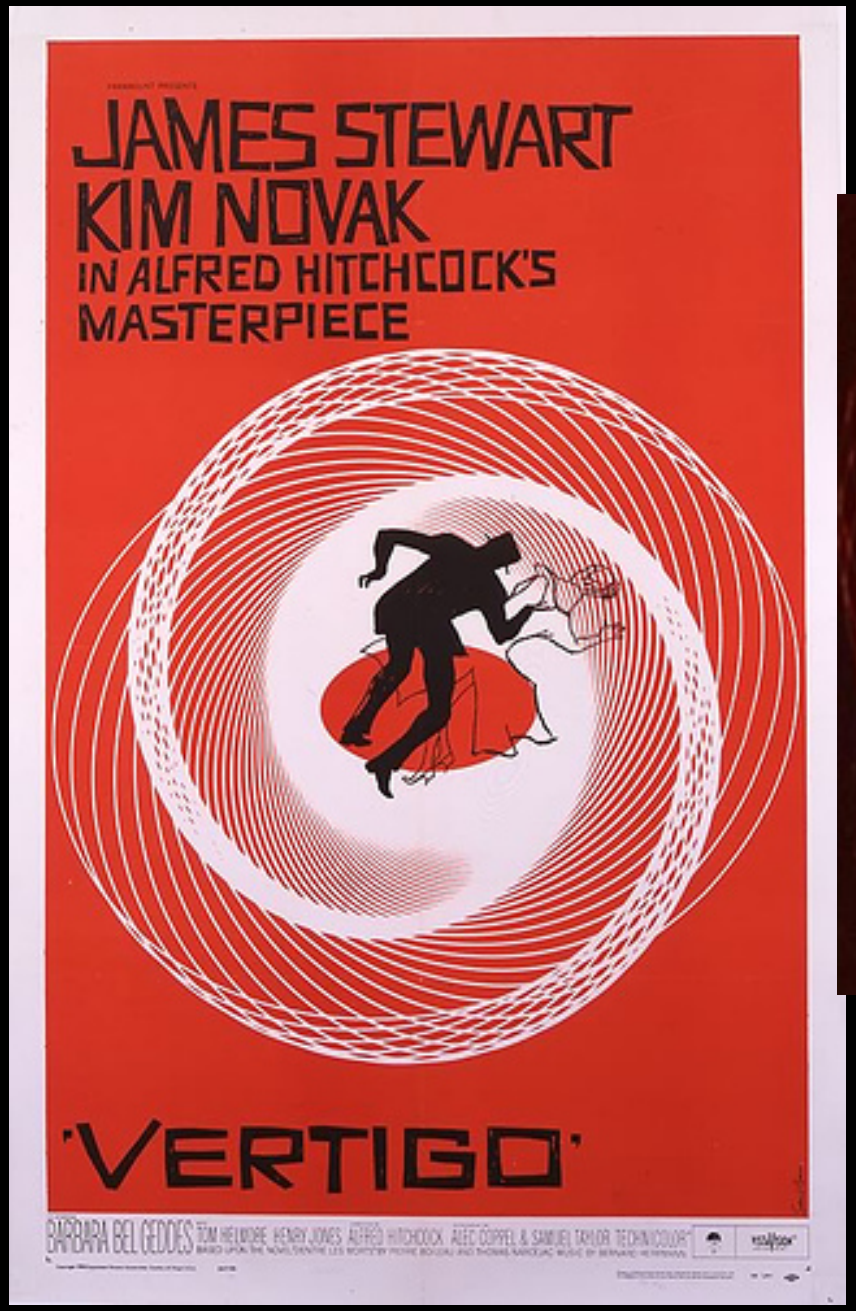


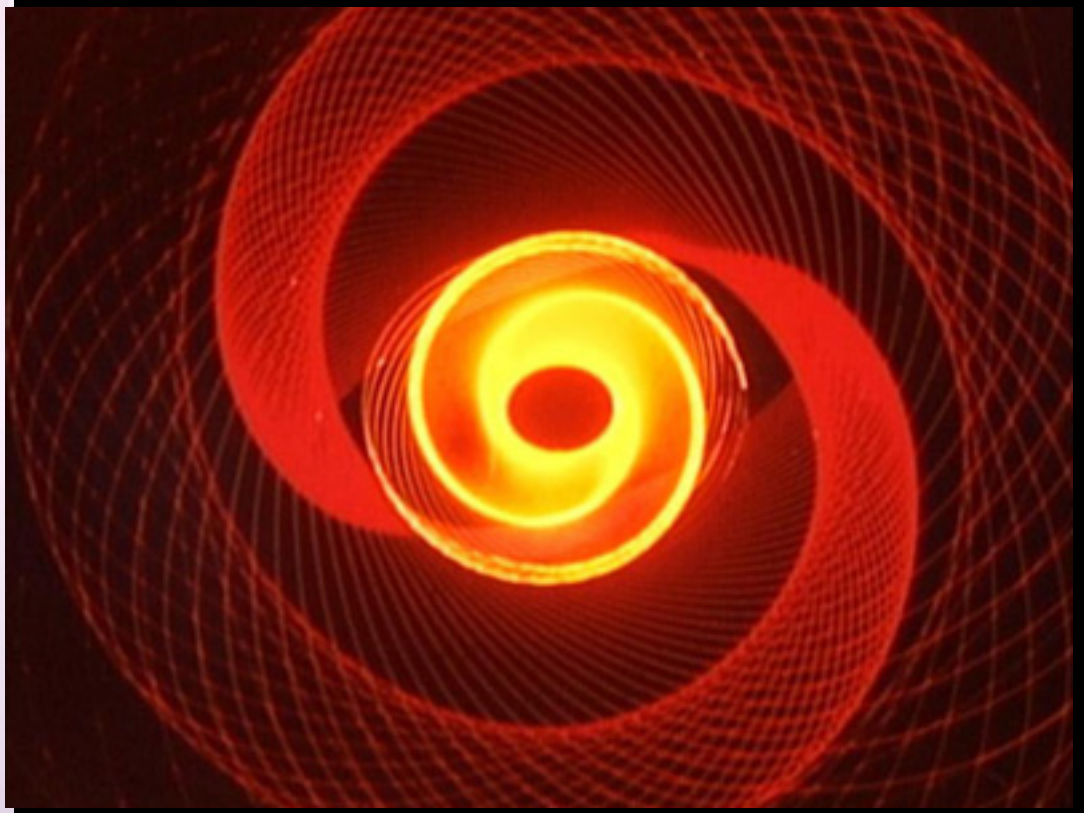
James Whitney, Yantra, 1950-57
https://www.youtube.com/watch?v=HidwTDZoz5c



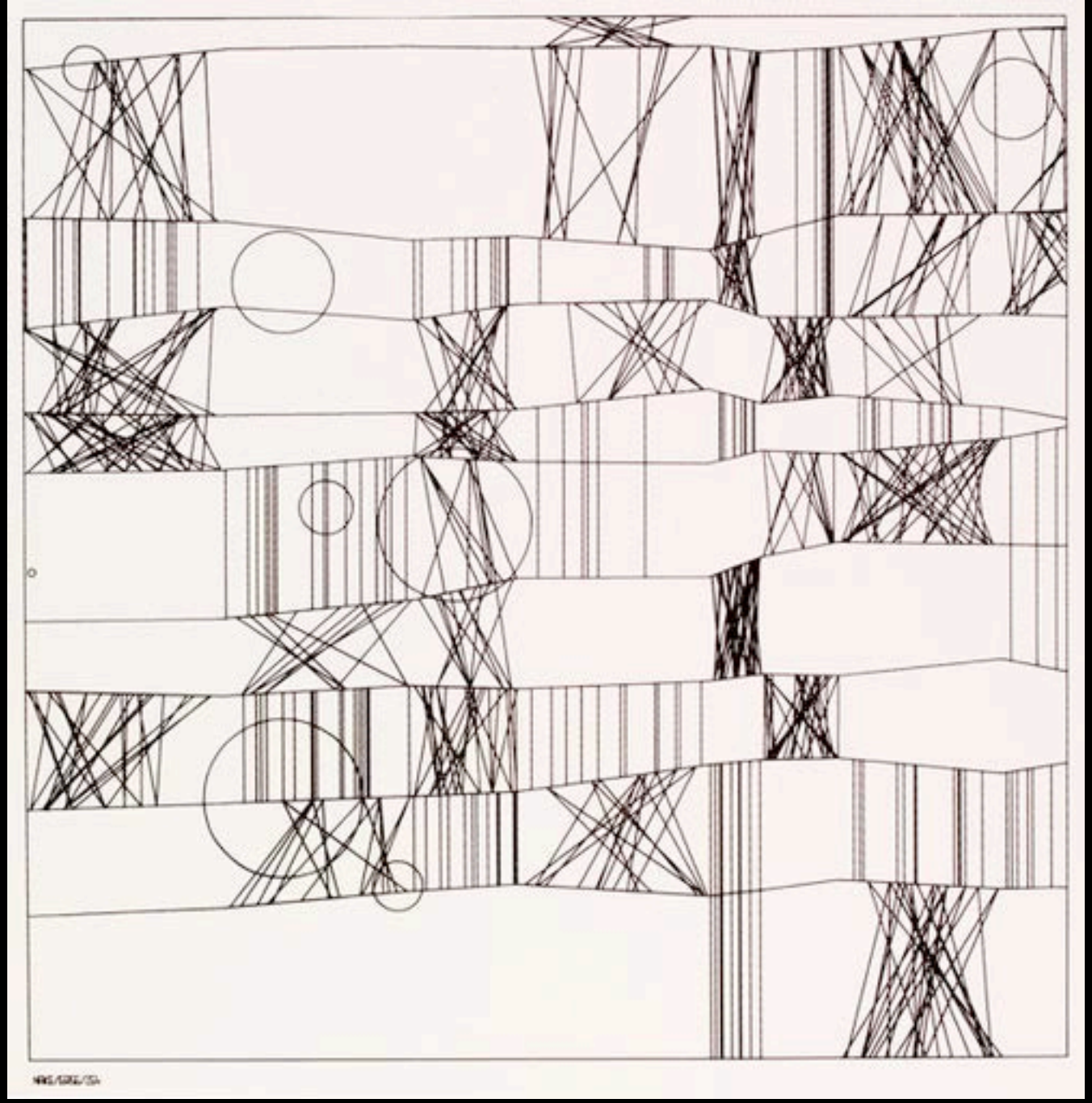
The analogue computer Whitney used to create his most famous animations was built in the late 1950s by converting the mechanism of a WWII M-5 Antiaircraft Gun Director. Whitney's son, John, Jr., described the mechanism in 1970:

“I don't know how many simultaneous motions can be happening at once. There must be at least five ways just to operate the shutter. The input shaft on the camera rotates at 180 rpm, which results in a photographing speed of 8 frame/s. That cycle time is constant, not variable, but we never shoot that fast. It takes about nine seconds to make one revolution. During this nine-second cycle the tables are spinning on their own axes while simultaneously revolving around another axis while moving horizontally across the range of the camera, which may itself be turning or zooming up and down. During this operation we can have the shutter open all the time, or just at the end for a second or two, or at the beginning, or for half of the time if we want to do slit-scanning.”

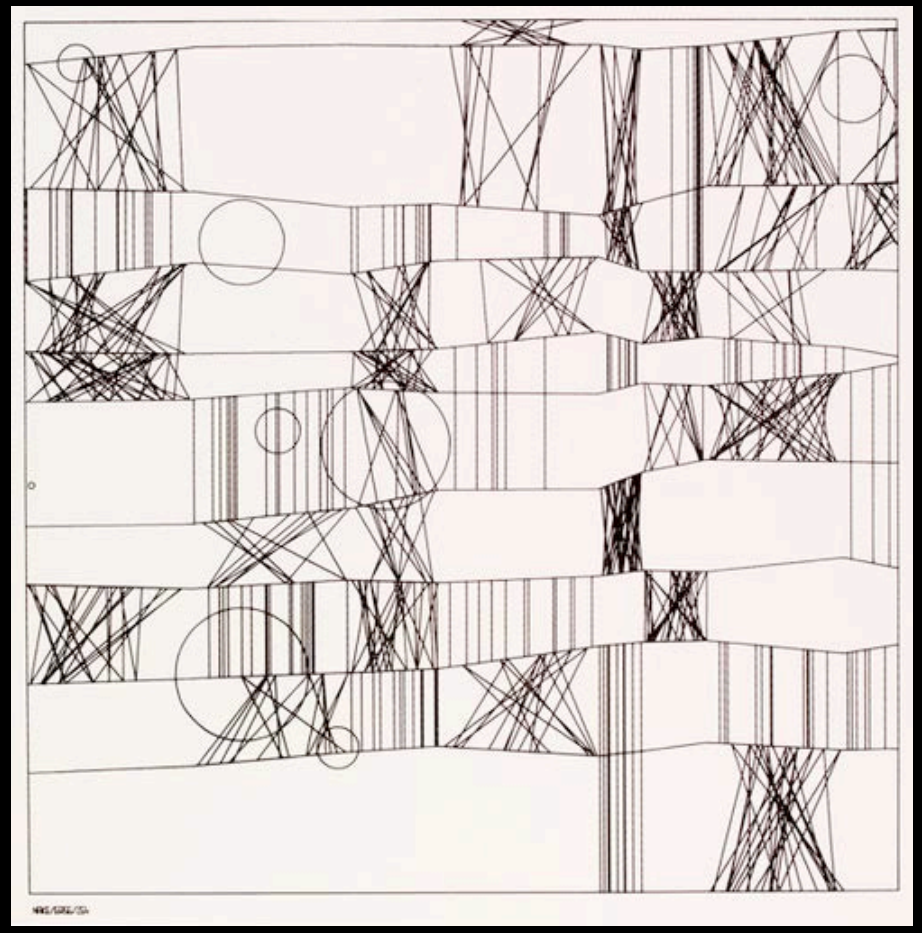




Saul Bass and John Whitney, Title Sequence to Alfred Hitchock's Vertigo (1958)
http://www.youtube.com/watch?v=5qtDCZP4WrQ

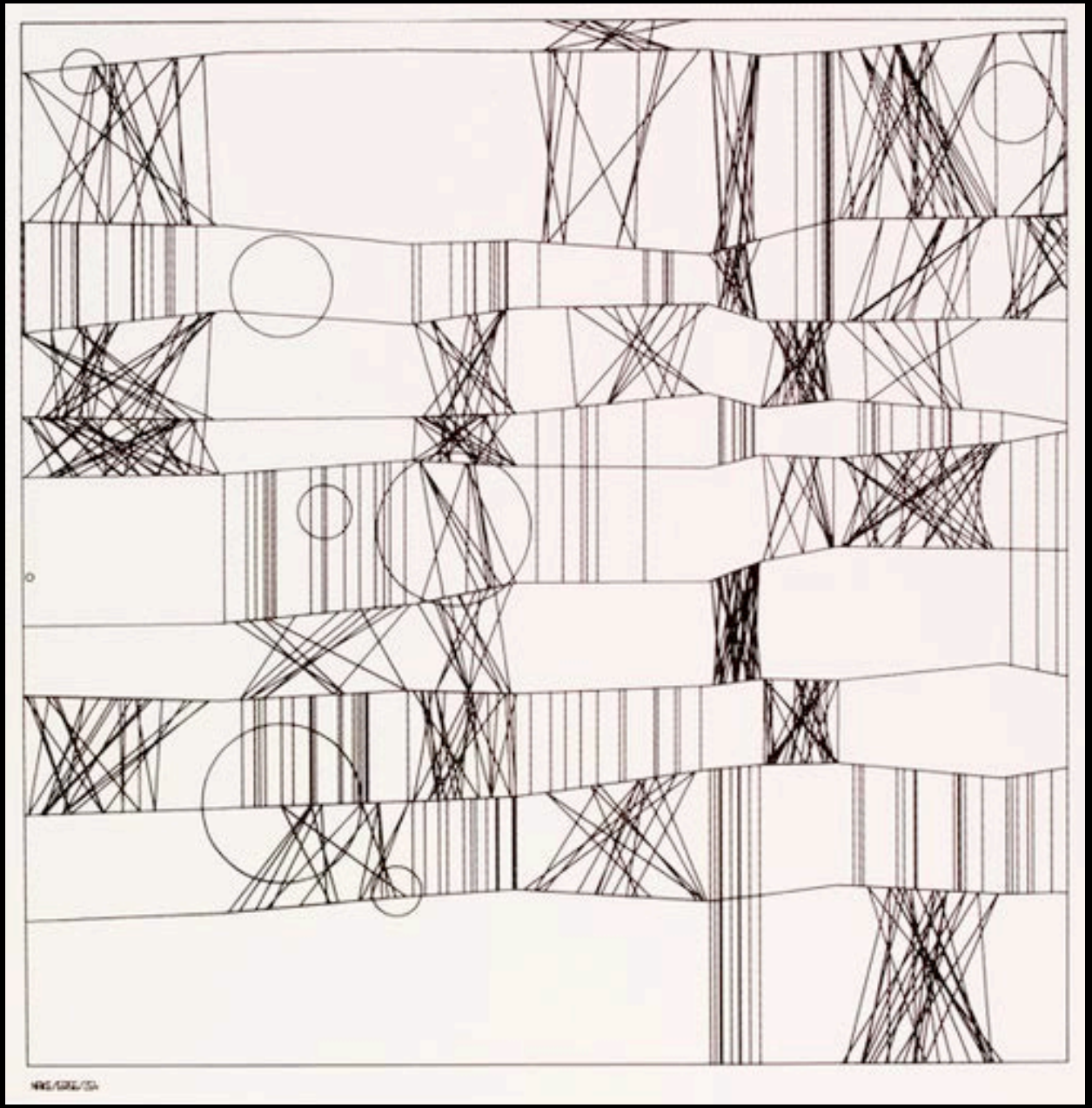


Frieder Nake, Homage to *Paul Klee* 13/9/65 No. 2, 1965

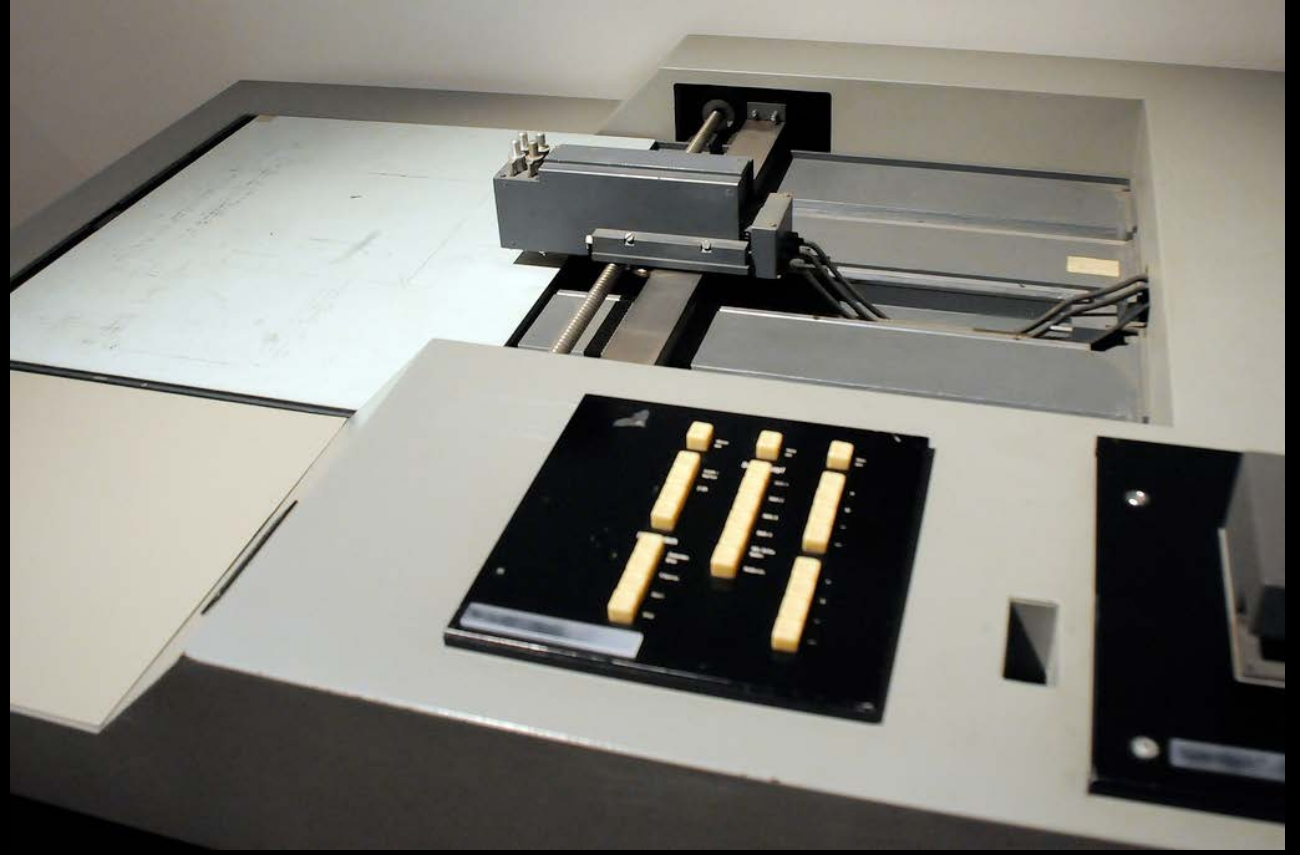


Frieder Nake, Hommage to *Paul Klee* 13/9/65 No. 2, 1965

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



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

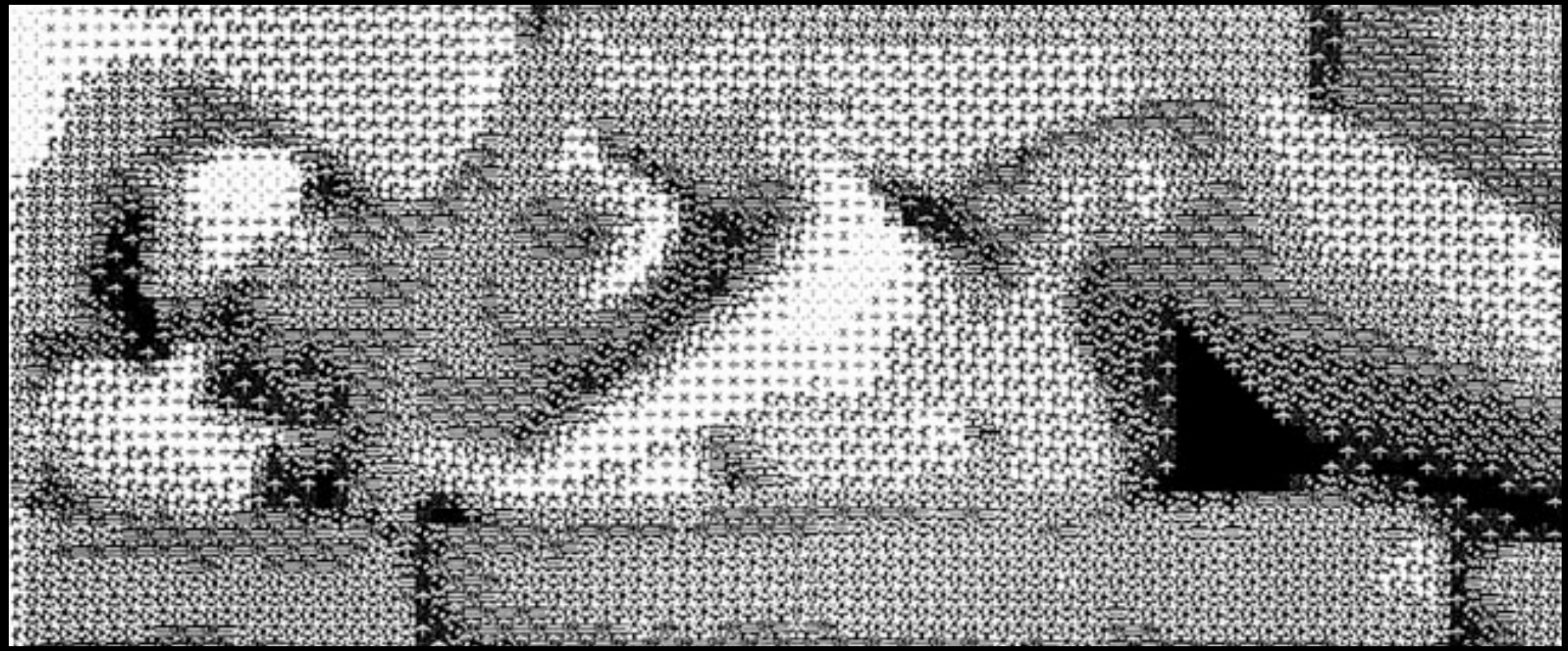


ZUSE Graphomat Z 64

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

In 1966, Ken Knowlton and Leon Harmon were experimenting with photomosaic at the Bell Labs, creating large prints from collections small symbols or images…



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

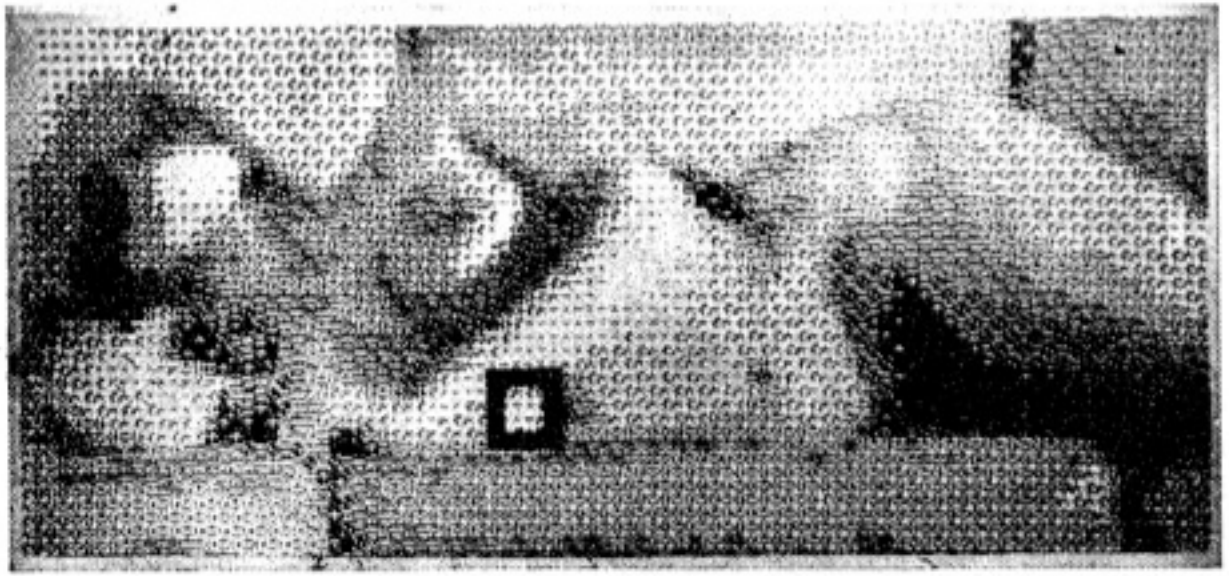
The information on the transparency was then stored on magnetic tape in the form of pulses standing for digits, with the brightness level of the picture elements represented by numbers ranging from 0 to 7. After processing all the numbers, the computer printed a drawing of micropatterns formed by clusters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

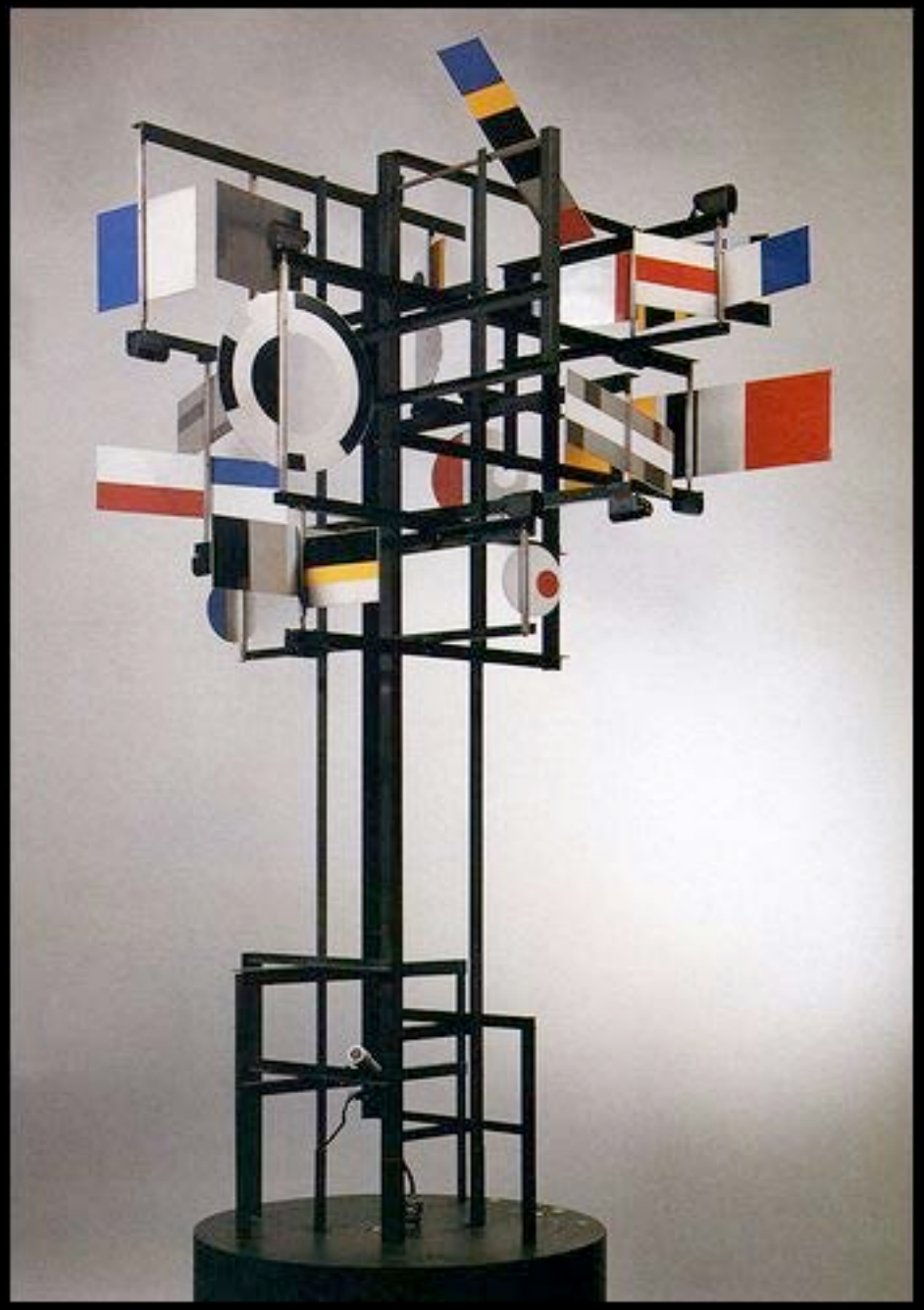
He noted that union members were also consumers, members of audiences and citizens concerned with the quality of society.

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-

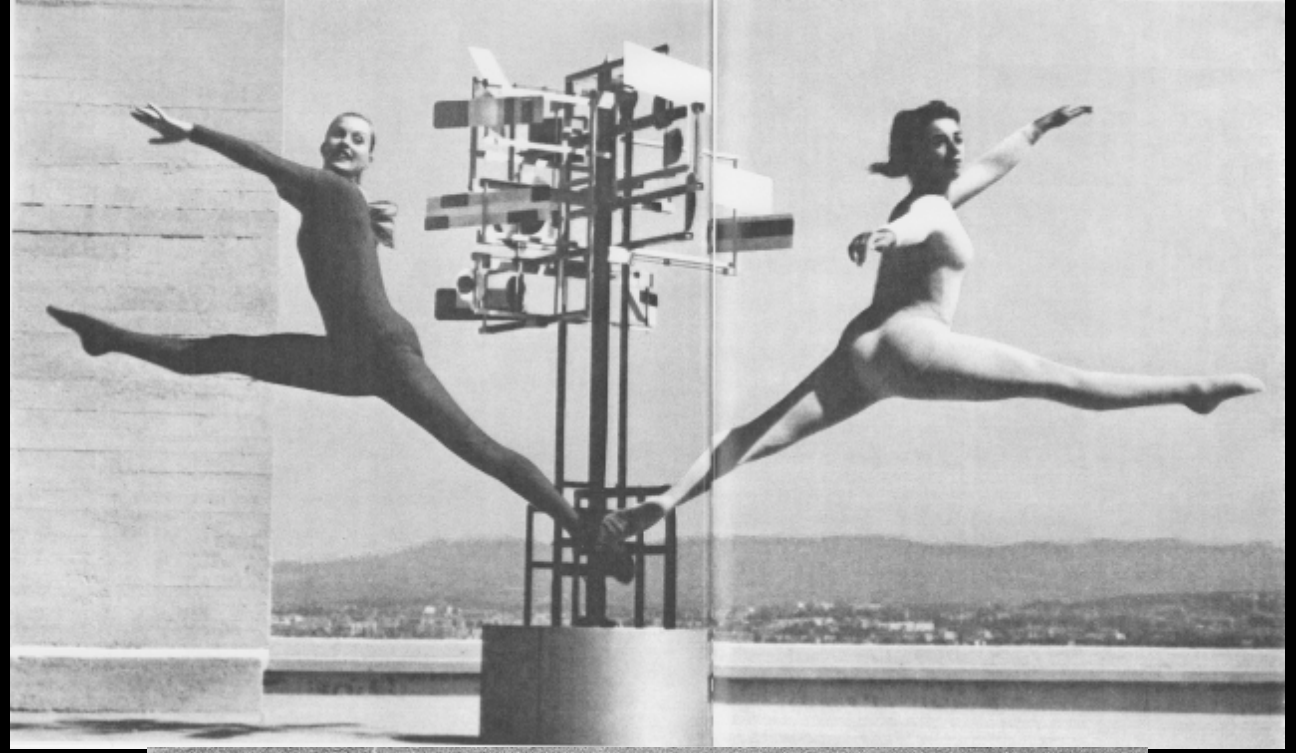
Stan Vanderbeek and Ken Knowlton, Poem Field No. 2, Life LIke, 1967
https://www.youtube.com/watch?v=V4agEv3Nkcs

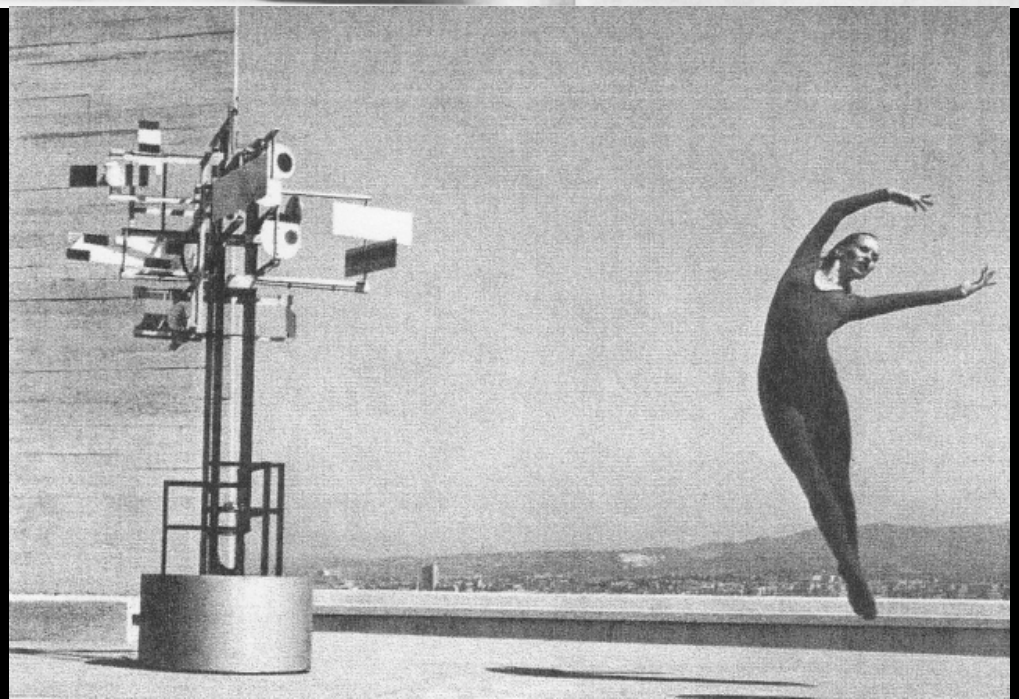


Nicolas Schöffer, CYSP 1, 1956

The name “CYSP” is composed of the first letters of cybernetics and spatiodynamic.

The first "spatiodynamic sculpture" …





Schöffer collaborated with engineers from the Philips Corporation to create the project and several others. They combine the fields of robotics and responsive environments with kinetic art and constructivism. They also reacted to the presence of observers, recalling the uncertainty principle and second-order cybernetics, both of which state that the act of observing alters the phenomena that is being observed.

https://www.youtube.com/watch?v=gJD27tJLoaQ

Le Corbusier, Unité d’habitation, Marseille, 1956

These kinetic sculptures were inspired by Galois Fields. In 1974 the artist wrote, "One of the most interesting aspects of this work [in Galois fields] is the demonstration of the different visual appearance of the patterns resulting from the polynomials that had not been noted before by mathematicians who have studied Galois fields."

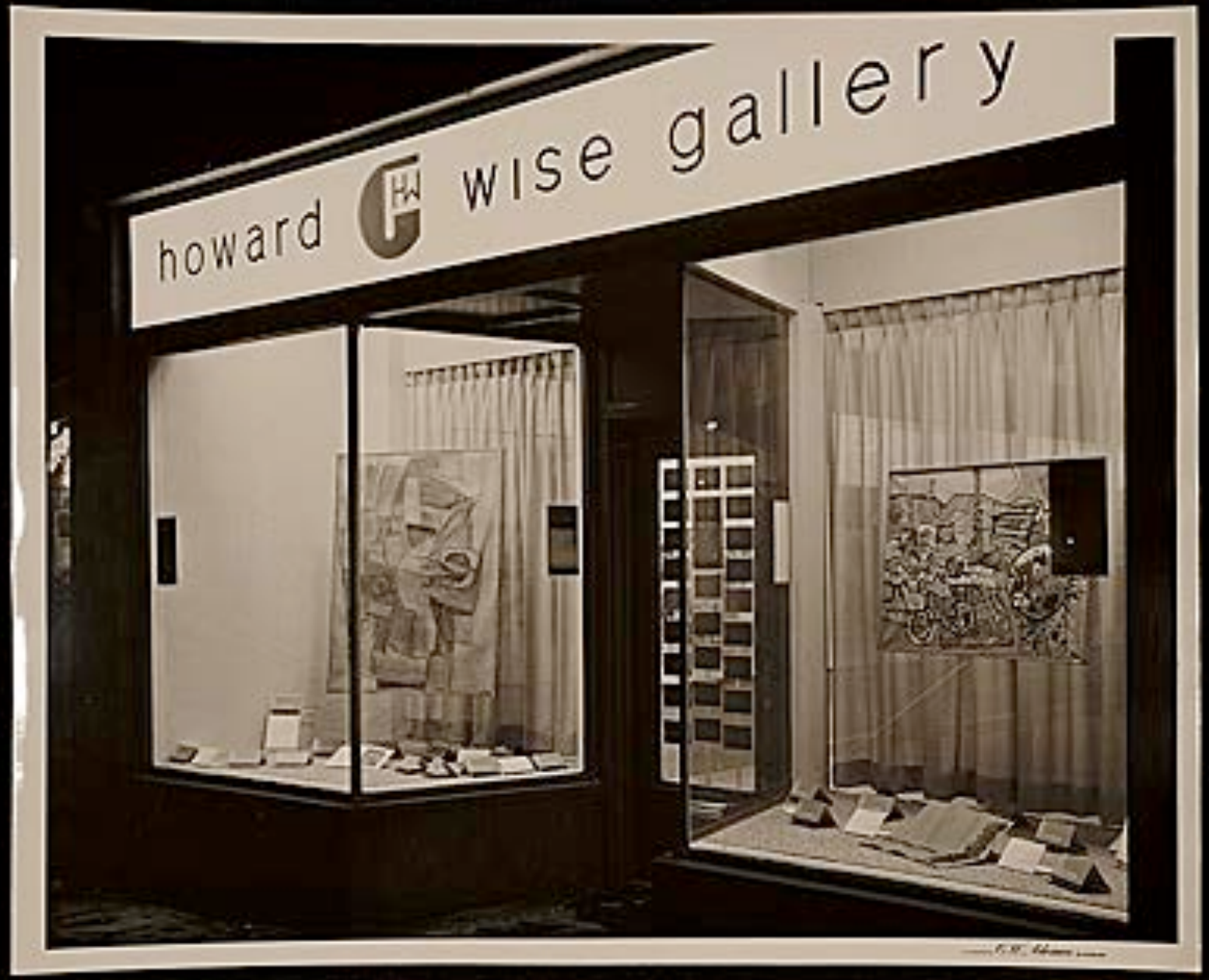
Vladimir Bonacic, GFE (16, 4), 1969-71

Vladimir Bonacic, DIN. GF100 V.B. 1969: https://www.youtube.com/watch?v=Qw764twB0CM

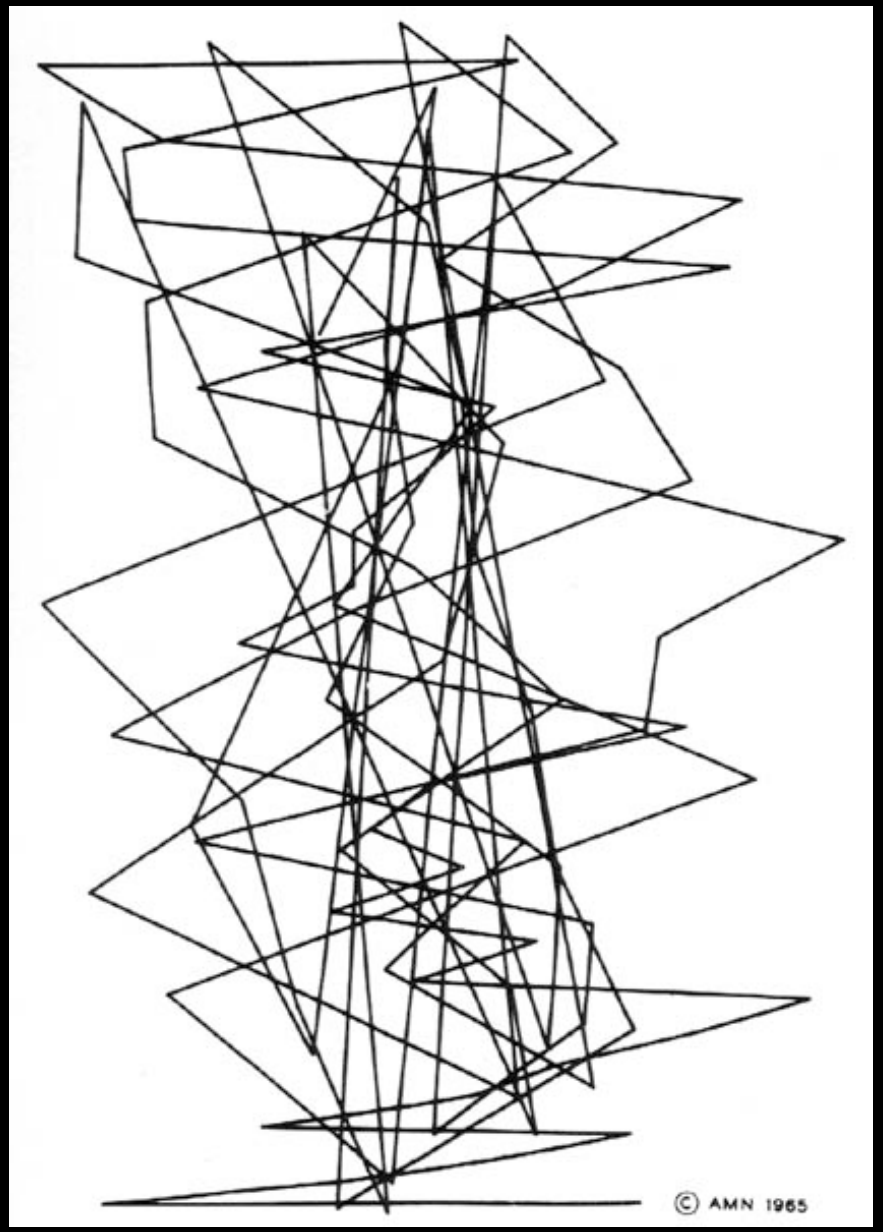
Bell Labs, Murray Hill, NJ

Bell Labs Holmdel Complex, in Holmdel Township, NJ

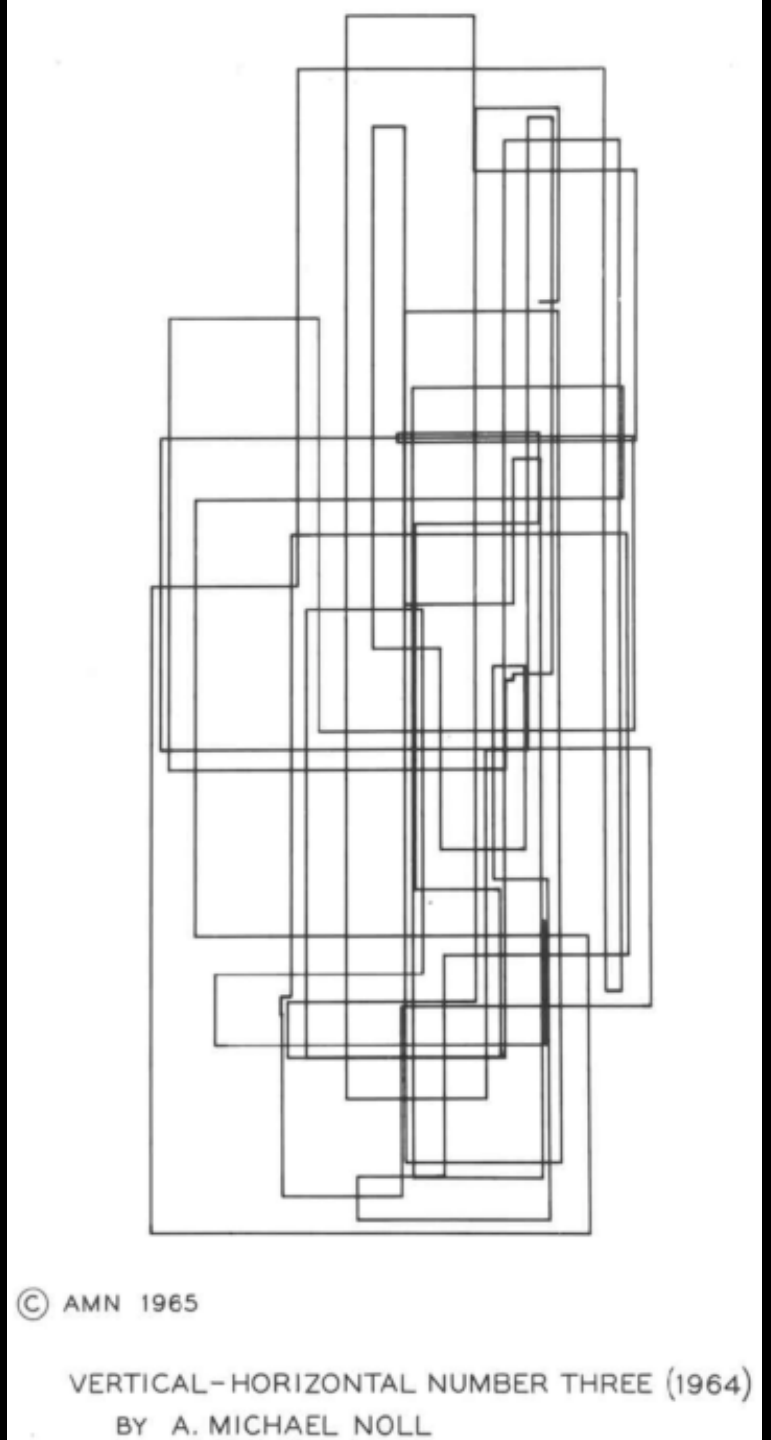
BELL LABS MEMOIRS:
Voices of Innovation
EDITED BY A. MICHAEL NOLL
AND MICHAEL GESELOWITZ


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

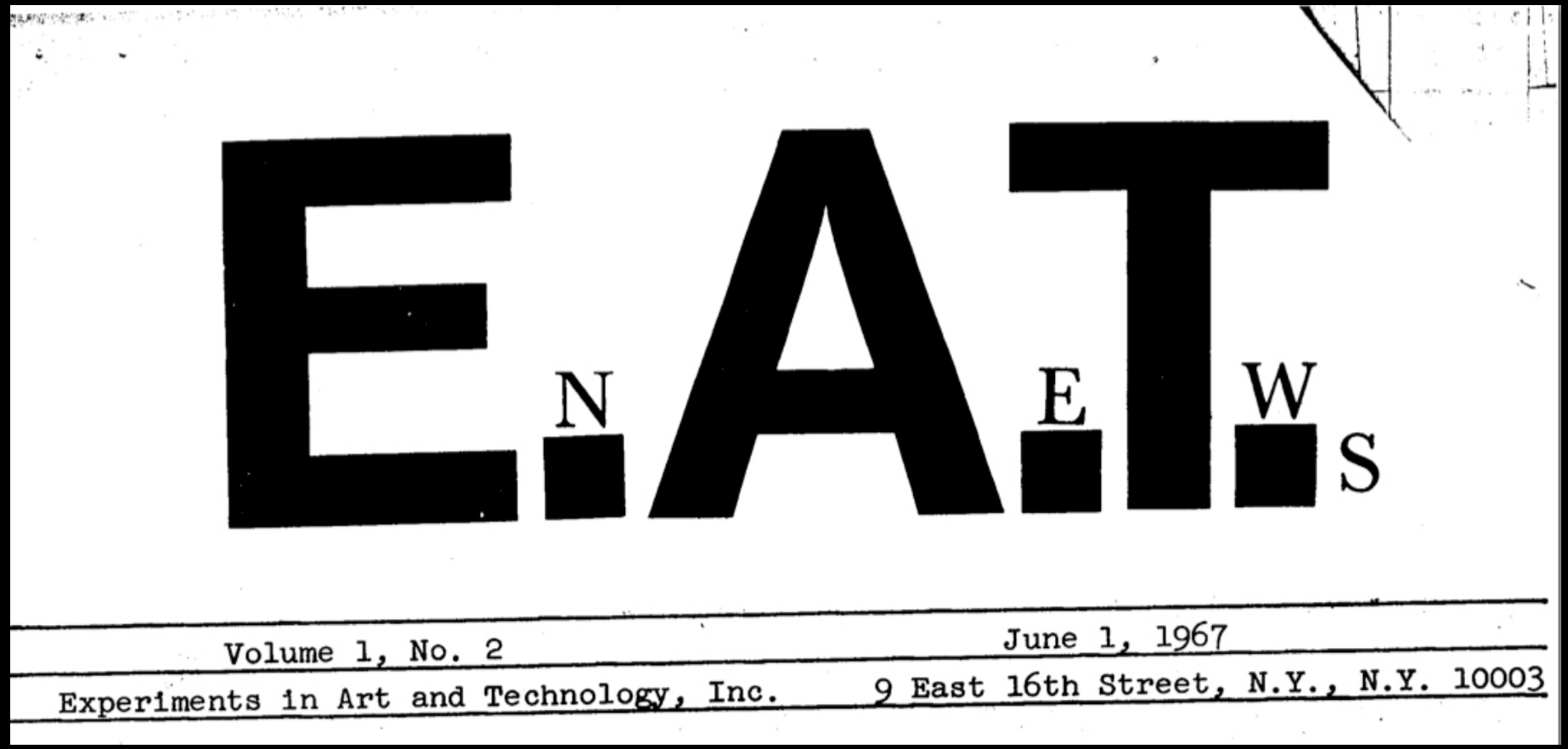


Mondrian

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/

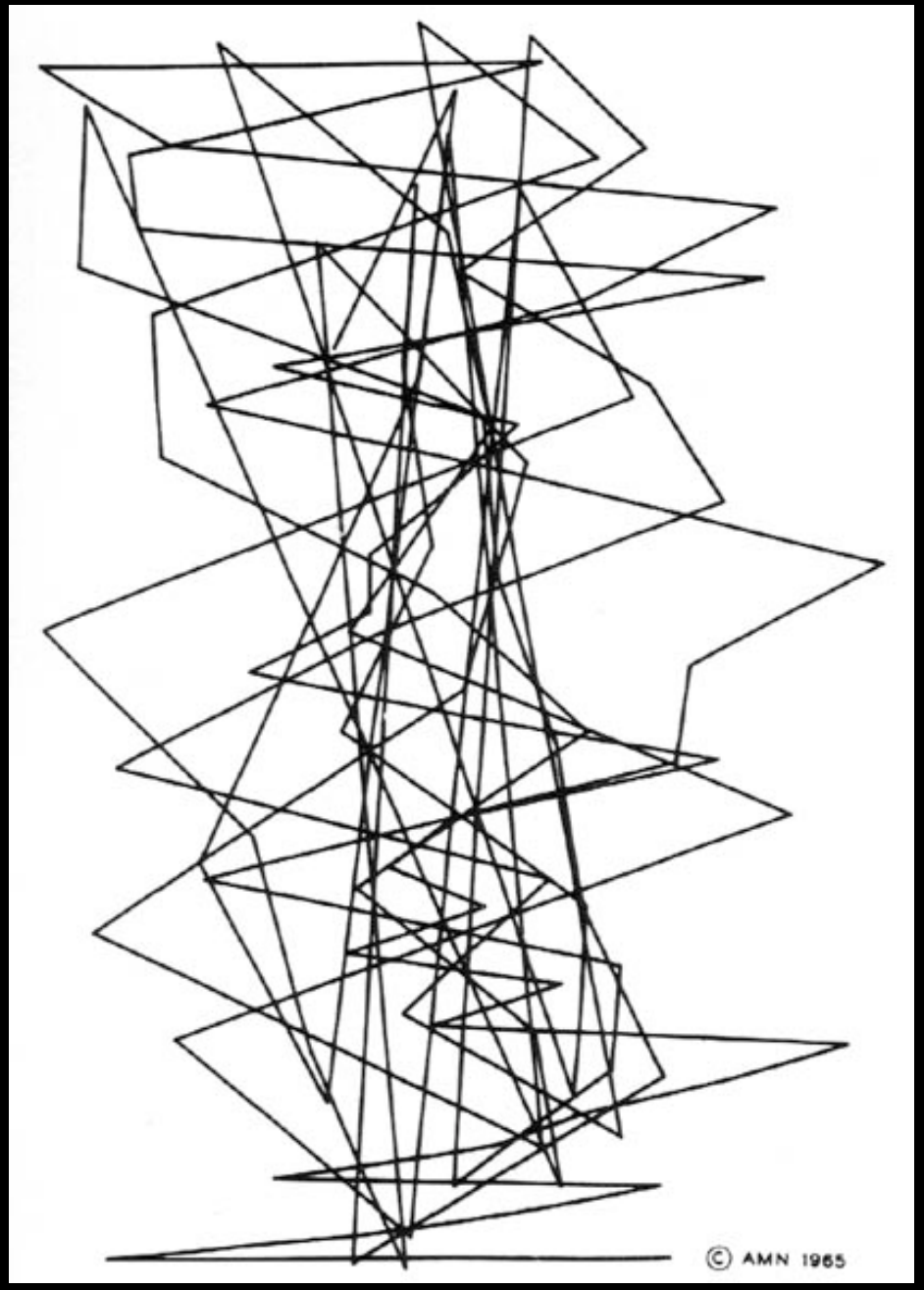


Experiments in Art and Technology was founded in 1966 by engineers Billy Klüver and Fred Waldhauer and artists Robert Rauschenberg and Robert Whitman.

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

AUTONOMY, DIGITAL TECHNOLOGY, AND ART

DIGITAL IMAGE
VS.
DIGITAL PERFORMANCE



A. Michael Noll, Gaussian Quadratic, 1962

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;

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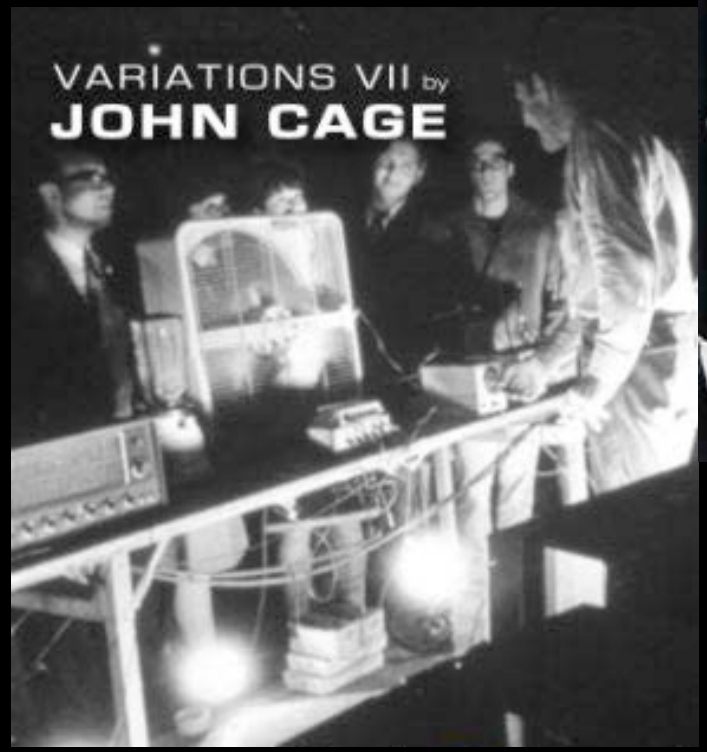
Goals: The organization placed artists working directly with engineers in the industrial environment where technology was being developed.



EAT/John Cage, Variations VII, 1966

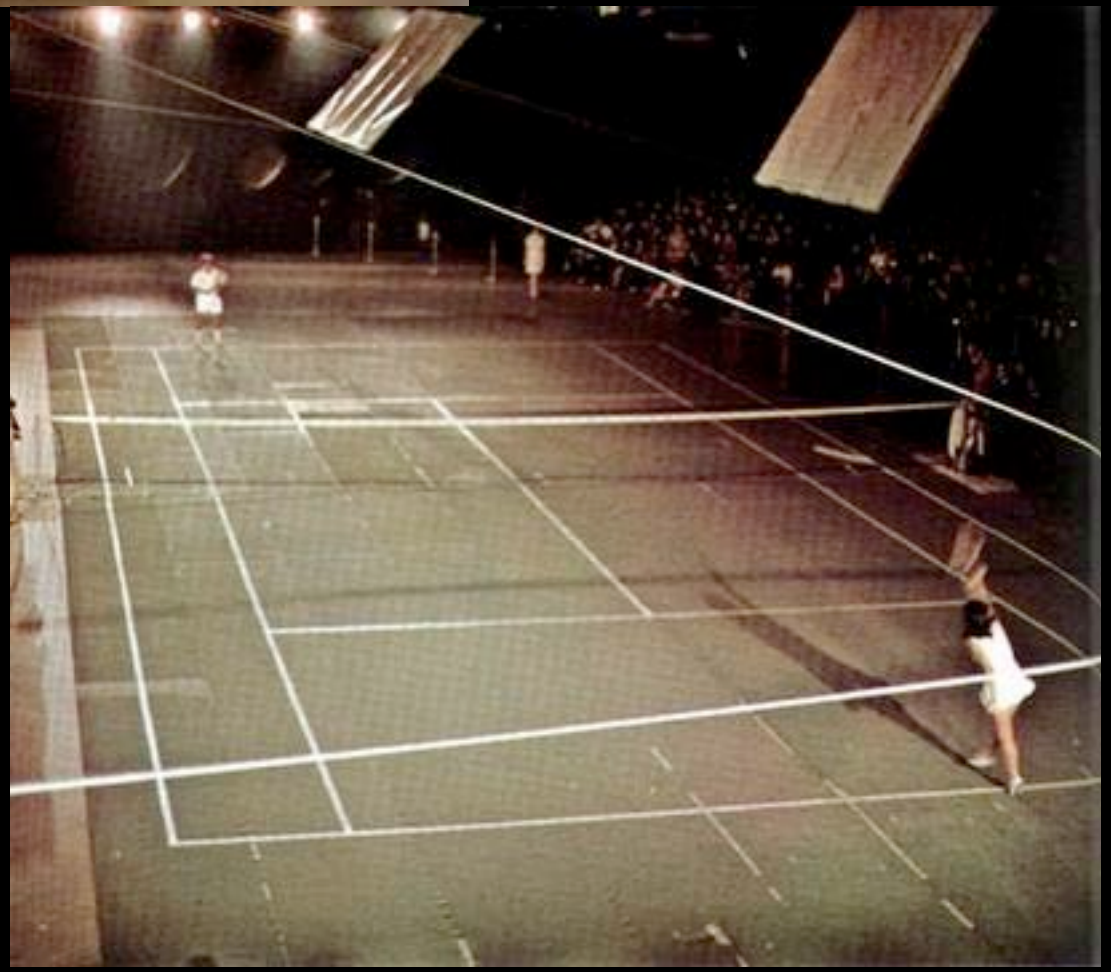
EAT/Lucinda Childs, Still from *Vehicle*, 1966

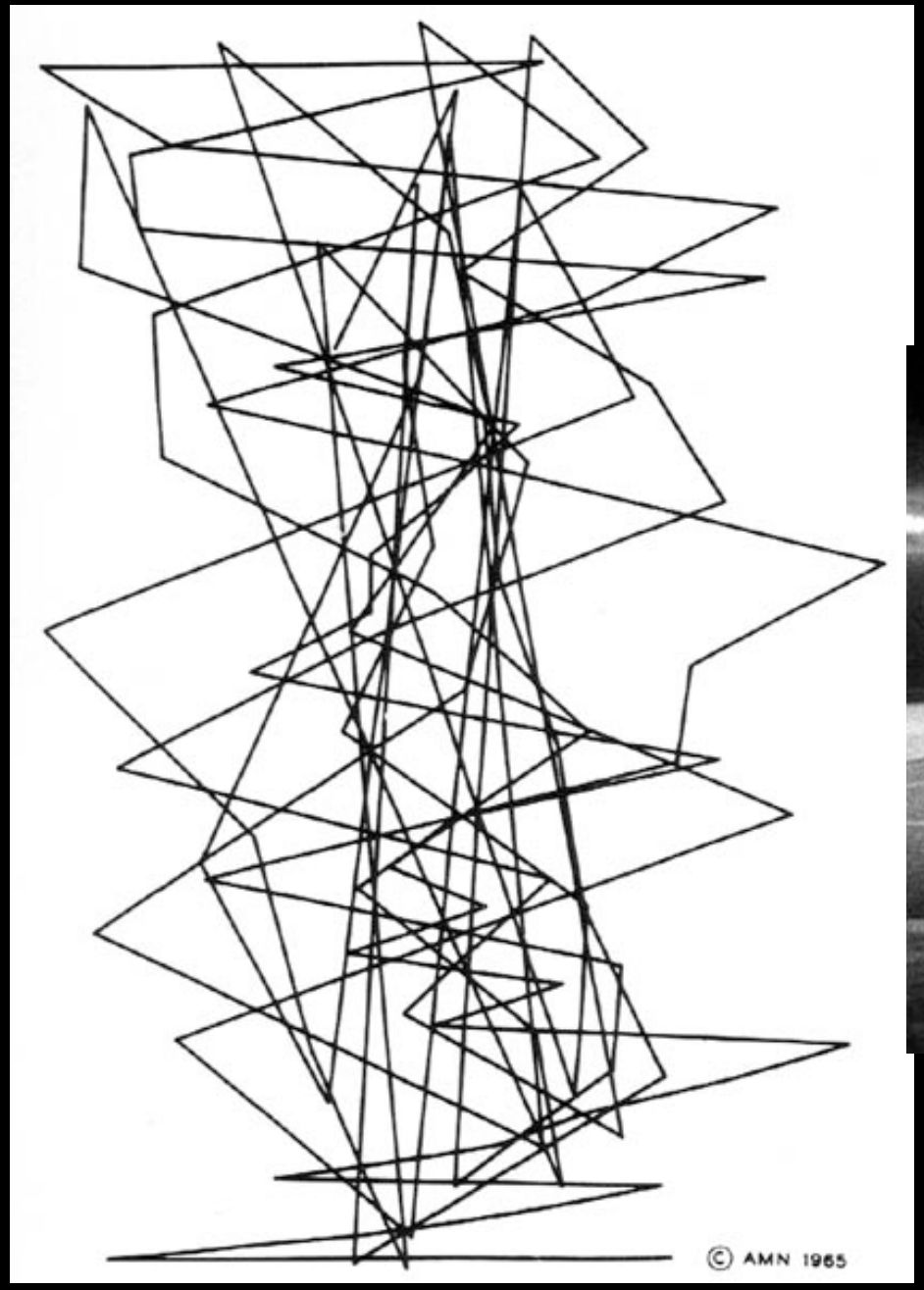
EAT/Robert Rauschenberg, Open Score, 1966

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

https://www.youtube.com/watch?v=W-cgnK-kFoo&list=PL_yedI2Wa-XNFgvFf8XTclwFssXpf8bLS

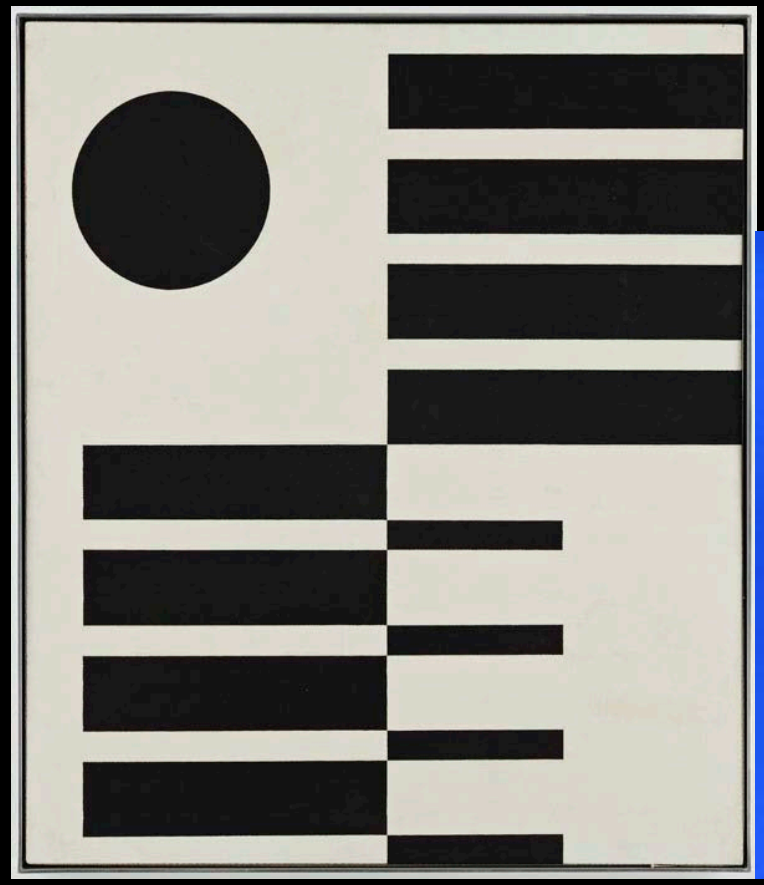




A. Michael Noll, Gaussian Quadratic, 1962

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

California Light and Space



John McLaughlin, Untitled, 1951

James Turrell, The Light Inside, 1999
Museum of Fine Arts Houston

John McLaughlin, Untitled, 1952

Phenomenal: California Light, Space, Surface
Museum of Contemporary Art San Diego
2011

phenomenal
adjective
adjective: **phenomenal**

1. very remarkable; extraordinary. "the town expanded at a phenomenal rate”
2. perceptible by the senses or through immediate experience. "the phenomenal world”

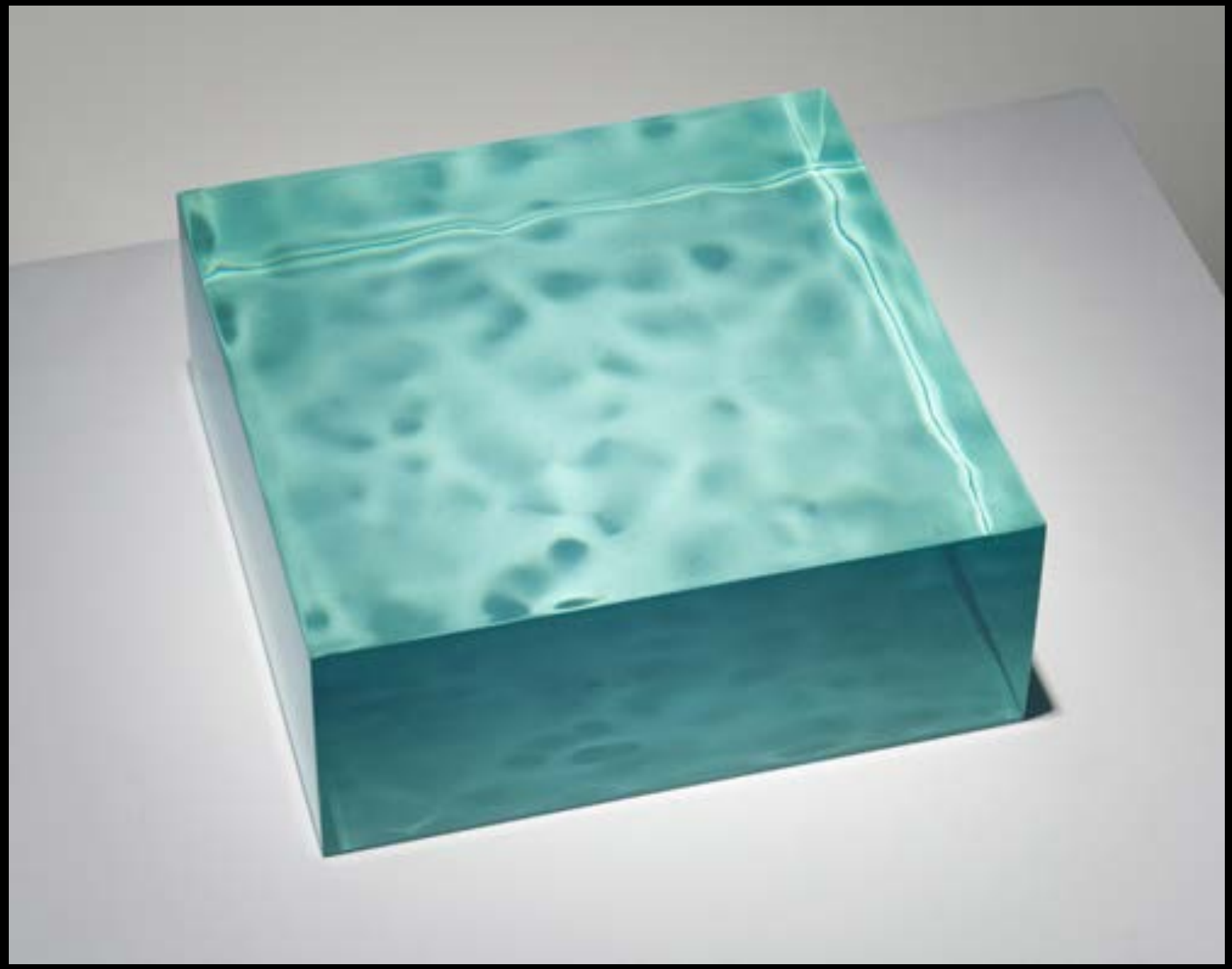
Phenomenology
Phenomenology is the study of structures of consciousness as experienced from the first-person point of view. The central structure of an experience is its intentionality, its being directed toward something, as it is an experience of or about some object. An experience is directed toward an object by virtue of its content or meaning (which represents the object) together with appropriate enabling conditions.

http://www.youtube.com/watch?v=9LUicwF5yTg

Peter Alexander, Orange Wedge, 1967, Cast Resin

Peter Alexander, Pink Wedge, 1968 Cast Resin

Peter Alexander, Orange Wedge, 1970
cast resin



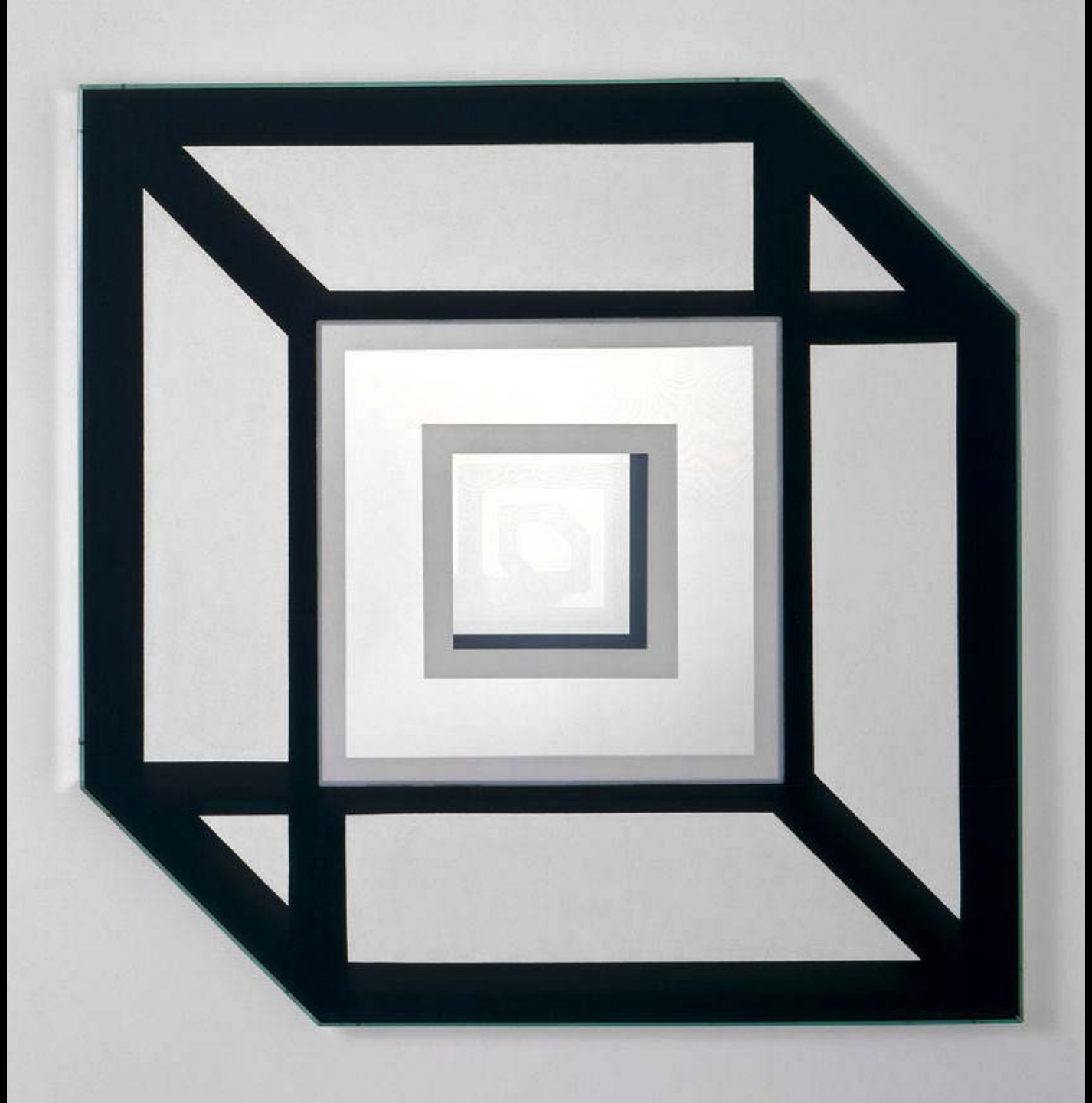
Peter Alexander, Mirasol, 2009, Polyester Resin

Larry Bell, Little Blank Riding Hood, 1962
acrylic on shaped canvas

British critic Michael Compton wrote the following to describe the effect of Bell's artwork:

At various times and particularly in the 1960s some artists have worked near what could be called the upper limits of perceptions, that is, where the eye is on the point of being overwhelmed by a superabundance of stimulation and is in danger of losing its power to control it... These artists sometimes produce the effect that the threat to our power to resolve what is seen heightens our awareness of the process of seeing...However, the three artists in this show... operate in various ways near the lowest thresholds of visual discrimination. The effect of this is again to cause one to make a considerable effort to discern and so to become conscious of the process of seeing.

Larry Bell, Ghostbox, 1962-1963
vacuum coated, mirrored, and sandblasted glass; acrylic on canvas



Larry Bell, The Aquarium, 1962-1963
Magic Box

mirror, glass, paint, silver leaf

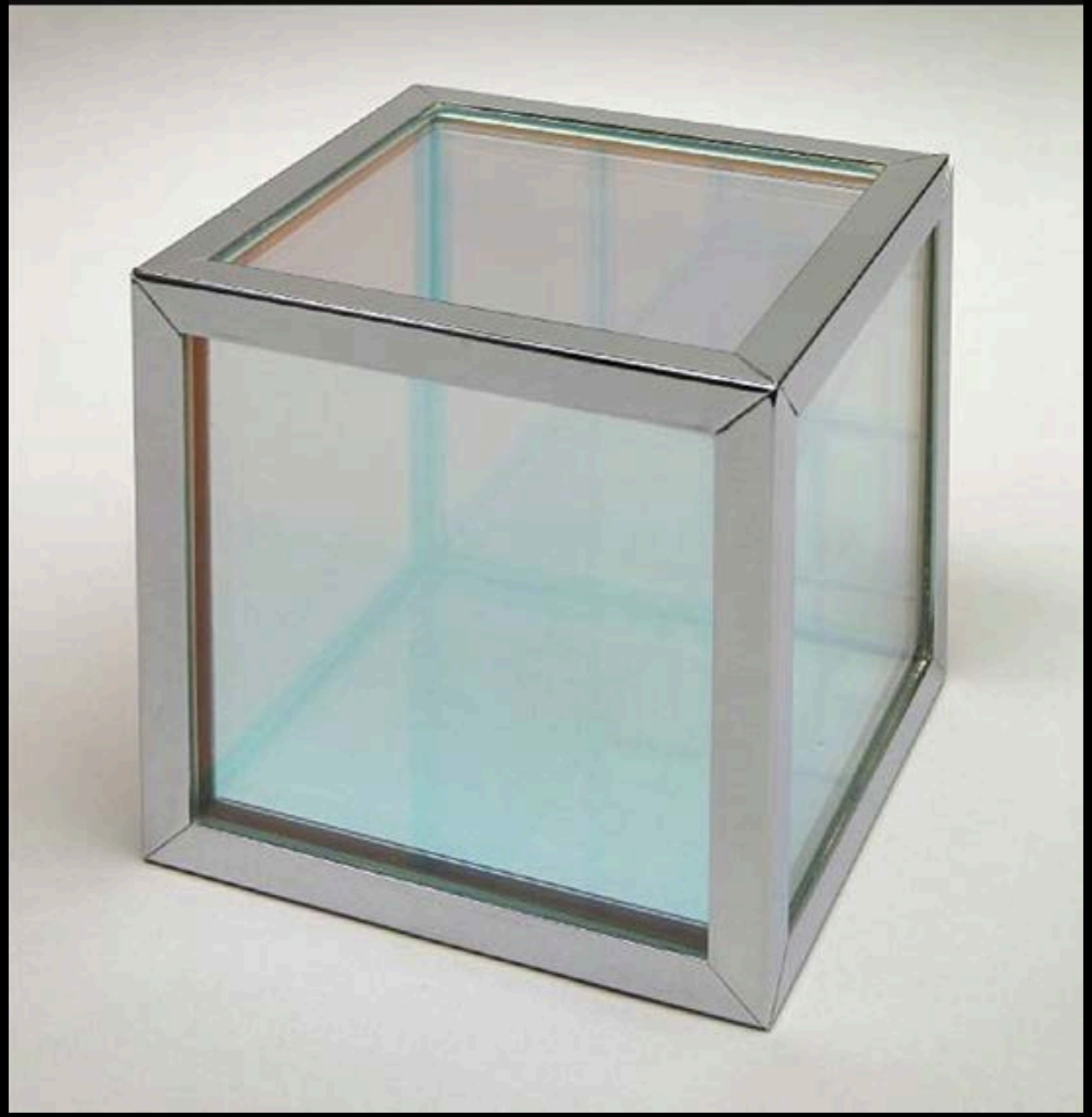
The checker-board pattern of Untitled (1962) was made by scraping away squares from a mirror, which he then painted black. The smoked effect on the four mirrored squares in the centre was achieved by applying a thin coating to the glass in a vacuum environment.

Larry Bell, Untitled, 1962

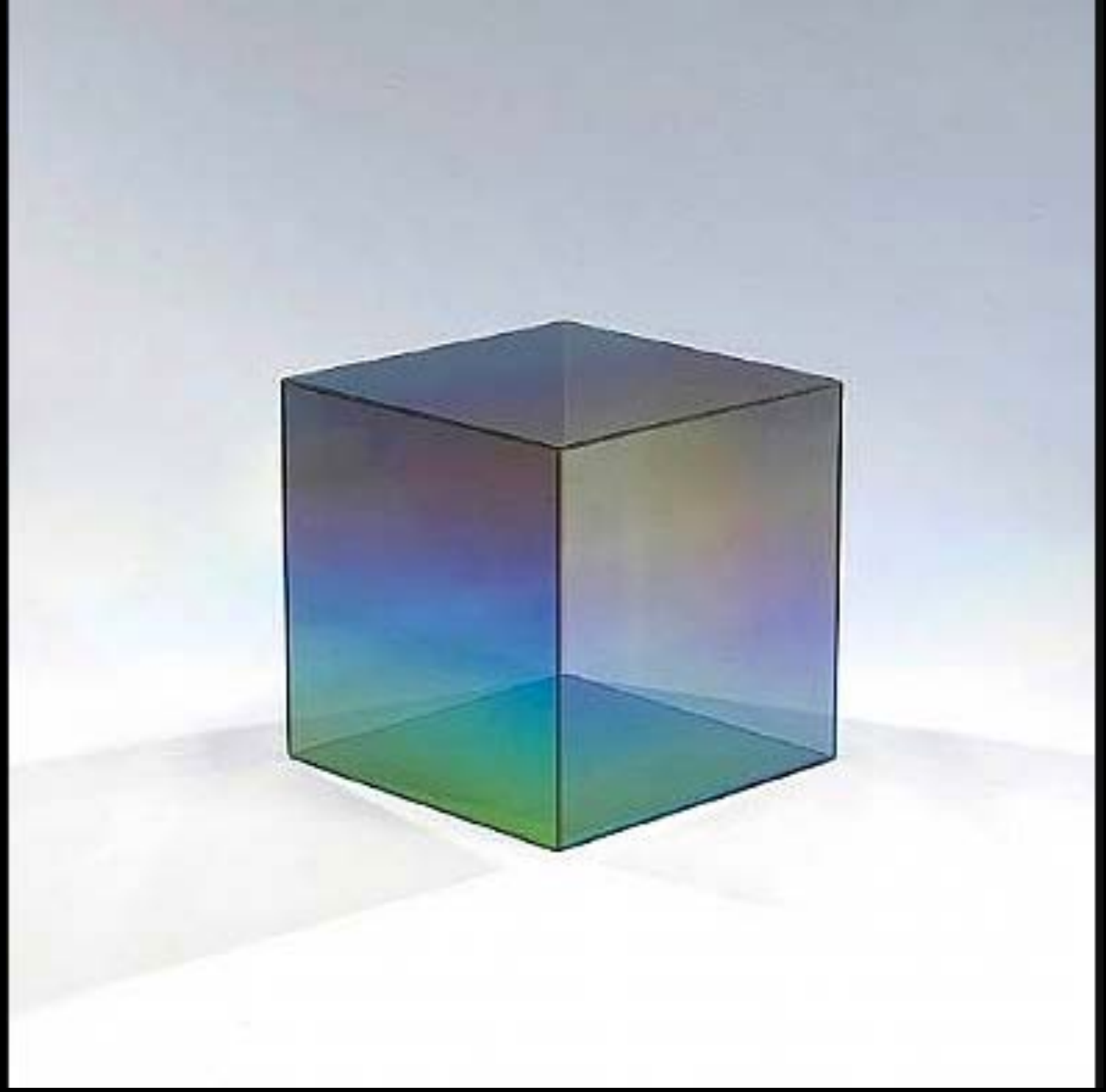
The oval patterns of Untitled (1964) were made by covering the glass with a chemical treatment that cuts off certain bands of light, so that they appear in different colours depending on the viewing angle.

Larry Bell, Untitled, 1964

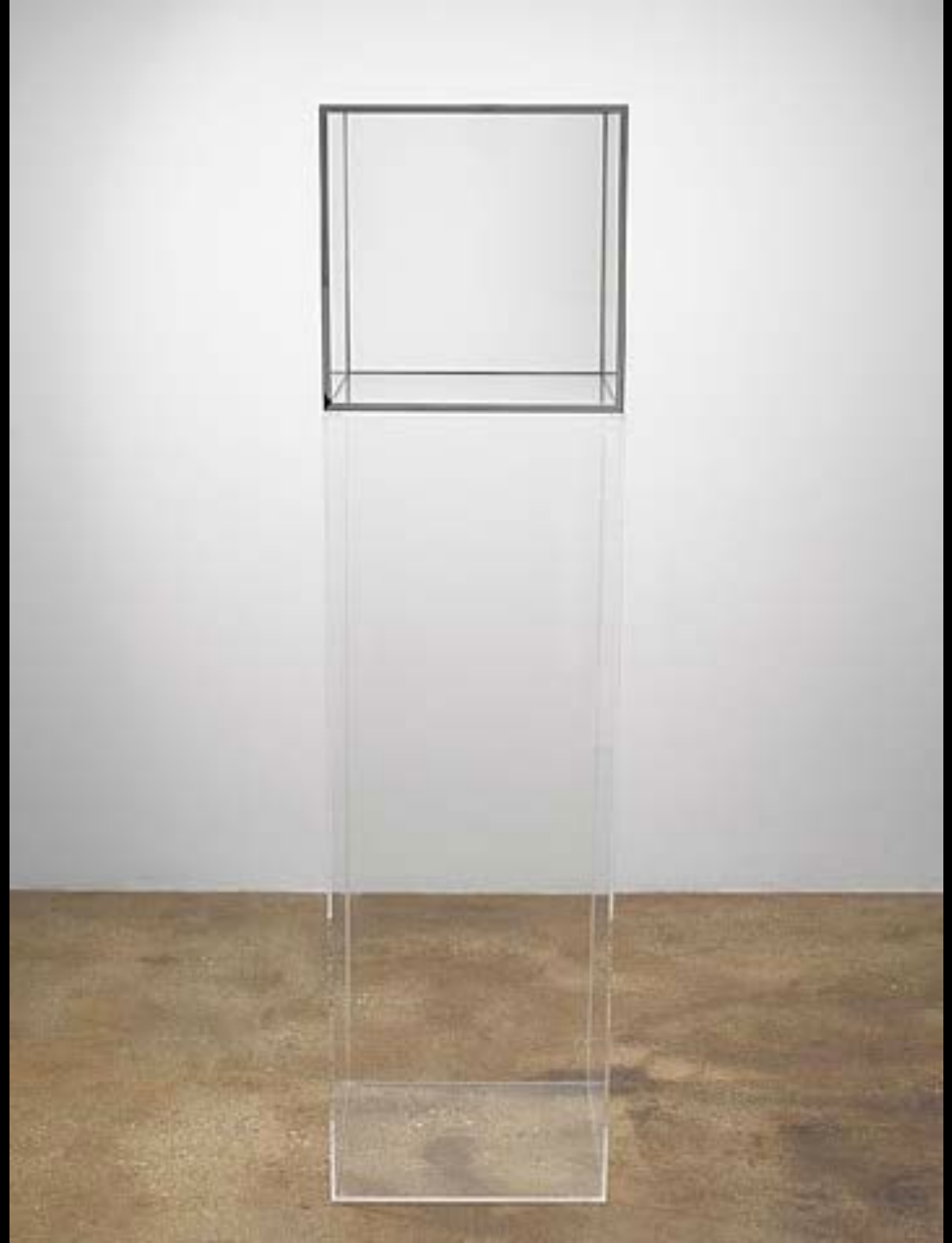
Installation view of the exhibition "Primary Structures" at the Jewish Museum in NYC, 1966



Larry Bell, Untitled (Iridescent Cube), 1964

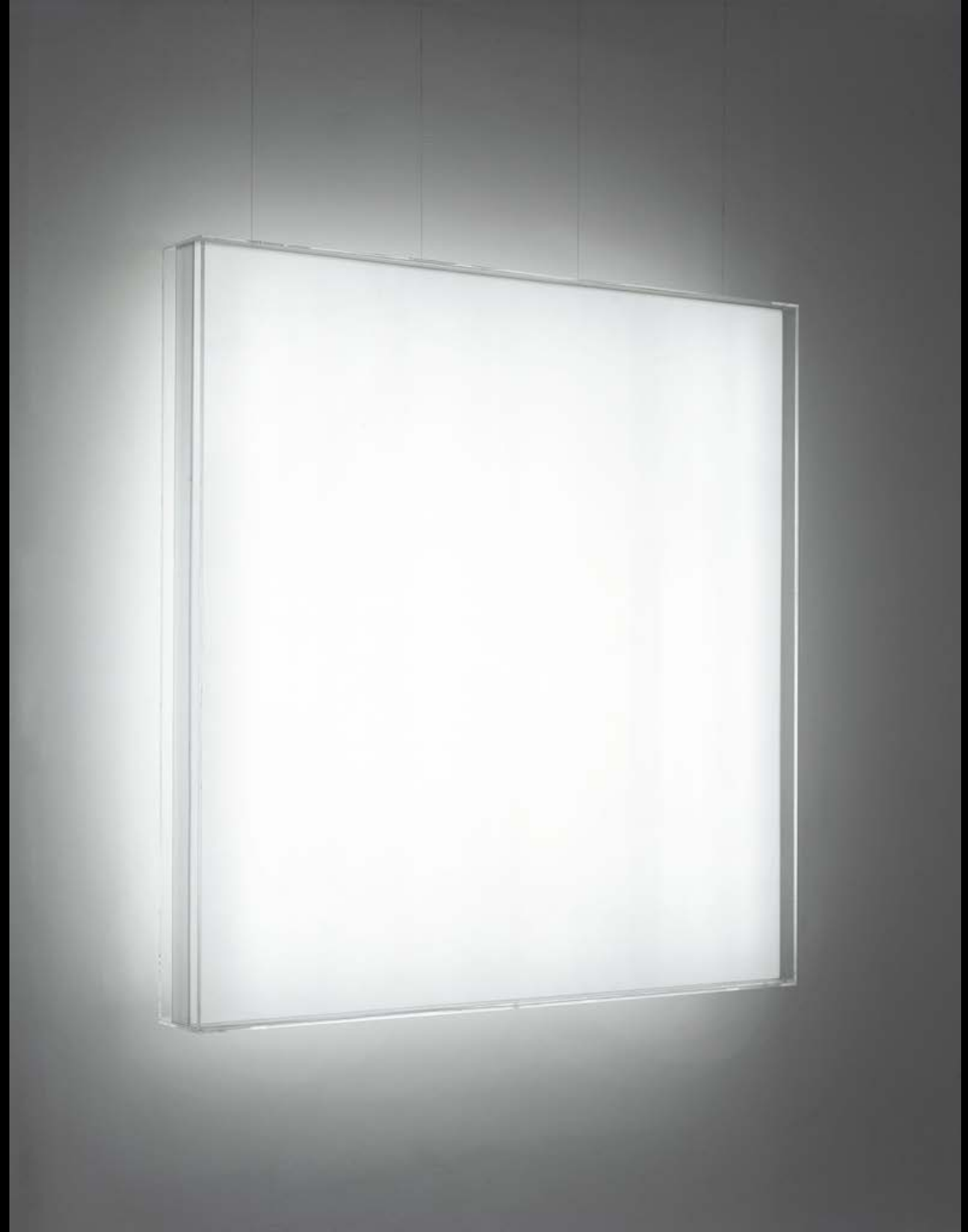


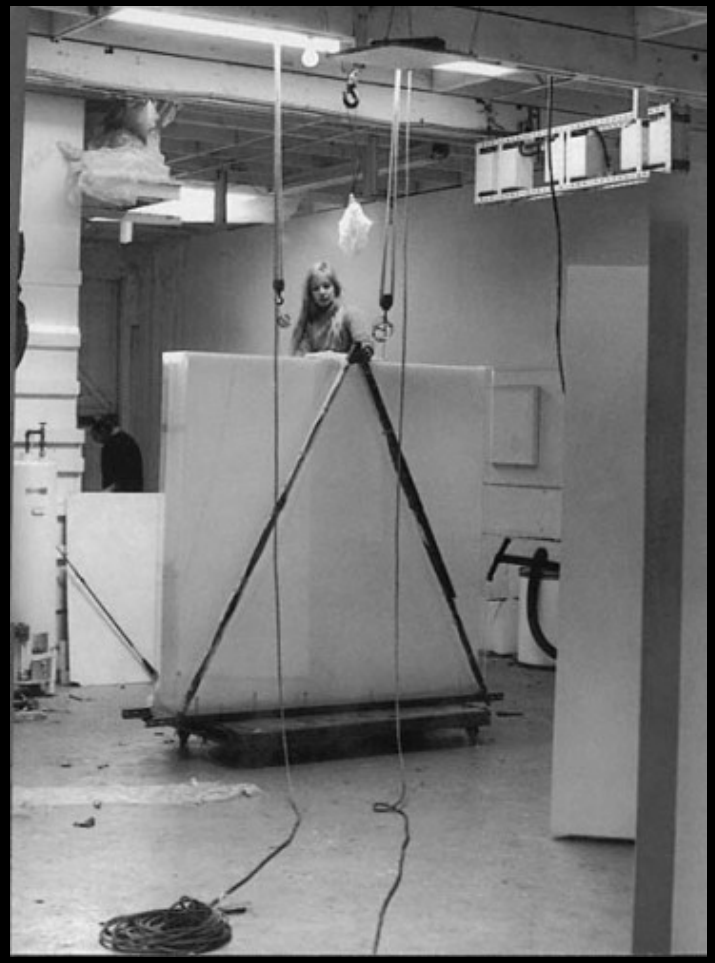
Larry Bell, 20” Cube, 1968



Larry Bell, Untitled, 1969

Larry Bell, Gus' Burg, 1975, coated glass panels



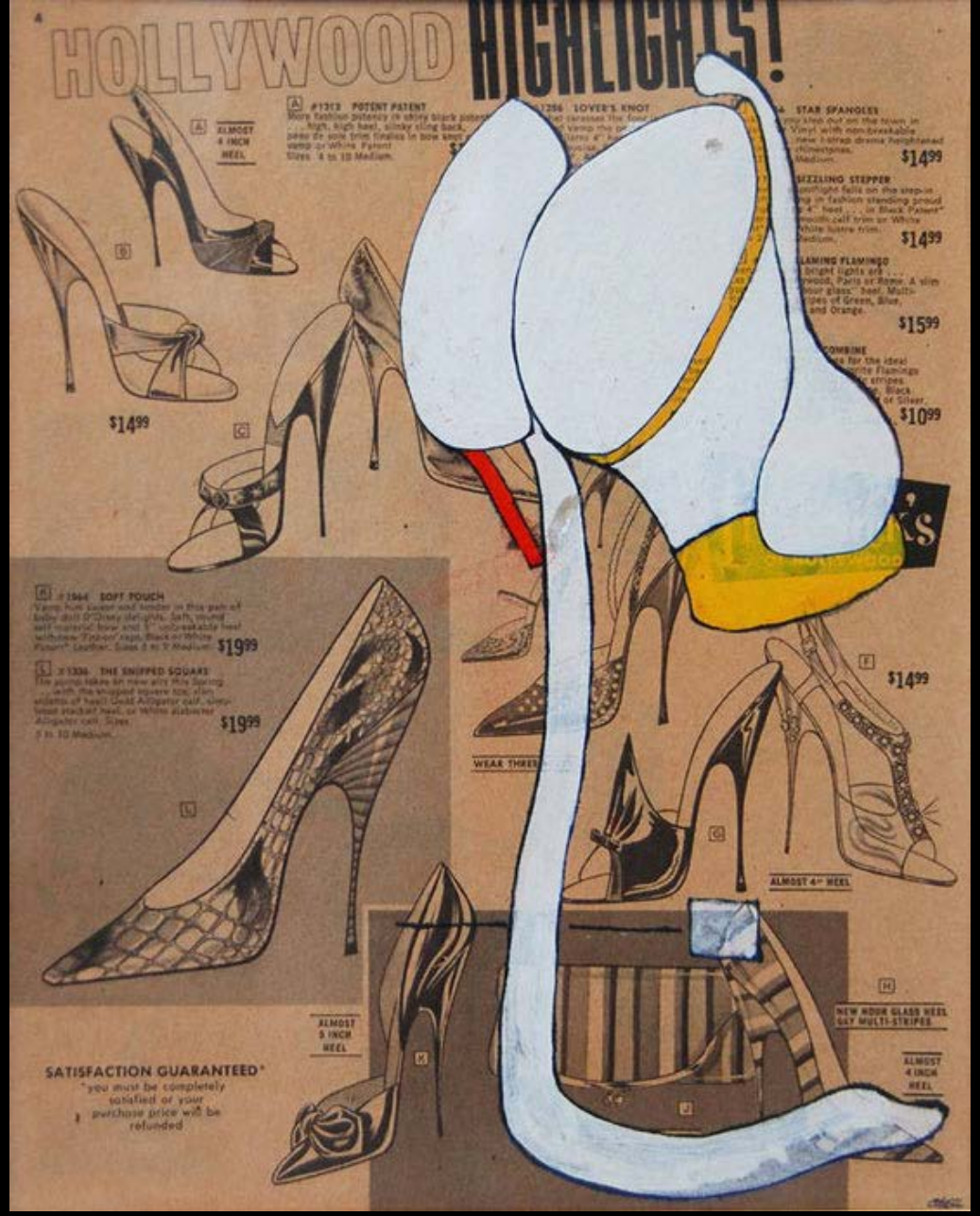


Mary Corse, Untitled (Space + Electric Light), 1968

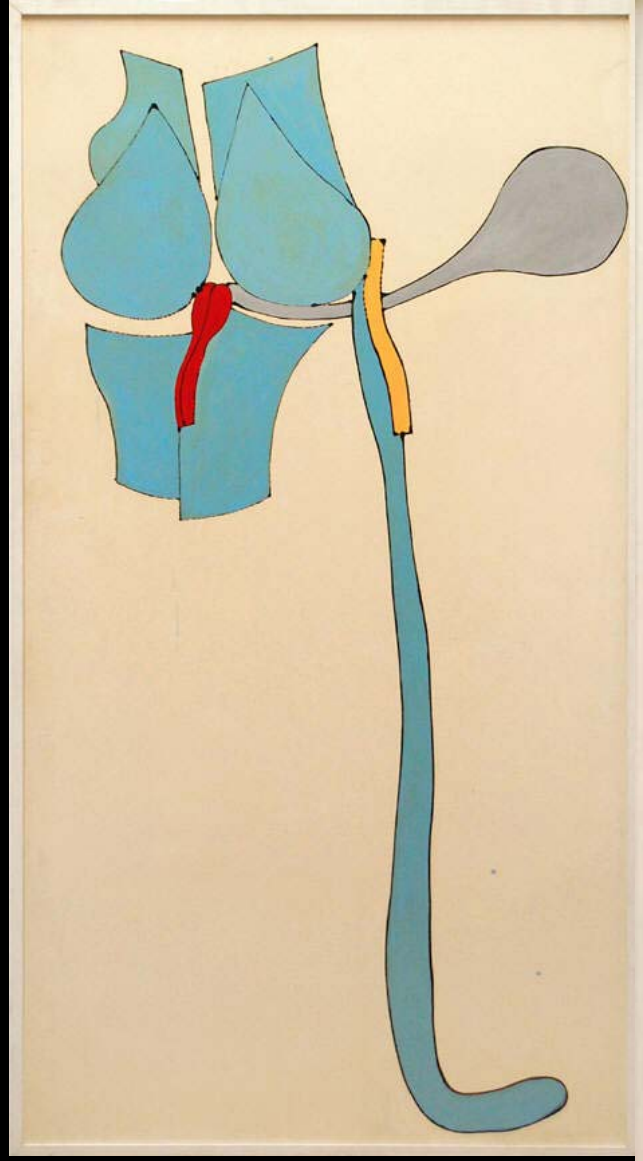
Craig Kauffman in his studio and images of an unidentified man also in a studio, ca. 1958

Craig Kauffman, Tell Tale Heart, 1958

Craig Kauffman, Still Life with Electric Fan and Respirator, 1958



Craig Kauffman, Untitled, 1962, acrylic on paper



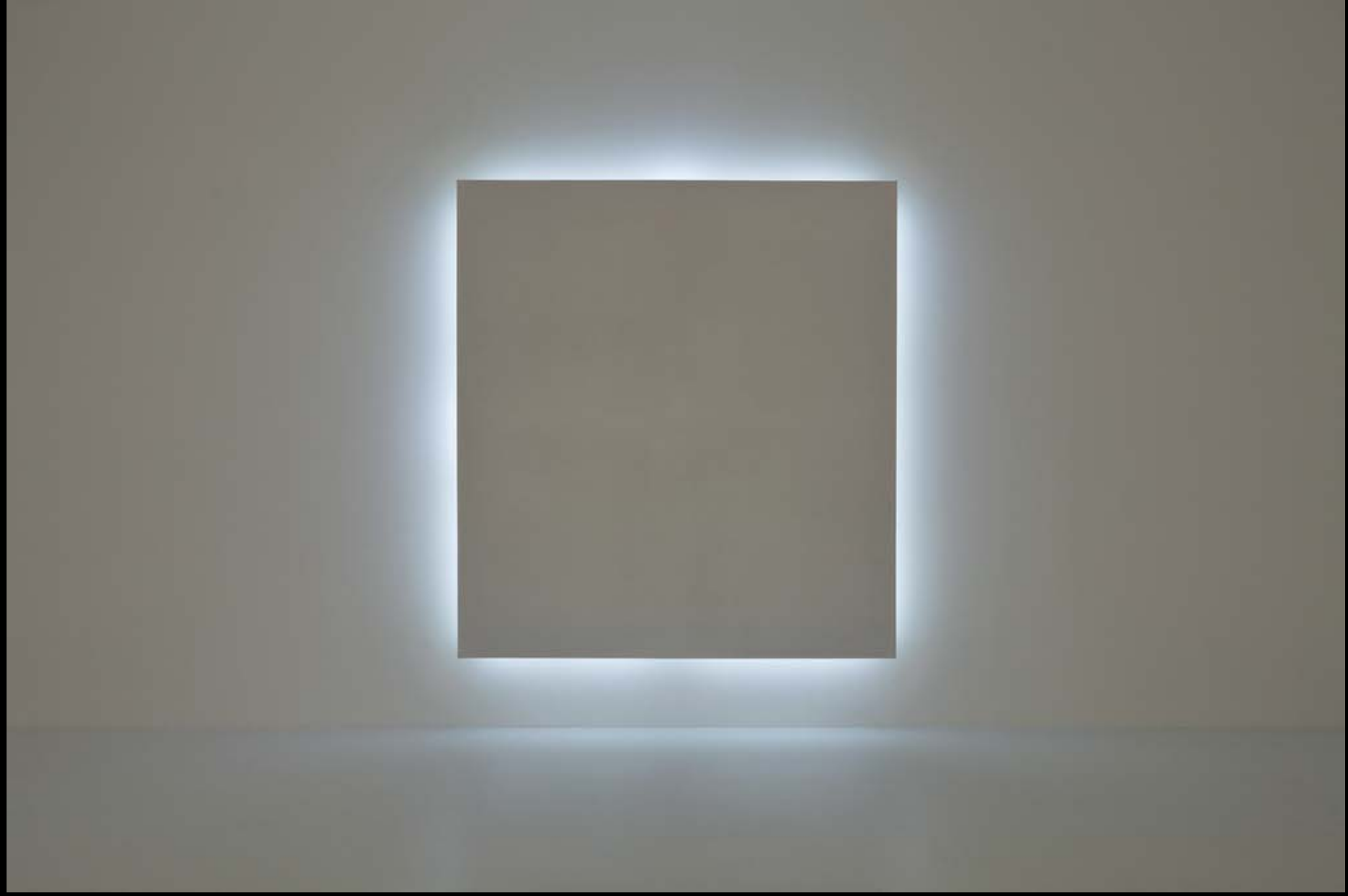
Kauffman, Git le Coeur, No. 3, 1962,
oil and enamel on paper mounted on wood

Craig Kauffman, No. 7, 1963, Acrylic lacquer
on plastic

Craig Kauffman, Untitled, 1964, acrylic
lacquer on vacuum-formed plastic

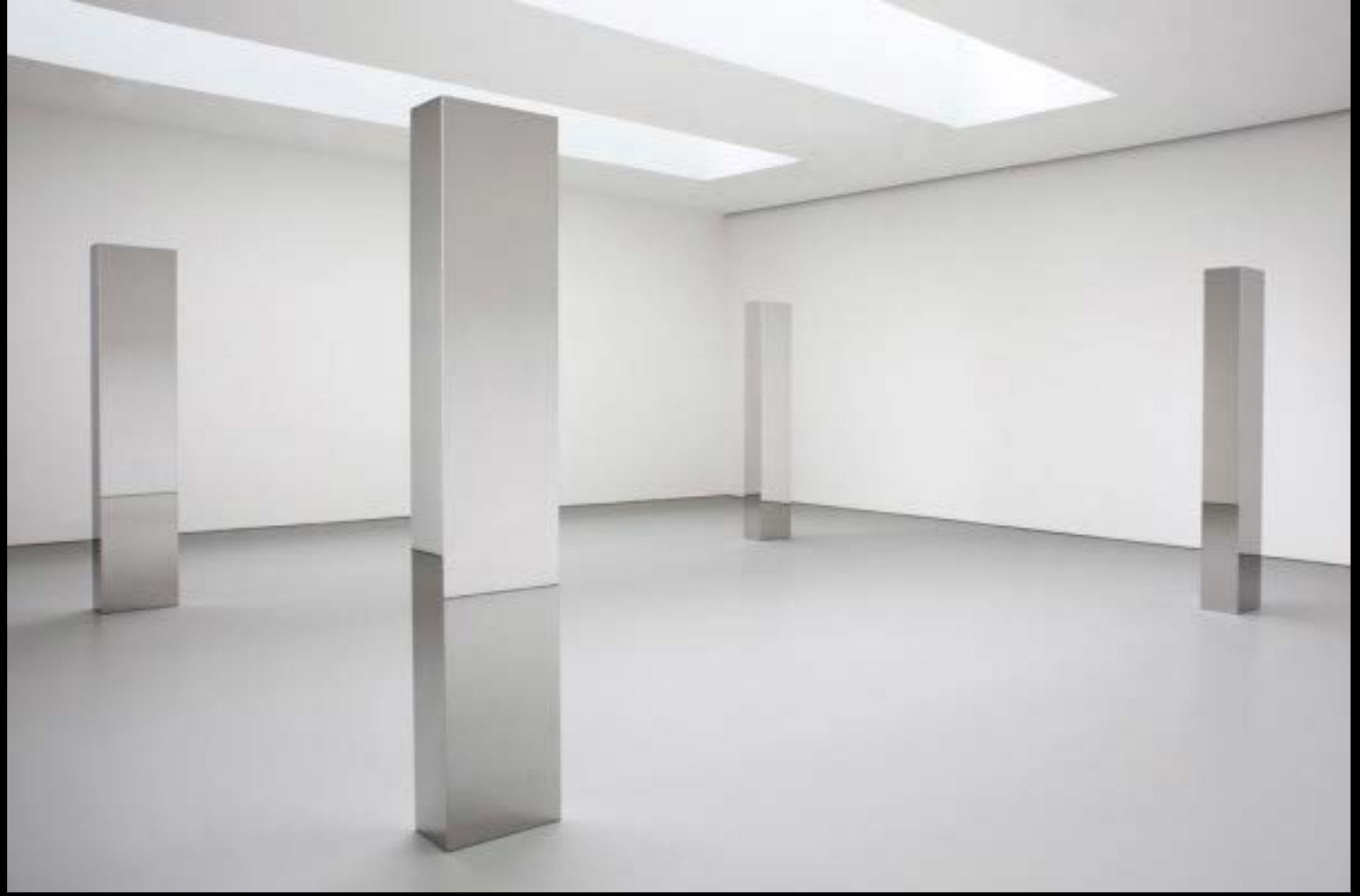
Craig Kauffman, untitled, 1968
synthetic polymer vacuum-formed plexiglas with acrylic lacquer

Craig Kauffman, Untitled, 1969, acrylic and lacquer on plastic



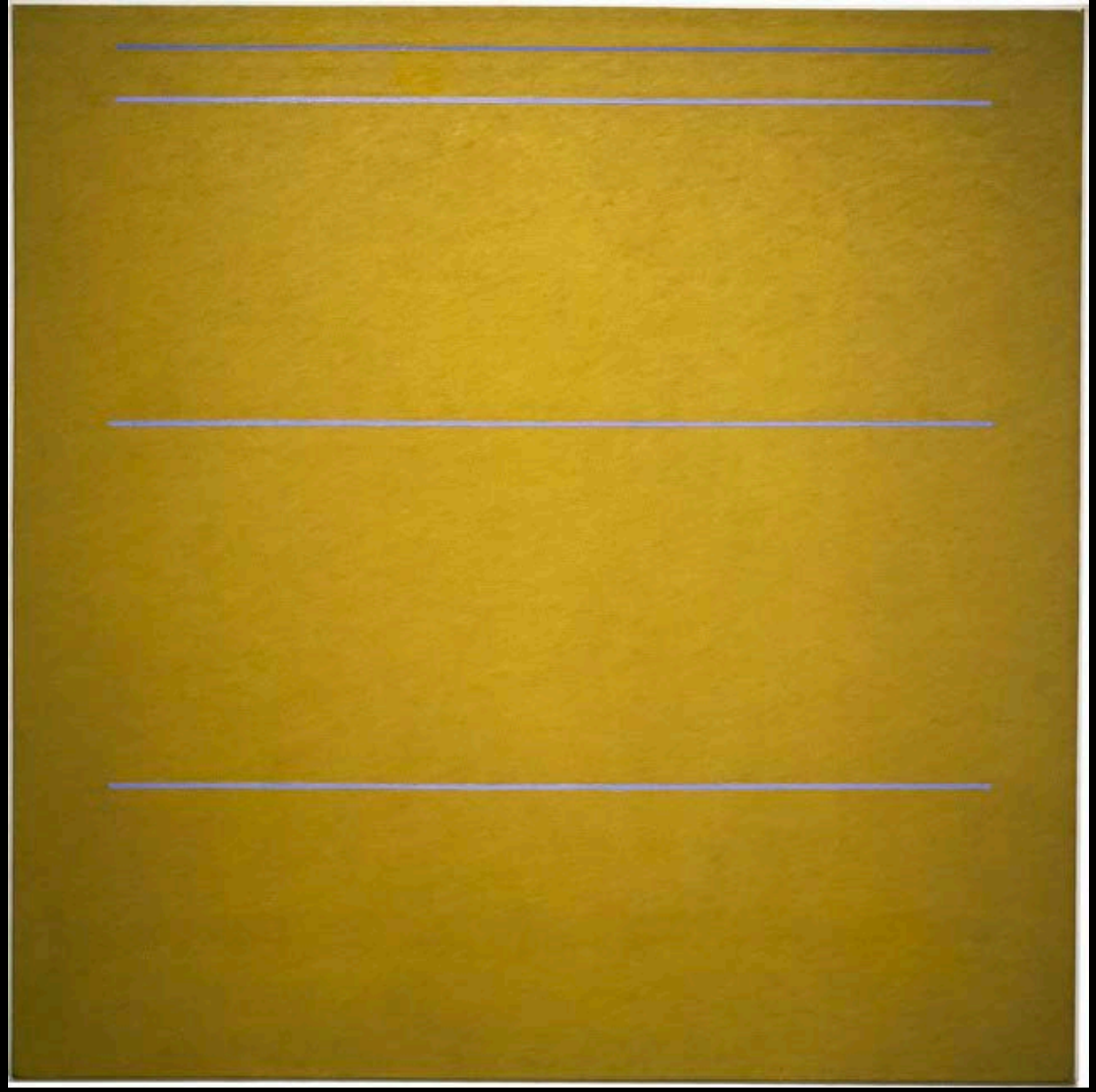
Douglas Wheeler, untitled, 1965
acrylic on canvas with neon tubing

John Mcracken, Blue Block in Three Parts, 1966
lacquer, polyester resin, fiberglass, plywood



John McCracken, *Infinite* (2010), *Electron* (2010), *Star* (2010), *Dimension* (2010)

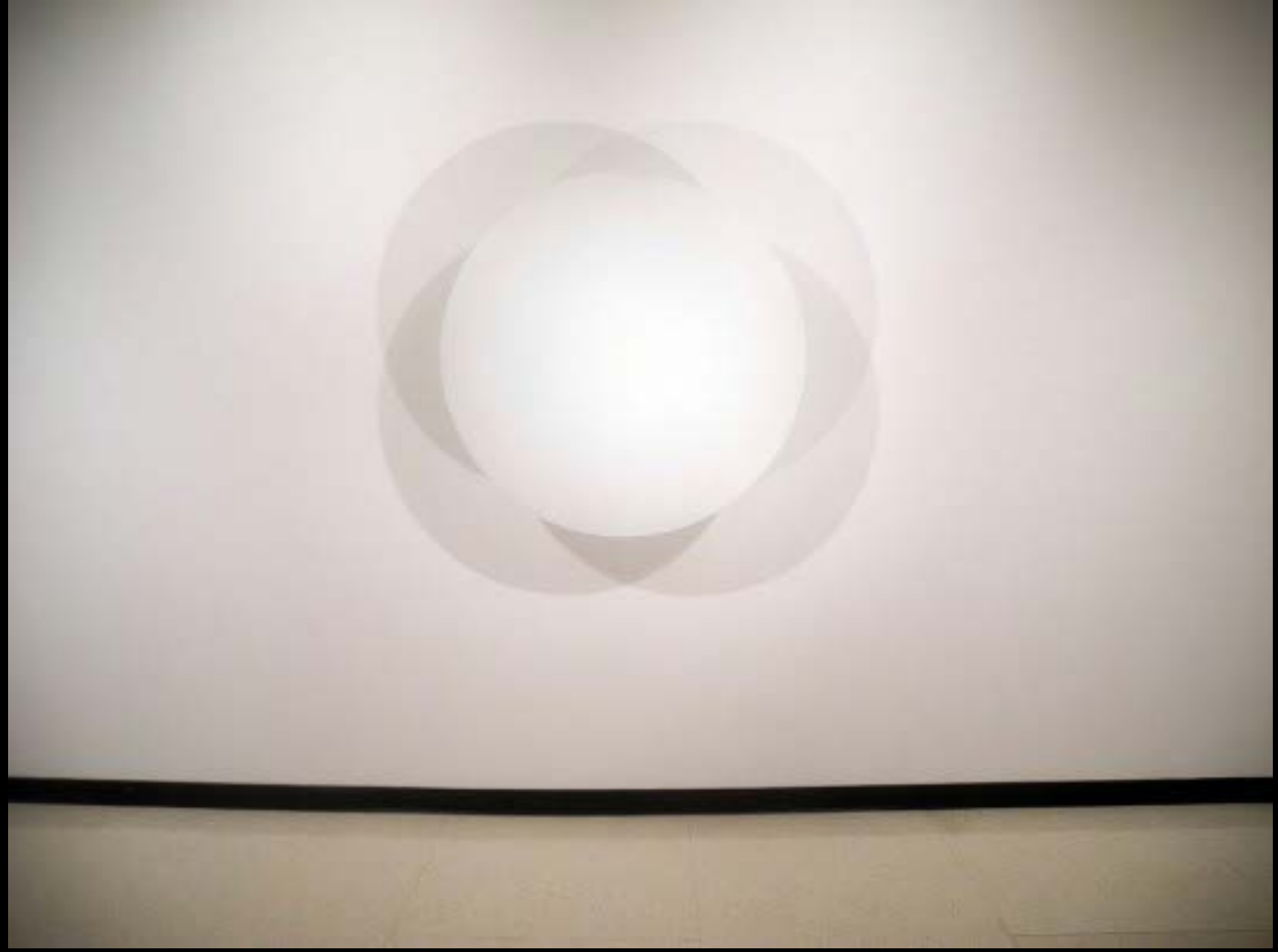
John McCracken, Galileo, 1989 and Saturn, 2000 flanking Duane Hanson, Lady with Shopping Bags, 1972



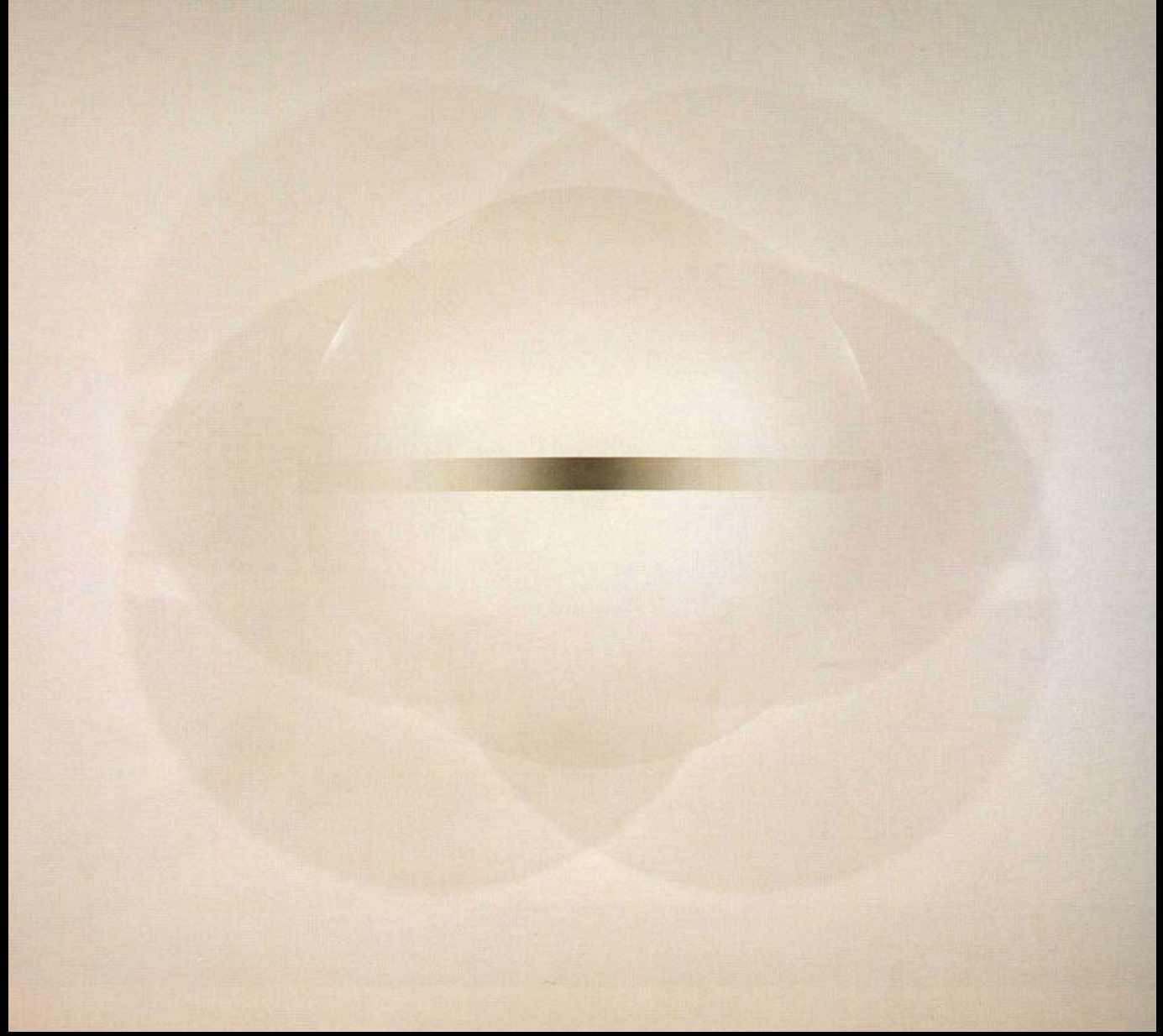
Robert Irwin, Crazy Otto, 1962 oil on canvas

Robert Irwin, Untitled, 1969-70 cast acrylic column

Robert Irwin, Untitled (Acrylic Column), 1969–2011



Robert Irwin, Untitled, 1968-69, acrylic lacquer on formed acrylic plastic

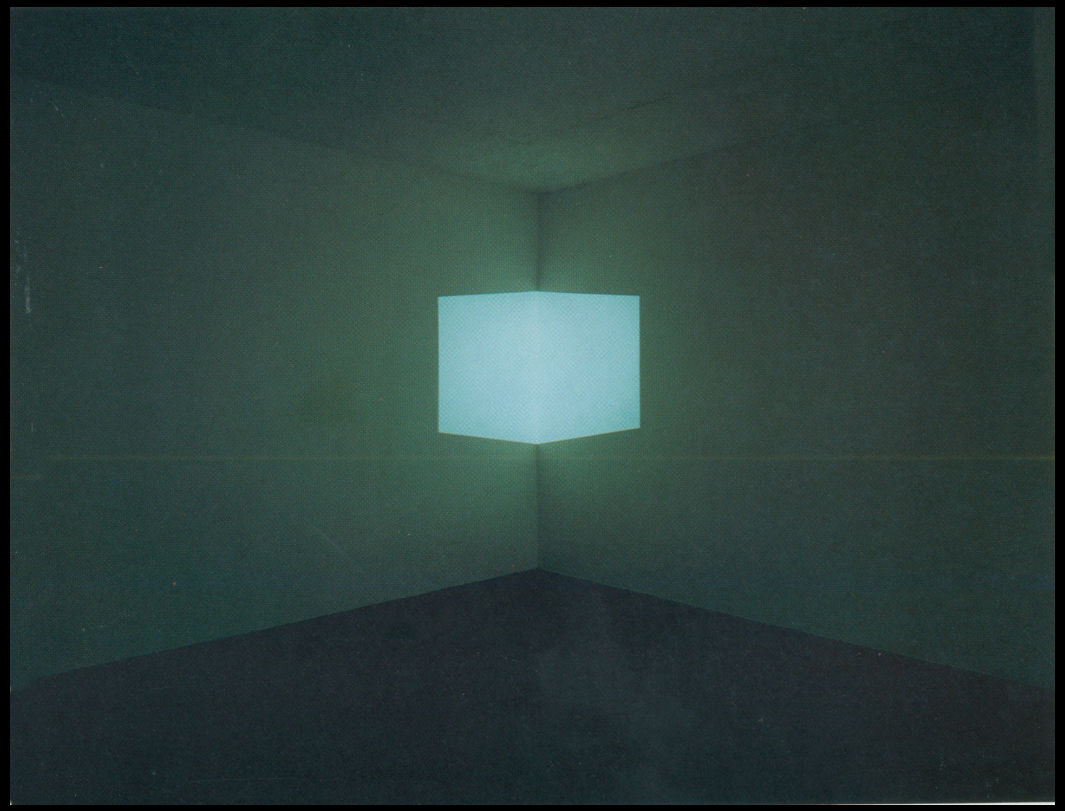


Robert Irwin, Untitled, 1967-6*8*
acrylic lacquer on formed acrylic plastic

Robert Irwin, Five x Five (installation view), 2007 Tergal voile, light construction, and framing materials

Robert Irwin, Black³, 2008 Tergal voile, light construction, framing materials and paintings (urethane paint and lacquer on aircraft honeycomb aluminum)

Robert Irwin, **Niagara**, 2011 Albright Knox Gallery, Buffalo, New York



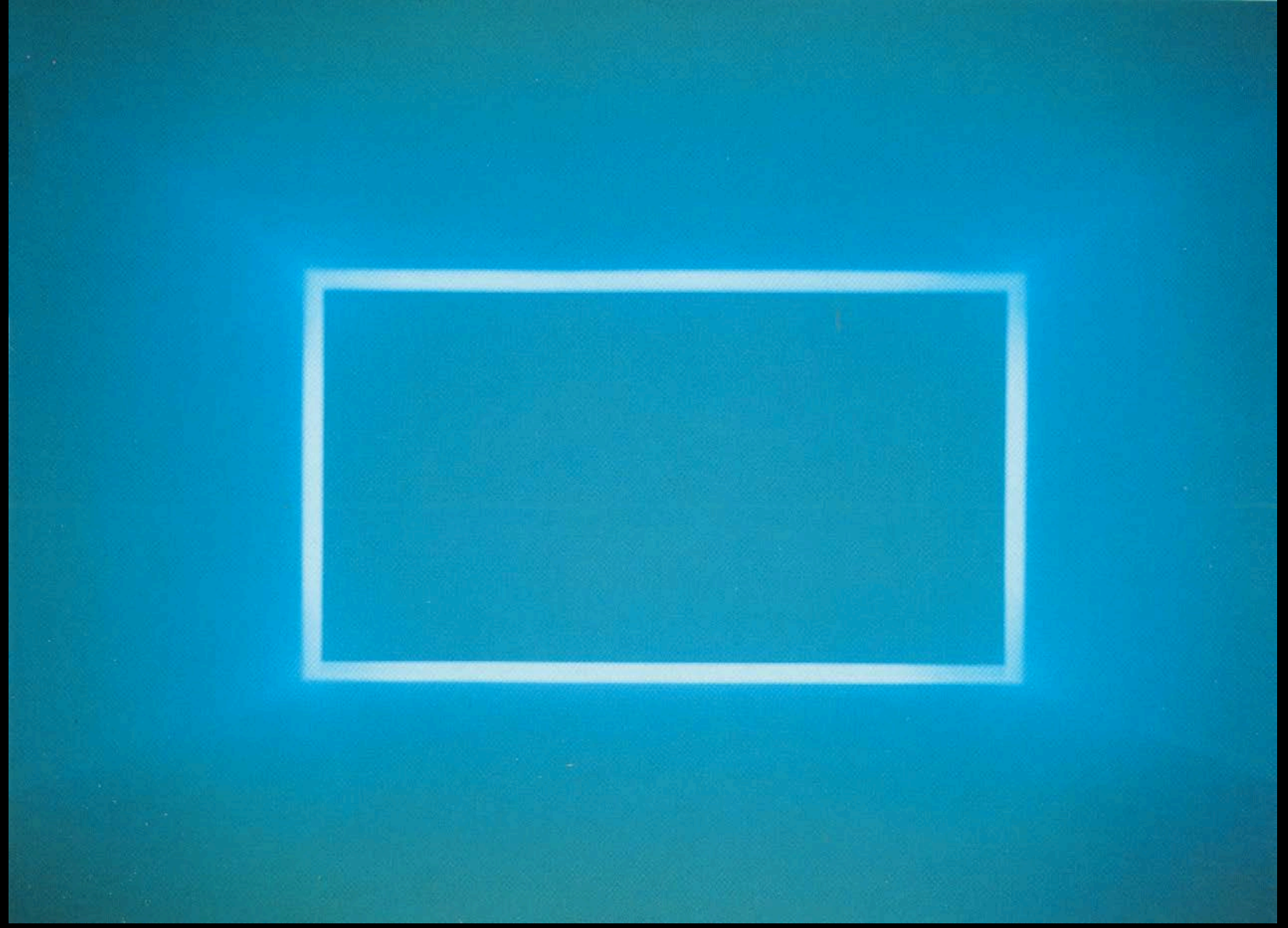
James Turrell, Afrum-Proto, 1966

PANORAMIC VIEW
OF OCEAN PARK, CAL.

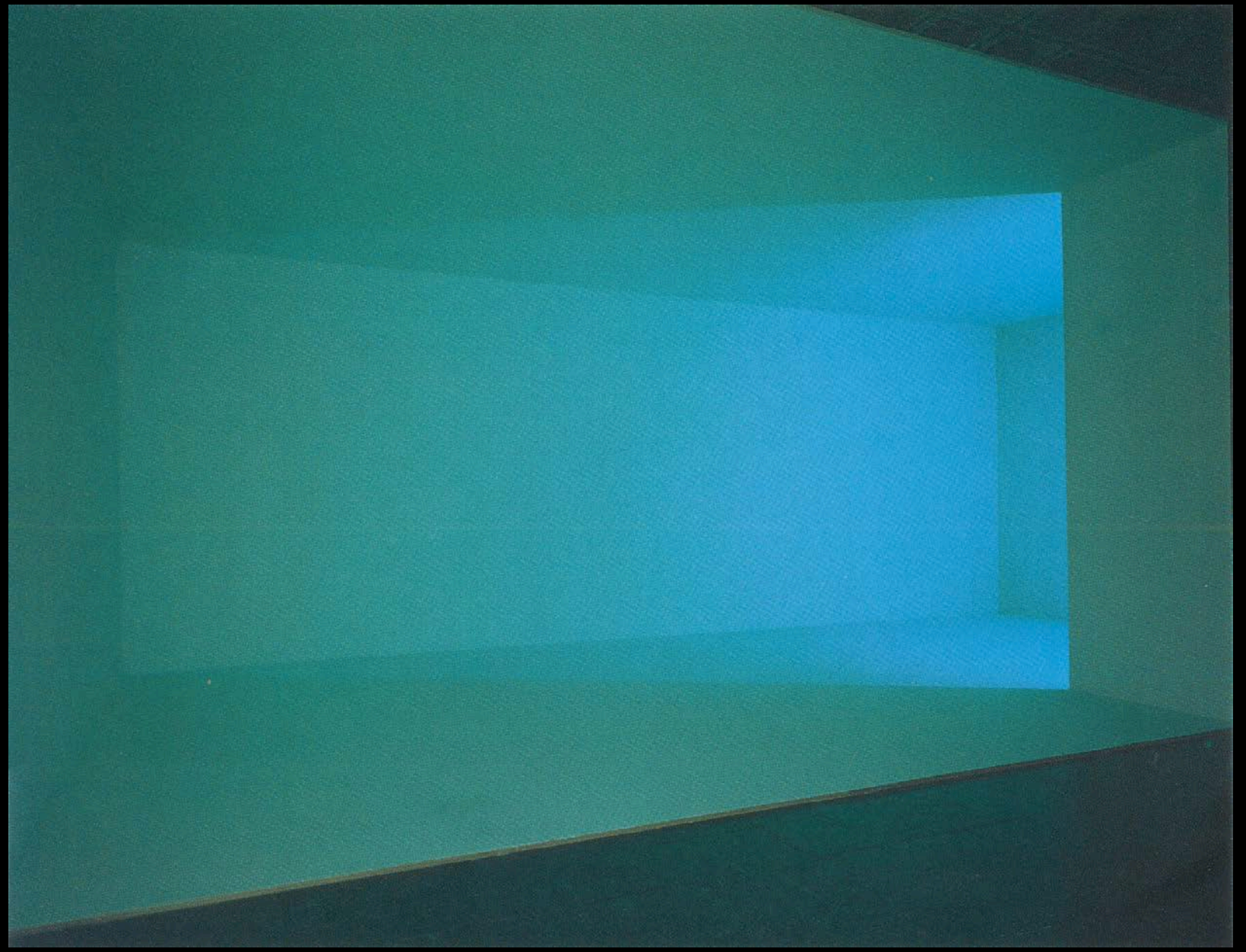
James Turrell, Afrum-Proto, 1966

Robert Irwin and James Turrell inside the anechoic chamber* at UCLA, 1969 an image from the archive of Art & Technology program at LACMA

*"an-echoic" meaning non-reflective, non-echoing or echo-free. An an-echoic chamber is a room designed to completely absorb reflections of either sound or electromagnetic waves. They are also insulated from exterior sources of noise. The combination of both aspects means they simulate a quiet open-space of infinite dimension, which is useful when exterior influences would otherwise give false results.



James Turrell, Raemar, 1967

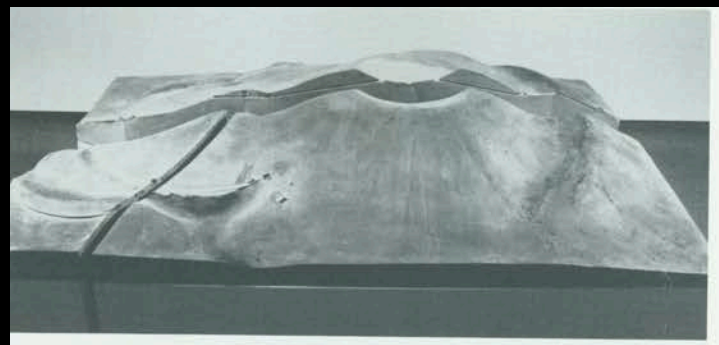


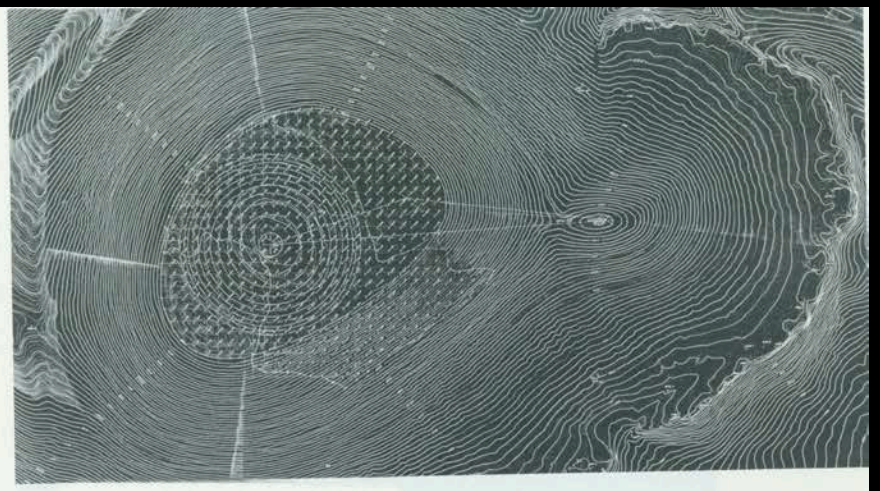
James Turrell, Wedgework, III, 1969

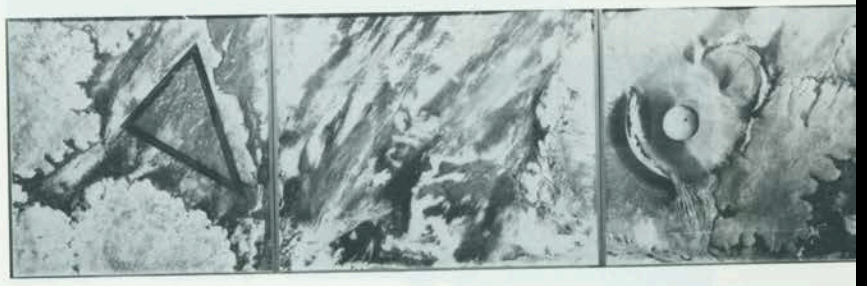
James Turrell, Meeting, 1980-86

James Turell, Hover, 1983

James Turell, Roden Crater, 1983- present





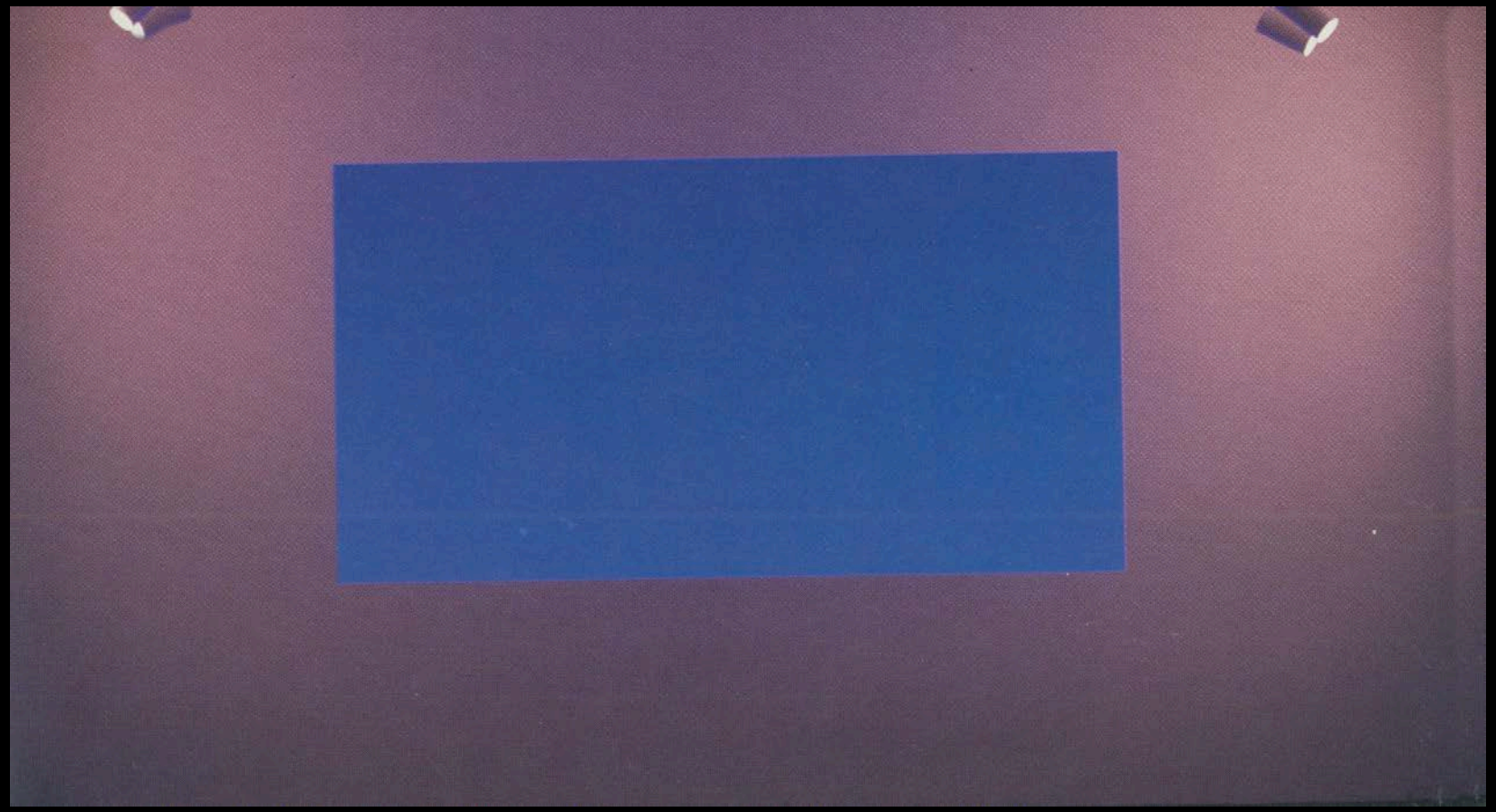


James Turrell, Light Reignfall , 2009

James Turrell, Skyspace, 1988

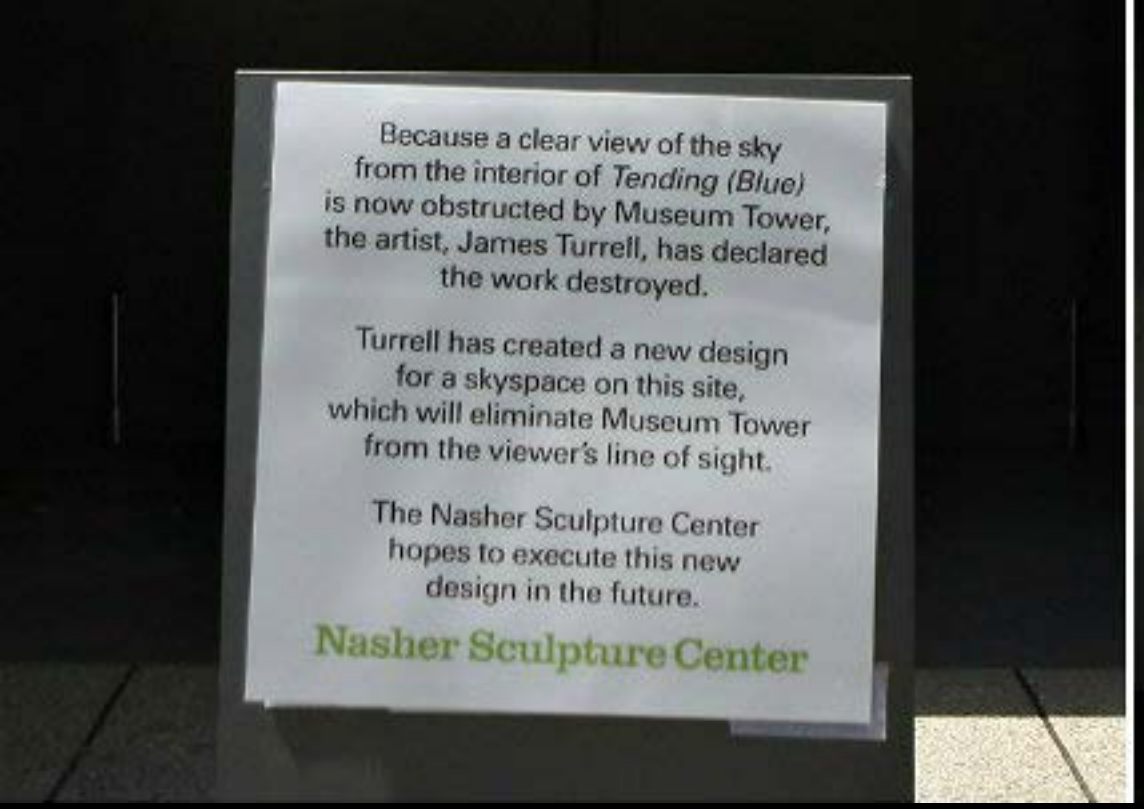
James Turrell, Skyspace, 1988

Blue Blood



James Turrell, Arcus, 1989

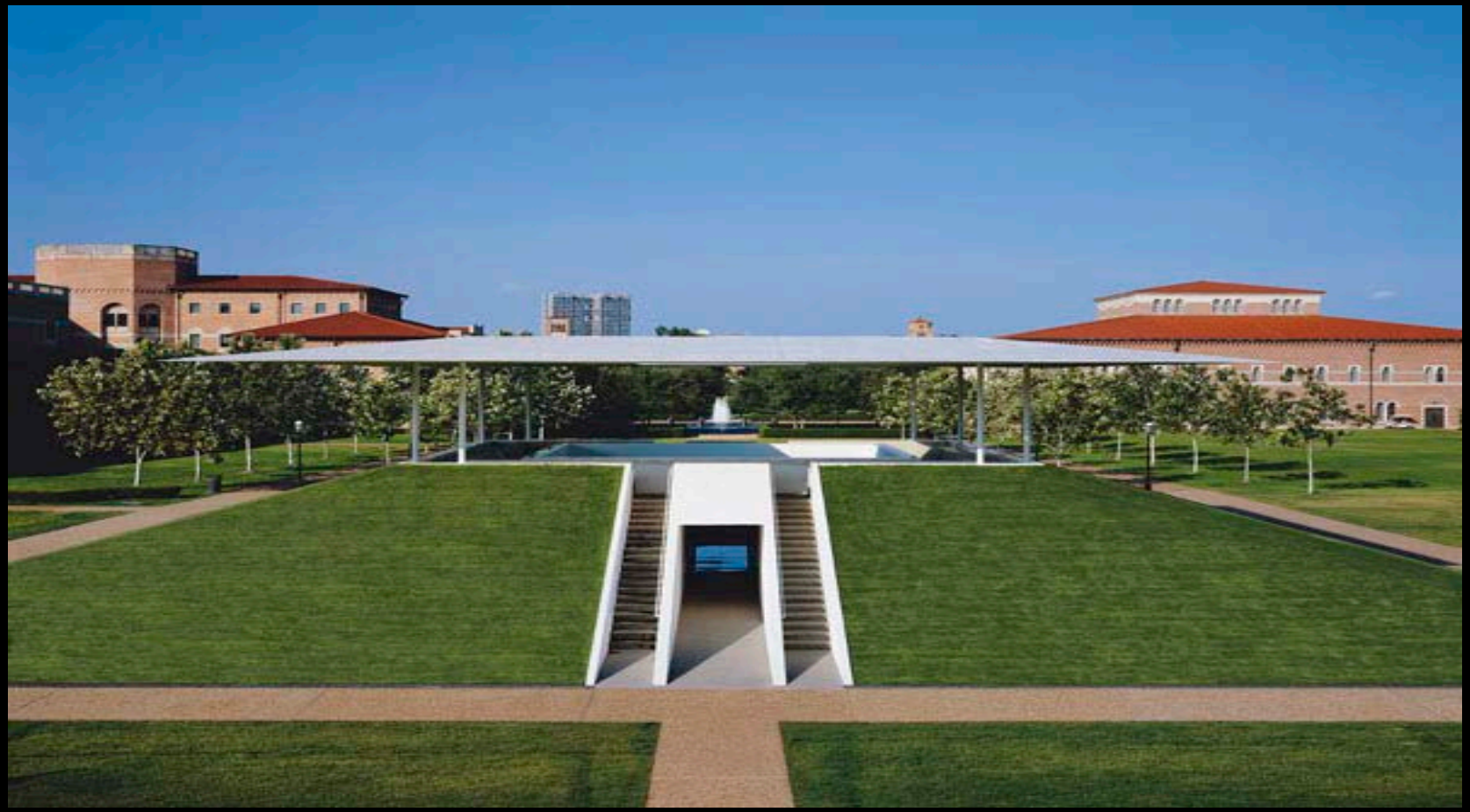
James Turrell, Tending Blue, Nasher Sculpture Center, 2003

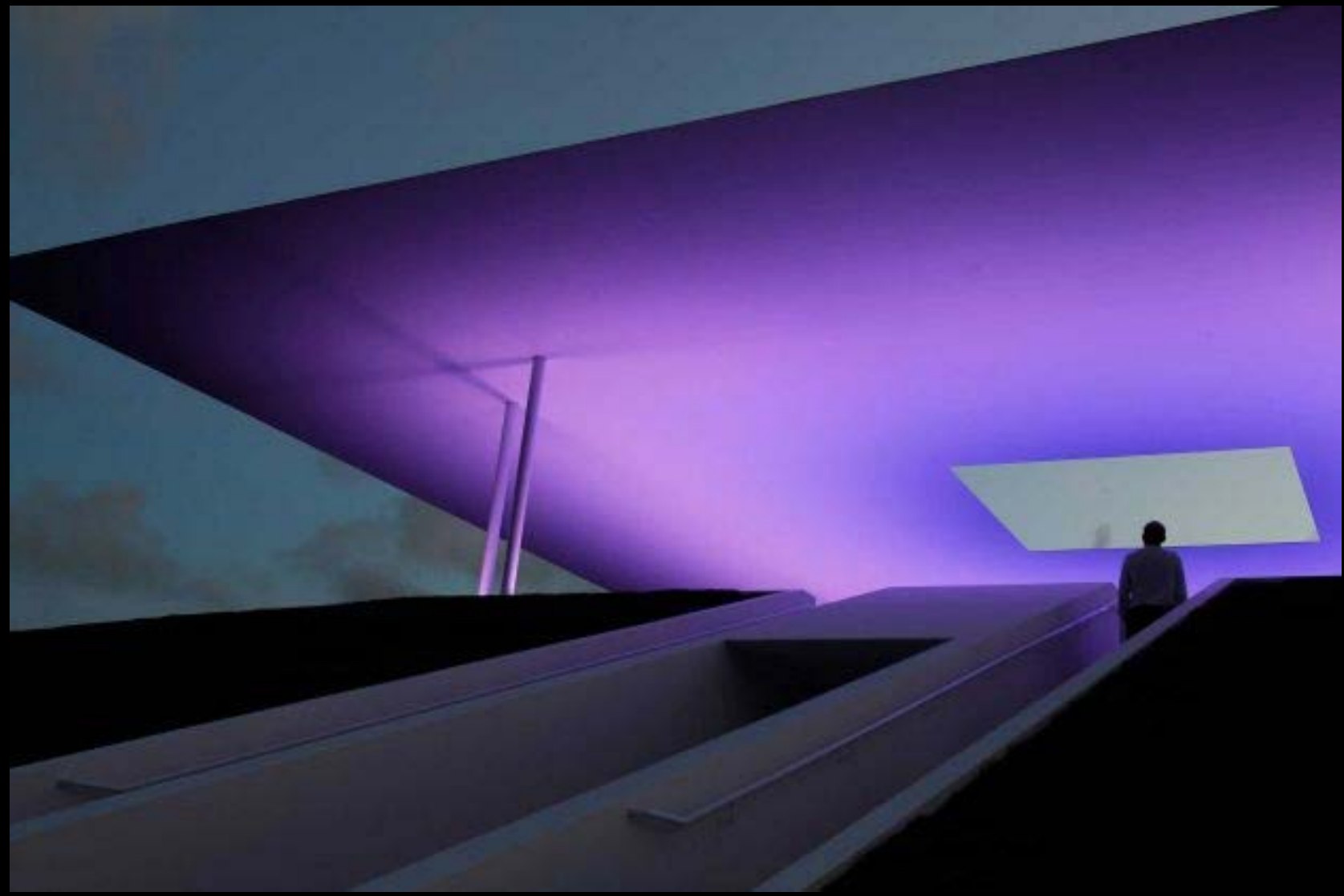

Because a clear view of the sky
from the interior of *Tending (Blue)*
is now obstructed by Museum Tower,
the artist, James Turrell, has declared
the work destroyed.
Turrell has created a new design
for a skyspace on this site,
which will eliminate Museum Tower
from the viewer's line of sight.
The Nasher Sculpture Center
hopes to execute this new
design in the future.
Nasher Sculpture Center

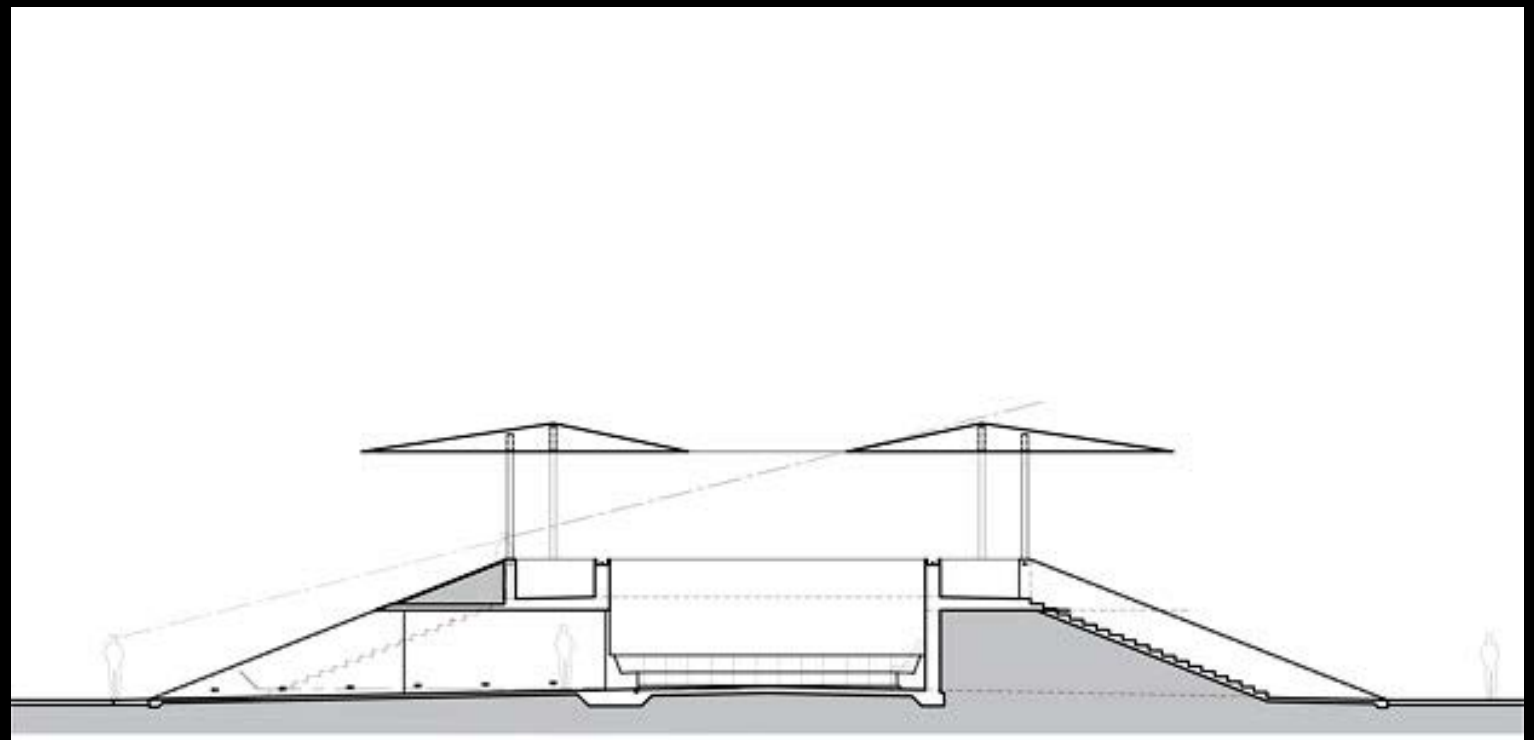
Turrell, Installation at the Guggenheim, 2013

Frank Lloyd Wright, Solomon R. Guggenheim, 1943-59

James Turrell, Twilight Epiphany, 2013, Rice University, Houston, Texas







EAST-WEST SECTION

0 10 FT.
3 M.