

THE UNIVERSITY OF CHICAGO

VERA MOLNAR'S PROGRAMMED ABSTRACTION: COMPUTER GRAPHICS AND
GEOMETRIC ABSTRACT ART IN POSTWAR EUROPE

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For Buckets

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Introduction

Are people becoming obsolete? A giant electronic brain is starting cogitating at the University of Pennsylvania. It's made of vacuum tubes, like your radio, and it can add up a column of numbers a yard long in a second. It's the world's first electronic computer!
—Newsreel announcing the Electronic Numerical Integrator and Computer (ENIAC), the first general-purpose electronic computer, February 1946

Cultural criticism finds itself faced with the final stage of the dialectic of culture and barbarism. To write poetry after Auschwitz is barbaric.
—Theodor W. Adorno, "Kulturkritik und Gesellschaft," 1949¹

[M]emory is not a static but rather an active process. A memory must be held in order to keep it from moving or fading.
—Wendy Hui Kyong Chun, "Always Already There, or Software as Memory," 2011²

As might be expected of an experience that is an important professional rite of passage, no one historian's archive is ever like another's (let alone like Jacques Derrida's). Each account of his or her experience within them will always produce counter narratives, or different kinds of discomfort."
— Carolyn Steedman, *Dust: The Archive and Cultural History*, 2002³

Vera Molnar made her first abstract drawings in 1946 (**Figure 0.01**). She was twenty-two, in her final year of art school in Budapest, gazing at the landscape of Balatonvilágos, the Hungarian lakeside resort town where she spent her childhood summers and first considered herself an artist. She translated these rolling hills into sinusoidal waves, long curving lines drawn with the sweep of a pencil. Trees became circles and line segments, dotting the landscape like stick figures or cartoon lollipops.⁴

¹ First published in 1951, then 1955 in *Prismen* in essay "Kulturkritik und Gesellschaft," translated by S. Weber and S. Weber as "Cultural Criticism and Society" in *Prisms* (Cambridge, Massachusetts: MIT Press, 1981, 34).

² Wendy Hui Kyong Chun, "Always Already There, or Software as Memory," in *Programmed Visions: Software and Memory*, Software Studies (Cambridge, Mass.: MIT Press, 2011), 167.

³ Carolyn Steedman, *Dust: The Archive and Cultural History* (New Brunswick, N.J.: Rutgers University Press, 2002), 167.

⁴ Recently, Vera Molnar and one of her Paris gallerists, Odile Aittouarès, remarked that these geometric hills and trees recall the landscape in the top-right corner of Albrecht Dürer's etching [The Desperate Man](#), c. 1515 (email correspondence

While Molnar's shapes are geometric and often drawn on graph paper, they have none of the exactness of mathematical figures nor the hard edges typically associated with postwar geometric abstraction. Her lines and circles are drawn freehand, disobeying the logic of the grid, and her forms are irregular, wobbly, and imperfect. They are rooted in a time and place, her loose marks and meandering lines evoking the grassy landscapes of the Transdanubian region.

Molnar would carry these shapes with her as she left her home the following year, heading to Rome on a scholarship for recent graduates of the Magyar Képzőművészeti Főiskola (MKF), the Hungarian fine arts academy, along with her soon-to-be-husband François (then Ferenc) Molnar. Along with their art school classmates Simon Hantaï, Judit Reigl, and Marta Pan, the Molnars used this sojourn in Rome to slip through the freshly drawn Iron Curtain, staying there only a year before making their way to Paris in December 1947, where they would stay the rest of their lives.

Though the end of the Second World War had brought a breath of fresh air to Budapest, a sense of freedom that was palpable in the halls of her art school, the country was rapidly closing off to outside influence, including Western culture, with the aesthetics of Socialist Realism coming to dominate visual culture east of the Iron Curtain. "For me, modern art *was* Paris," she recalls.⁵

Though she only knew Picasso, Matisse, and Breton from books shared by her French professor, François Gachaut, in Budapest, these figures captivated her and drew her westward.⁶ While art

with Odile Aittouarès, January 13, 2023). Molnar bought her first book of Dürer etchings, a book she still has today, as a teenager in Budapest, so it is possible that this detail had an impact on her.

⁵ Jean-Pierre Arnaud, "Une Hongroise à Paris: Entretien avec Vera Molnar," in *Artistes hongrois en France, 1920-2000: autour de la collection Szöllösi-Nagy-Nemes: [exposition, Angers, Hôtel Bessonneau, 13 avril-15 juin 2002]* (Angers: Présence de l'art contemporain, 2002), 52. Emphasis added.

⁶ Vera Molnar, "Cher Matisse," in *Cher Matisse: 12 artistes écrivent à Matisse*, ed. Michèle Lécuse (Suresnes: Bernard Chauveau, 2015), 19. Molnar in conversation with the author, October 22, 2019.

historian Serge Guilbault would later argue that “New York stole the idea of modern art” from Paris around 1945, meaning that the cultural center of the West shifted across the Atlantic, the French capital continued to attract young artists of Molnar’s generation throughout the Cold War, especially those flocking from Central-Eastern Europe and Latin America, regions linked by what art historian Armin Medosch calls their “peripheral modernity.”⁷

It was not until after she arrived in Paris that Molnar became familiar with the Hungarian avant-garde and the Bauhaus, as she joined a cohort of emigrés, many of their passports also reading *refugié*, who would gather weekly at Le Select in Montparnasse.⁸ She soon met Sonia Delaunay, a fellow “wild woman” from the East who became a role model for Molnar, encouraging her to pursue abstraction.⁹ These early years in Paris were spent trying on different languages of abstraction, emulating artists from Kandinsky to Picasso to Mondrian, until she landed on the geometric vocabulary of *l’abstraction froide*, or cold abstraction, soon emptying her forms of any reference to the natural world.¹⁰

⁷ Serge Guilbault, *How New York Stole the Idea of Modern Art: Abstract Expressionism, Freedom, and the Cold War* (Chicago, IL: University of Chicago Press, 1985); Piotr Piotrowski, *In the Shadow of Yalta: Art and the Avant-Garde in Eastern Europe, 1945-1989* (London: Reaktion, 2009); Armin Medosch, *New Tendencies: Art at the Threshold of the Information Revolution (1961-1978)*, Leonardo (Cambridge, Massachusetts: The MIT Press, 2016), 74.

⁸ Arnaud, “Une Hongroise à Paris: Entretien avec Vera Molnar,” 54.

⁹ Hans Ulrich Obrist, “Vera Molnar in Conversation with Hans Ulrich Obrist,” in *Bookmarks: Revisiting Hungarian Art of the 1960s and 1970s*, ed. Hans Ulrich Obrist and András Szántó (Koenig Books, 2018), 86. Molnar recalls going to the Delaunays’ regularly to share her work with other young artists, shortly after arriving in Paris. As this was after Robert Delaunay’s death in 1941, this would have been different from the famous *salons* the Delaunays hosted in their home (I am grateful to Tamar Kharatishvili for this contextual observation). In this moment of postwar reconstruction, Sonia Delaunay served tea and biscuits, “And biscuits were a sign of wealth,” Molnar says, “We were so hungry ... we had to be careful not to eat too many cookies all at once. And I showed my work to Sonia Delaunay, and she said, in front of a bunch of people, ‘*Cette petite, si elle travaille bien, ira loin.*’” (Vera Molnar, conversation with the author, July 15, 2018. My translation from Hungarian.)

¹⁰ In the catalogue for SIGMA 1973, Vera Molnar writes of her own practice: “dès 1946 fait de la peinture abstraite géométrique « froide ».” (*SIGMA 9: Art et ordinateur, Bordeaux, 19 novembre au 8 décembre 1973, [2]: Contact II*, SIGMA 9. (Bordeaux: SIGMA, 1973), 9.)

Programming Abstraction

“Cold” abstraction was first named by the Swiss typographer, designer, and artist Karl Gerstner in 1957, in a short book titled *Kalte Kunst? (Cold Art?)*. Hesitant to call it a movement—evidenced by his lingering question mark—Gerstner identifies coldness as a tendency in twentieth-century European abstraction, emerging in two waves or generations. The first, interwar generation included the painter Theo van Doesburg, who spearheaded *l’art concret*, or Concrete Art, in Paris in 1930, as well as Josef Albers and Piet Mondrian. These artists, Gerstner suggests, developed the *words* to a new visual language: the forms of geometric abstraction. The second, postwar generation, led by Swiss designer, artist, and educator Max Bill, who studied at the Bauhaus and founded the Hochschule für Gestaltung in Ulm, Germany, developed a *grammar* for this language, a more robust set of rules and principles to theorize these geometric shapes.¹¹

Cold abstraction and Concrete art, while not synonymous, have been used interchangeably to describe European abstraction in the 1950s and 1960s that was geometric, systematic, unemotional, and executed using scientific tools and methods. *L’art concret*, as it was originally formulated, called for a “universal” art that would be intelligible to all viewers by using “simple and visually controllable” elements that did not signify anything beyond themselves (**Figure 0.02**). In this language, circles and lines did not mean trees or hills; they meant, simply, circles and lines. Van Doesburg called for art uninfluenced by nature, sensuality, or sentimentality; to achieve this, he proposed that a painting “must be entirely conceived and shaped by the mind before its execution” and that the act of painting should be “mechanic” and “anti-impressionistic.”¹² In so doing, artists could suppress the subjective factors that had characterized painting for centuries.

¹¹ Karl Gerstner, *Kalte Kunst? Zum Standort der heutigen Malerei*. (Tüfen: Schweiz, A. Niggli, 1957). In 1964, Gerstner would publish a book called *Designing Programmes: Programme as Typeface, Typography, Picture, Method*.

¹² Jean Hélion, ed., “Art Concret (Revue)” N. d’introduction (1930). My translation; see figure 0.02 for original French.

The desire to rid abstraction of referentiality, already present in van Doesburg's manifesto, was rearticulated in Jean Arp's essay "*art concret*," written for Max Bill's exhibition *Konkrete Kunst* in Basel in 1944: "We don't want to *reproduce* [nature], we want to *produce* ... as there is no trace of abstraction in this art we name it: concrete art."¹³ Building on the prewar idea of "universal" art, Bill proposed a "mathematical approach" to painting, arguing that, by following the natural laws of mathematics, artists could become "free creators and not copycats after nature's model."¹⁴ Bill and his ideas traveled far and wide, impacting artistic practices not only in Switzerland and Germany but also in Brazil and Yugoslavia.¹⁵ In the French context, his legacy is summarized by art historian Yve-Alain Bois as "an art entirely programmed by a set of a priori rules, an art that in principle leaves no room for the subjectivity of the artist and the arbitrariness of composition."¹⁶

Vera Molnar was, like many artists in postwar Paris, intrigued by the idea that art could be "programmed"—that by creating a system, a set of rules or instructions, she could approach an art

¹³ Jean Arp, "Art Concret," in *Konkrete Kunst* (*Kunsthalle Basel*, 18. März – 16. April 1944), ed. Max Bill (Basel: Kunsthalle Basel, 1944), 11. "nous ne voulons pas copier la nature. nous ne voulons pas reproduire, nous voulons produire. ... comme il n'y a pas la moindre trace d'abstraction dans cet art nous le nommons : art concret." Emphasis added.

¹⁴ Héliou, Jean, ed. "Art Concret (Revue)" N. d'introduction (1930). In 1944, Bill wrote, "Ich lese in den Manifesten der Moderne, daß dieses Leute freie Schöpfer sein wollen und nicht Nachschöpfer nach dem Naturvorbild" (Max Bill, *Konkrete Kunst* (*Kunsthalle Basel*, 18. März – 16. April 1944) (Basel: Kunsthalle Basel, 1944), 5; the significance of mathematics was articulated in Max Bill, "The Mathematical Approach in Contemporary Art (1949)," in *Theories and Documents of Contemporary Art: A Sourcebook of Artists' Writings*, ed. Kristine Stiles and Peter Selz (Berkeley: University of California Press, 1996).

¹⁵ Medosch, *New Tendencies*; Marta Dziewanska, Dieter Roelstraete, and Abigail Winograd, eds., *The Other Transatlantic: Kinetic and Op Art in Eastern Europe and Latin America* (Museum of Modern Art in Warsaw, 2018).

¹⁶ Yve-Alain Bois, "François Morellet/Sol LeWitt: A Case Study Revisited," *October*, no. 157 (2016): 164. this dissertation, I employ the term *systematic* to maintain consistency with this discourse as well as Molnar's own descriptions of her method. Whereas *systemic*, the term used in the American context by Lawrence Alloway in his *Systemic Painting* (1966), more generally describes something relating to a whole system (as opposed to a particular part), *systematic* is more of a synonym for methodical, done according to a fixed plan or system. *Systematic*, in other words, emphasizes the procedural aspect of Molnar's practice. It is important to note that while postwar Concrete abstraction came to be associated with coldness and rationality, a machinic anonymity, Bill and Arp's focus was not on objectivity, but rather a way to bring man [sic] closer to nature (see their essays in *Konkrete Kunst*, 1944).

free from subjective input and interpretation.¹⁷ That is to say, even before she learned how to program a computer in 1968, Molnar's art was already programmed. As her visual language became strictly geometric in the mid-1950s, seriality became a crucial part of her practice around 1958. Learning about computers, she dreamed of using one; it would be the ultimate mechanical tool that van Doesburg could have only imagined. Afs computers remained prohibitively expensive, enormous, and off-limits to ordinary people, Molnar developed a *machine imaginaire*—a method rather than an object—which she later described as “algorithms executed by hand.”¹⁸ This was an early instance of what is now referred to as *generative art*, which might be defined as art produced with a combination of rules or parameters and chance processes, using a system that, to a certain extent, operates autonomously. It is characterized by seriality—the use of series—and iteration, in the mathematical or computational sense of repeating slightly different versions of the same thing, a means of obtaining successively closer approximations to the solution of a problem. While it is not the term she uses to describe her own practice, generative art is a useful term for approaching Molnar's work, for it bridges the handmade, the analog, and the digital, referring to a mode of making rather than a particular medium, material, or type of object.¹⁹

¹⁷ Lucile Encrevé argues that “programming” (*la programmation*) was a key concept for artist groups in France, including the Groupe de recherche d'art visuel (GRAV), of which Vera Molnar was a founding member (“Les développements de l'art concret aux États-Unis et en Europe dans les années soixante,” in *Art concret*, ed. Serge Lemoine (Paris: Réunion des musées nationaux : Espace de l'art concret, 2000), 41.) In 1962, François Morellet, a co-founder of GRAV, wrote, “programmed experimental painting seems to meet two needs: first, the need of the audience, which is keen to take part in the 'creation' of the works, is keen to demystify art and wants to understand things a little better and, second, the great need for new materials for aestheticians, those scientists who are at once mathematicians and psychologists and who, starting out from the theories of modern psychology (in particular on the transmission of messages), are laying the foundations for a new science of art” (François Morellet, “The Case for Programmed Experimental Painting (1962),” in *A Little Known Story About a Movement, a Magazine and the Computer's Arrival in Art: New Tendencies and Bit International, 1961-1973*, ed. Margit Rosen (Karlsruhe, Germany: ZKM/Center for Art and Media, 2011), 92.)

¹⁸ Michael Tilson, ed., *1975 Canadian Computer Show Art Exhibition* (Toronto, 1975); Vera Molnar, “Simulation de Mondrian à Partir de 3 Éléments (1959-1974)” (1974), Carton 05: Texts: Français; Vincent Baby, “Introduction à la « machine imaginaire » / Introduction to the ‘imaginary machine,’” in *Vera Molnar: Pas froid aux yeux*, ed. Vincent Baby and Francesca Franco (Paris: Bernard Chauveau Editeur, 2021).

¹⁹ The recent buzz around NFTs and art made on the blockchain has ignited an interest in a longer history of digital practices, and Molnar has been embraced and celebrated as a founding mother of generative art—a term that is, frankly, new to her (see Zsofi Valyi-Nagy, “An Interview with Vera Molnar,” *Right Click Save*, August 26, 2022, <https://www.rightclicksave.com/article/an-interview-with-vera-molnar> (accessed April 20, 2023); I would also like to thank my fellow participants in the Generative Art Writing Group, organized by Art Blocks and *Outland*, for their

While Bill's "mathematical approach" referred to calculation rather than computation, this notion of programming took on new significance at the dawn of the Information Age. When Molnar began working with a real computer in 1968, she kept one foot in the world of systematic painting and another in that of "computer art," as it came to be called, without pledging allegiance to one or the other. These two camps, who I unite under the term *programmed abstraction*, had a common goal: to demystify the artistic process and to debunk the myth of the artist-genius, to show that anyone (even a computer) could make art.

In the second half of the 1950s, Bill invited the Stuttgart-based philosopher Max Bense to Ulm to lecture about his budding field of *information aesthetics*, a quantitative approach to images that drew on cybernetic and information theory, bringing concepts such as order and disorder, chaos and redundancy, to bear on visual art and communication. Bense's theories, which would be collected in a volume titled *Programmierung des Schönen (Programming the Beautiful, 1960)*, proposed a "generative" aesthetics, which would, in the words of art historian Lindsay Caplan, "remove subjectivity from art and aesthetic judgment and imbue both with the transparency and clarity of science—striving, in his words, to 'transform the metaphysical discipline into a technological one.'"²⁰ Under Bense's mentorship, the earliest approaches to computational art in postwar Europe came out of Stuttgart, not from artists but from mathematicians including Georg Nees and Frieder Nake.

collaborative work in developing this working definition of generative art on March 23, 2023 via Zoom.) Note that while generative art *need* not be abstract, abstraction is a tendency in the work of many historical and contemporary generative artists (see my roundtable interview "Fxhash: The Artists," *Right Click Save*, May 12, 2022).

²⁰ Lindsay Caplan, "The Social Conscience of Generative Art," January 3, 2020, *Art News*.

Meanwhile, information aesthetics were also being theorized in France by the sociologist Abraham Moles, a close friend of the Molnars (**Figure 0.03**). While Bense never actually touched a computer, Moles was, himself, an enthusiastic user of these technologies from the beginning and had their practical functionality in mind as he developed his thinking on artificial creativity.²¹ His ideas were a touchstone for the working group *Art et informatique* that the Molnars co-founded in 1969 at l'Institut d'esthétique et des sciences de l'art at the Sorbonne, where F. Molnar worked. The group served as a space to discuss information aesthetics as it related to creative practices in the visual arts, music composition, poetry, and art theory and criticism.²²

Around this time, a handful of artists in France, including Molnar, brought computational technology to bear on systematic painting practices.²³ The ultimate mechanistic tool, the computer had the potential to fully remove the artist's hand—both literally and figuratively—from the creative process. This was a moment of a rational turn in art, as many artists embraced science and technology and idolized the Renaissance polymath, in an attempt to reunite the disparate “Two Cultures” of art and science.²⁴ Molnar, too, fashioned herself a sort of “Leonarda da Budapest.”²⁵ *To know and to know how*—this is a phrase she repeats often, always in English, attributing it to da

²¹ Frieder Nake in conversation with the author in Bremen, Germany, February 9, 2022; Abraham Moles papers, Bibliothèque Universitaire de Strasbourg.

²² Vincent Baby and Francesca Franco, eds., *Vera Molnar: Pas froid aux yeux* (Paris: Bernard Chauveau Editeur, 2021), 106. “ELECTRA: Concert de Janine Charbonnier, 21.1.84” Fonds Frank Popper, Archives de la critique d'art, Rennes. The group included composers Pierre Barbaud, Jean-Claude Marquette, and Janine Charbonnier, critic Georges Charbonnier, and poet Jacques Mayer, among others. This group is not to be confused with the other Groupe de l'art et Informatique (GAIV) based at Paris XVIII at Vincennes, which had little overlap with the Sorbonne group, save for an invited lecture Vera Molnar gave in Vincennes on May 22, 1969 (“[talk for Vincennes, Art et Informatique]” (May 22, 1969), Carton 05: Textes: Français; Jean-Claude Marquette in conversation with the author, Paris, July 2, 2021).

²³ Zdeněk Sýkora in Czechoslovakia, Manuel Barbadillo in Spain, and Waldemar Cordeiro in Brazil followed similar trajectories. I explored these connections in my talk “From Concrete Art to Computer Art, São Paulo to Paris.” *Konkret Global*, Museum im Kulturspeicher, Würzburg, Germany, October 26, 2022.

²⁴ C.P. Snow, “The Two Cultures (The Rede Lecture 1959),” in *The Two Cultures* (London; New York: Cambridge University Press, 1993).

²⁵ Vera Molnar, conversation with the author, August 30, 2017 and July 15, 2018. See also: “Vera Molnár Interview by Angeria Rigamonti Di Cutò for Studio International.” In *Writing New Codes: Cordeiro / Mallary / Molnár: 3 Pioneers of Computer Art 1969-1977*. London: The Mayor Gallery, 2018.

Vinci. Even as she turned to the computer, Molnar insisted that she was, first and foremost, a painter. “I am a painter, an image-maker, in particular of images of a nonfigurative kind,” reads the opening line to her article “Toward Aesthetic Guidelines for Paintings with the Aid of a Computer,” penned in 1974 and published the following year in the journal aptly titled *Leonardo* (**Figure 0.04**).²⁶ She seems to uphold an idea of painting from the Renaissance, in the sense of *disegno*, an umbrella term for the “fine arts”—painting, sculpture, and architecture—all rooted in the practice of drawing.²⁷ Like her hero Leonardo, Molnar diligently kept notebooks of her sketches and ideas, which she calls her *journaux intimes* or diaries, though their contents are far more scientific than personal.²⁸ Even when she works with computers, her art practice continues to explore questions central to painting and drawing.

The vocabulary of drawing, in particular, shaped the visual language of early computer graphics, as well as its discourse. For starters, these images were made with a ‘drawing machine,’ *une machine à dessiner* or *eine Zeichenmaschine*.²⁹ A plotter (**Figure 0.05**) was a peripheral device—that is, a machine external or supplementary to the main machine used for calculating—that was used to output graphics to paper.³⁰ Connected to a mainframe computer (**Figure 0.06**), it had a mechanical arm

²⁶ *Leonardo* was a journal founded in Paris in 1968 by kinetic artist and former astronautics engineer Frank Malina. Patricia Bentson writes, “Malina envisioned *Leonardo* as being a vehicle of communication for artists who worked with media involving science and technology and as having a primary focus on artists’ writings about their own work.... The journal has come to serve as an archive documenting technology-based artworks as the technologies on which the works are based and exhibited become obsolete.” Patricia Bentson, “Foreword: The Leonardo Women, Art, and Technology Project,” in *Women, Art, and Technology*, ed. Judy Malloy, Leonardo (Cambridge, Mass.: MIT Press, 2003), xi–xiii.

²⁷ David Rosand, *Painting in Sixteenth-Century Venice: Titian, Veronese, Tintoretto*, Rev. ed. (Cambridge; New York: Cambridge University Press, 1997), 11. I am grateful to Cleo Nisse for clarifying this concept.

²⁸ She began a systematized practice of this in 1976 until c. 2020, in A5 sized Clairefontaine notebooks with quadrille lining. Thanks to Vincent Baby, Pierre Braun, et al., her notebooks (through 2003) have been digitized: *Véra Molnar: Journaux Intimes 1976-2003* (CD-ROM), ed. Gwenaél Bacle, 2009.

²⁹ “Rapports au comité du Direction du CIRCE,” October 20, 1972, Archives Nationales de France, Pierrefitte-sur-Seine; <http://dada.compact-bremen.de/item/device/5>; Frieder Nake in conversation with the author, February 9, 2022; One of the earliest high-precision plotters, the Zuse Graphomat Z64, was mainly used for the production of maps and land registration processes.

³⁰ By foregrounding the CRT screen, a peripheral terminal in the network of mainframe computing systems, I build on Zabet Patterson’s scholarship, which emphasizes how mainframe computing was not centralized around a single

that drew lines on paper using a small pen (**Figure 0.07**), following instructions given by the computer programmer.³¹ Unlike a printer, which output information line-by-line, in a linear fashion, the plotter pen could move in any direction—up and down, side-to-side. It simply had to be given instructions to move from coordinate to coordinate along an x-y axis. When we think of a digital image today, we usually think of a *raster* image, comprised of pixels, short for “picture elements.” Molnar, however, worked with *vector* graphics, which built images from geometric shapes defined on a Cartesian plane: points, lines, and polygons.³²

It is thus tempting to attribute Molnar’s choice of subject matter—lines segments, squares, and polygons—to the limitations of her chosen medium; it was simply easier to program a square than a meandering line. But this would occlude the art-historical significance of Molnar’s choice of geometric forms: her squares not only spoke the visual language of *l’art concret*; they also opened up a dialogue with Kazimir Malevich’s black square, the “zero of form,” an origin point for modern abstraction. Moreover, Molnar’s use of simple geometric shapes nodded to the studies of perceptual psychology that she was steeped in, thanks to her husband, who became a researcher in experimental aesthetics; these scientists privileged the square for its horizontal and vertical lines and right angles. In other words, Molnar’s computer “drawings” brought the square, an emblem of twentieth-century abstraction, into dialogue with an icon of postwar technology: the computer.

machine, the way we think of desktop machines today, but rather was made up of a sprawling system of “peripheral” hardware (Zabet Patterson, *Peripheral Vision: Bell Labs, the S-C 4020, and the Origins of Computer Art*, Platform Studies (Cambridge, Massachusetts: The MIT Press, 2015)).

³¹. The plotter pen was interchangeable, and while Molnar usually filled hers with India ink, she also recalls experimenting with alternative liquids, from beet juice to vials of blood. Vera Molnar in conversation with the author, November 14, 2020.

³². To this day, vector graphics continue to be used in printing, for they are ‘scalable’ (think .eps files made in Adobe Illustrator).

While it is clear that Vera Molnar's work was programmed long before it was computational, this dissertation focuses on her experiments with electronic computers between 1968 and 1988, and the encounters between abstract painting and computer graphics. The year 1993 signals an end to Molnar's direct engagement with computers, for after her husband's death she donated their home computer to his laboratory, opting to instead delegate this work to studio assistants and collaborators with more technological savvy. In other words, Molnar stepped away from computers at the very moment that they became accessible and appealing to a wider public. She has never had an email address and professes a total lack of interest in new technologies—a conviction that I question in the chapters that follow.

Molnar provides a unique case study for the relationship between art, technology, and gender in postwar Europe, for her career not only spans the entire Cold War period but also major developments in computing, from the advent of the computer screen to the introduction of personal computers, when these machines shrank from room-size to tabletop and migrated from the laboratory to the domestic sphere (**Figure 0.08**). As such, the history of technology forms the backbone of my study. That said, I am careful to avoid a technologically deterministic approach to the relationship between art and technology, instead drawing on methods of media archaeology, a critical concept I will return to, to trace a nonlinear narrative of art and technology.

Cold War, Cold Abstraction

Computing and abstract painting: two distinctly postwar phenomena that, on the surface, have nothing in common and could not offer more radically different approaches to processing the mass destruction and despair following the Second World War. The year 1945 was only the beginning for the burgeoning electronic computing industry, which received unrelenting support from the defense

industry, the military-industrial-university complex. While computing forged full speed ahead after 1945, the Cold War brought on a period of existential crisis for European painting, an impasse that, as many theorists have argued, could only be articulated through abstraction. For Jean Baudrillard, writing at the end of the 1980s, the abstraction of the 1950s was “the very abstract image of the Cold War itself, for the Cold War is abstract.” Postwar abstraction, he argues, “emerged from that impossibility of conceiving, of representing such an outrageous and monstrous history.”³³

Abstraction reflected “the rage to create meaning even when there is no longer any sense.”

Following Theodor Adorno, who famously declared that there could be no poetry after the Holocaust, the end of the Second World War became a metaphor for the end of modernity and the end of representation.³⁴ Serge Guilbaut locates this paradigm in painting in the work of Jean Fautrier, a leading practitioner of *tachisme* in France, who made “paintings like raw wounds”—formless, textured shapes teetering on “the edge of figuration.” Guilbaut, paraphrasing Jean-Paul Sartre, writes, “such a painting could not talk about wars ... but the texture somehow could.”³⁵

Geometric abstraction, by contrast, was met with suspicion in postwar Paris. Decorative at best and dystopian at worst, it was thought to be out of touch with reality. “[G]eometric art, 'cold abstraction' as it was known in Paris,” writes Guilbaut, “seemed fossilized, historicized, dead by asphyxiation in its geometric matrix.” This “sterilized” abstract art, exemplified by Piet Mondrian and embraced by MoMA in New York, came to be symbolic of a mechanized American dystopia.”³⁶ At a moment when art needed grit, dirtiness, geometric abstraction strove for something too “pure,” too

³³ Jean Baudrillard, “Hot Painting: The Inevitable Fate of the Image,” in *Reconstructing Modernism: Art in New York, Paris, and Montreal, 1945-1964*, ed. Serge Guilbaut (Cambridge, Mass.: MIT Press, 1990), 22–24.

³⁴ Max Silverman, *Facing Postmodernity: Contemporary French Thought on Culture and Society*, Social Futures Series (London: Routledge, 1999), 20.

³⁵ Serge Guilbaut, “Postwar Games: The Rough and the Slick,” in *Reconstructing Modernism: Art in New York, Paris, and Montreal, 1945-1964*, ed. Serge Guilbaut (Cambridge, Mass.: MIT Press, 1990), 56, 59–60.

³⁶ Guilbaut, “Postwar Games: The Rough and the Slick,” 52; Baudrillard calls it “calculated” in “Hot Painting” 23.

restrictive, too “calculated.” “Composition, rules, mathematics are all there in order to put the poetical (read liberating automatism) potential of art into straight-jackets.”³⁷ Cold abstraction was, in a word, too cold.

It should come as no surprise, then, that cold abstraction, especially when made with the cold (war) machine of the computer, would be unwelcome in most Parisian galleries, as the postmodern philosopher-critics the French art world held in high esteem “demonized” rationality.³⁸ While it was not until the twenty-first century that the wartime cooperation between IBM and Hitler’s National Socialist Party was revealed, it is safe to say that computer technology was not a popular choice of creative tool at this moment.³⁹ Just as the Art and Technology movement flopped in the United States, artists in Paris engaging with high technology in 1960s and 1970s, if paid any attention at all, were met with stark criticism and pushback.⁴⁰

Molnar tells a story about using the IBM mainframe computer during the May 1968 student uprising, as students and university workers took to the streets, leaving the lab unusually quiet. While

³⁷ Guilbaut, “Postwar Games,” 50.

³⁸ Silverman, *Facing Postmodernity*, 20.

³⁹ Edwin Black, *IBM and the Holocaust: The Strategic Alliance Between Nazi Germany and America’s Most Powerful Corporation-Expanded Edition*, Third (Dialog Press, 2012; first edition published 2001).

⁴⁰ Manfred Mohr, who was an artist in residence at the national meteorological laboratory in Paris, recalls people associating computing technology with a pro-war, military-industrialist worldview, a bias that was not aided by his German nationality; he also shared an anecdote about François Molnar’s students throwing eggs at him in response to a lecture on computational aesthetics (Manfred Mohr in conversation with the author, August 6–7, 2018, New York City). On the occasion of his first computer art show in 1971, Molnar hung sheet of plotter paper on the wall, inviting visitors to answer the question “What do you think of aesthetic research done with a computer?” Responses ranged from “questionable” to the German inscription “Man sollte der Maschine in den Arsch treten (You should kick the machine in the ass)” (<http://emohr.com/paris-1971/m1.html>). For the American context, see Edward A. Shanken, “Gemini Rising, Moon in Apollo: Attitudes on the Relationship Between Art and Technology in the US, 1966–71,” in *ISEA97: Proceedings of the Eighth International Symposium on Electronic Art*, ed. Anders Nereim (Chicago, 1999); Anne Collins Goodyear, “Gyorgy Kepes, Billy Kluver, and American Art of the 1960s: Defining Attitudes Toward Science and Technology,” *Science in Context*, no. 17(4) (2004): 611–35; Anne Collins Goodyear, “From Technophilia to Technophobia: The Impact of the Vietnam War on the Reception of ‘Art and Technology,’” *Leonardo* 41, no. 2 (2008): 169–73.

the veracity of this story is questionable, it is curious that Molnar, despite her support of the left, recalls tinkering with a U.S.-made machine the size and cost of a spaceship, given that these protests were, in large part, against capitalism and American imperialism in French universities. Between the execution of Hungarian communist László Rajk in October of 1949, which cemented her decision to make France her permanent home, and the violent 1956 revolution in Budapest, the leftist political spirit she had had in her twenties had waned closer to apathy.⁴¹

It seems that, like her close friend François Morellet, it was around 1968 that Molnar began to question the possibility of objectivity in art.⁴² While Morellet turned to a Duchampian “anarco-dadaism,” Molnar took a seemingly opposite approach, searching for a logical process in the electronic computer (like Bense, Morellet never used these machines, despite his engagement with information theory). Like the German artist Manfred Mohr, who was also working with an IBM mainframe in Paris at this time, Molnar’s desire to use the computer was met with deep distrust, as computing technology was associated with a pro-war, military-industrialist worldview. She recalls of these early days, “everyone jumped at me saying, ‘you’re completely crazy, you’re dehumanising art: what is this – bringing art closer to machines...’”⁴³ Cold abstraction was already met with suspicion; combined with this cold technology, it appeared deeply suspect. These suspicions are reflected in the art historical record, which has only just begun to take postwar geometric abstraction seriously.

What is left out of these narratives is that, at least in theory, the midcentury surge of interest in cold abstraction and information aesthetics was not purely formal, nor was it completely apolitical. At its

⁴¹ Vera Molnar, conversation with the author, October 10, 2021

⁴² At this moment, François Morellet drew a line between reason, which was “a doctrine, a belief,” opting instead to search for logic, which was “a science.” Quoted in Bois, “François Morellet/Sol LeWitt: A Case Study Revisited,” 170.

⁴³ Obrist, “Vera Molnar in Conversation with Hans Ulrich Obrist,” 80.

roots, postwar Concrete art was engaged, in its own way, with current events. While Max Bill expressed skepticism toward outwardly “Political Art,” regardless of whether it came from the left or the right, seemingly advocating for an art as neutral as his native Switzerland, his Concrete art had an underlying message about the social responsibility of the artist and the potential effects of art on civilization.⁴⁴ In the final moments of World War II, Jean Arp formulated his *art concret* as a response to “the atrocious confusion of our time” (*la confusion atroce de notre époque*), in which modern science and technology were in the process of turning “man into a megalomaniac,” one who “overestimates reason.”⁴⁵ Caplan suggests that Bense, an antifascist German, “argued that rationality is humanity’s first defense against fascism.” Applying rationality, mathematics, and logic to art offered a “sustained inquiry into the possibilities for a more transparent, participatory process of collective communication.”⁴⁶ In other words, the return to rationality was about transparency and demystification, a search for objectivity that could democratize art and perhaps make an impact on the wider world.

Ultimately, these subtly political ideologies of postwar geometric abstraction did not have much hold in France, and despite their best intentions, received widespread criticism for their failure to enact real social or political change. Still, it is important to keep these ideas in mind as we examine Molnar’s unrelenting commitment to lines, squares, and polygons. Her cold abstraction was not an out-of-touch nostalgia for prewar Paris, but was an explicit *rejection* of the expressionism of *tachisme* and *art informel*. While expressionistic painting captured a certain postwar angst, one way of processing the horrors of war, it also reinforced ideas about gesture being tied to the unconscious and perpetuated myths of singular artistic genius. In other words, Molnar’s interest in rationality was

⁴⁴ Bill, “The Mathematical Approach in Contemporary Art (1949)”;

⁴⁵ Arp, “Art Concret,” 11.

⁴⁶ Caplan, “The Social Conscience of Generative Art.”

not a tacit endorsement of war, nor technocratic politics, even if her work shared some of its bureaucratic aesthetics. Her experiments with the computer were not about applying new tools to tried-and-true painting practices. Molnar's generative art was not just about generating images, but also about understanding the creative process and the artist's role in it. Her "systematic pictorial experimentation" (*experimentation picturale systématique*) involved constructing controlled, measured aesthetic experiments, which exemplified a *la science de l'art*, or the "science of art."⁴⁷

La science de l'art

The science of art was a concept that Vera Molnar's husband, François, first explored in his writing in the fall of 1959, in a text he penned for Galerie Denise René to accompany an exhibition of Victor Vasarely, a leader of the Op art movement and a fellow Hungarian emigré who became a close friend of the couple. The science of art, according to F. Molnar, was not a "scientific art" (*une art scientifique*) but referred to the study of images according to theories of experimental aesthetics, a field of psychology founded by Gustav Fechner in the nineteenth century to empirically study aesthetics through the measurement and analysis of experiential visual perception. Like Moles and Bense, F. Molnar used equations and theorems such as mathematician George David Birkhoff's notion of "aesthetic measure" to quantify and thereby demystify the processes of art making and viewing. While he first embraced the science of art in the role of a critic, F. Molnar would soon develop what it meant to utilize this approach as an artist, an image-maker.

The spring after the Vasarely show, F. Molnar wrote the invitation text for an exhibition at LATINOAMERICA in Brussels, a show that laid the groundwork for the *Centre de recherche de l'art*

⁴⁷ Vera Molnar, "Description Du Programme « Molnart (1974-1976) » (Unpublished)" (c. 2002), Archives Vera Molnar: Carton 05: Textes: Français.

visuel (CRAV), which Vera and François Molnar would co-found later that year with ten other artists including François Morellet, Julio Le Parc, and Vasarely's son, who used the pseudonym Yvaral (**Figure 0.09**). CRAV used geometric shapes and the principles of Gestalt psychology to explore anonymity, collective authorship, and the development of a universal, pictorial language that would radically redefine abstraction and destabilize traditional, Romantic notions of singular artistic genius. The group would later become known as GRAV, the *Groupe de recherche de l'art visuel*, focusing on opto-kinetic art.⁴⁸ In his text for LATINOAMERICA, F. Molnar denounced a "Romantic attitude" toward art, one that prized individual artistic intuition, instead pleading, "Let us try to come back to reason." He urged artists to approach problems "systematically," drawing analogies between artistic problem-solving and the fields of topology, game theory, combinatorial analysis, and information theory, which explored the relationship between order and chaos, calling on artists to "use the results of these sciences" in their work.⁴⁹

F. Molnar's position reflected a wider enthusiasm, at this time, for *visual* or *artistic research*, which was a unifying principle of the Zagreb, Yugoslavia-based movement *Nove tendencije* or New Tendencies, a series of publications, exhibitions, and symposia organized between 1961 and 1973, the first one curated by Brazilian-born, Ulm-based artist Almir Mavignier, who also befriended the Molnars (**Figure 0.10**). In the catalogue for *New Tendencies 3*, the Italian art historian, critic, and politician Giulio Carlo Argan defined *artistic research* as the "capacity for art to pose and solve certain problems,

⁴⁸ Lily Woodruff, "The Groupe de Recherche d'Art Visuel against the Technocrats," *Art Journal* 73, no. 3 (Fall 2014): 18–37; Lily Woodruff, *Disordering the Establishment: Participatory Art and Institutional Critique in France, 1958–1981* (S.I.: Duke University Press Books, 2020).

⁴⁹ "F(rançois) M(olnar), texte du carton d'invitation / Invitation card text, p.(II)" in Yves Aupetitallot, ed., *GRAV, Groupe de recherche d'art visuel, 1960-1968: stratégies de participation: Horacio Garcia Rossi, Julio Le Parc, François Morellet, Francisco Sobrino, Joël Stein Yvaral: 7 juin-6 septembre 1998, Magasin--Centre d'art contemporain de Grenoble* (Grenoble: Le Magasin, 1998), 56-57.

or to present itself as a problem for the artist to solve.”⁵⁰ While the New Tendencies exhibitions reflected a broader shift from Concrete and constructive painting to computer-generated art, even focusing its fourth iteration on “The Computer and Visual Research” in 1968, Vera Molnar was curiously never invited to participate, even after F. Molnar and Morellet co-wrote a text for *New Tendencies 2* in 1962.⁵¹

François Molnar’s idea of visual research, however, did not seem to align with those of his collaborators. While the articles of foundation for CRAV called for “a joint team effort” in developing “organized research ... unfettered by all the aesthetic, social, and economic pressures,” the group could not seem to agree on what, precisely, was meant by *research*. Only four months later, as CRAV prepared for its first exhibition, F. Molnar submitted a letter of resignation from the group. He had asked the others, in vain, to hold off on showing their work until they had reached a consensus on what this “organized research” would look like. By hastily organizing an exhibition of finished artworks, he warned, CRAV was appealing to the critics and “snobs” of the Paris art world instead of redefining painting through collective, experimental practice.⁵² “Painting should belong to everyone,” he wrote, citing Vasarely’s commitment to the democratization of art. “We are, I believe, at one in our rejection of tachism, dripping,” he wrote, “But we need to have the lucidity and the courage to admit that our paintings are hardly any different from current art except in that they were made using a ruling pen.”⁵³

⁵⁰ Margit Rosen et al., *A Little Known Story About a Movement, a Magazine and the Computer’s Arrival in Art: New Tendencies and Bit International, 1961-1973* (Karlsruhe, Germany: ZKM/Center for Art and Media, 2011), 194.

⁵¹ This is all the more surprising given that the Molnars and the Morellets vacationed in Yugoslavia in the summer of 1963, where they serendipitously met Matko Meštrović, an artist and theorist involved with New Tendencies (photograph, Archives Vera Molnar; Vera Molnar in conversation with the author, October 10, 2021).

⁵² Art historian Jenevive Nykolak notes that collective art practices in France would really pick up *after* 1968. (Jenevive Nykolak, “Painting with Desire: Color after Collectivity, 1972-1974,” *Selva: A Journal of the History of Art*, no. 1 (Fall 2019): 29–62.)

⁵³ François Molnar, “Lettre de démission / Letter of resignation, 30.11.1960,” in *GRAV, Groupe de recherche d’art visuel, 1960-1968: stratégies de participation: Horacio Garcia Rossi, Julio Le Parc, François Morellet, Francisco Sobrino, Joël Stein Yvaral: 7*

What, then, was artistic research to F. Molnar? While his writing is difficult to follow, his appeal for *la science de l'art* seems to offer two main suggestions: first, artists should privilege the *process* of research over producing finished works of art. Second, conceptualizing art practice as a *science* emphasizes its collectivity and its experimental nature. While his previous text urged artists to study the results of experimental aesthetics, this letter further pushed the boundary between art and science by suggesting that “‘scientific’ work must necessarily be done by ourselves, by artists.” He seems to suggest that artists should not only study the *results* of perceptual psychology; they also have the potential—the responsibility, even—to *contribute* to science through their artistic practices.

A Marriage of Art and Science

When François Molnar resigned from CRAV in November of 1960, Vera Molnar and their friend Servanes followed suit in solidarity. Shortly thereafter, F. Molnar quit making paintings, deciding to tackle the science of art from the other side of the “Two Cultures” debate, becoming a researcher in experimental aesthetics, eventually pursuing a doctorate and directing l’Institut d’esthétique et des sciences des arts at the Sorbonne. Vera Molnar, however, continued to paint, turning her attention to the *machine imaginaire* until she was able to access a *machine réelle* in 1968.

Because F. Molnar was a more vocal theorist in the 1960s, we know more about his ideological position at this moment than that of his wife. It is, therefore, tempting to read his writings as a cipher to her pictures, her images as illustrations of his theory. However, I want to avoid assuming

juin-6 septembre 1998, *Magasin--Centre d'art contemporain de Grenoble*, ed. Yves Aupetitallot (Grenoble: Le Magasin, 1998), 59–61.

that, just because they were married for forty-five years, the Molnars shared an ideology.⁵⁴ As Vera Molnar's own writing practice took off in the 1970s, it becomes easier to disentangle their voices, but the boundaries between their thinking and making, in their individual practices and in their collaborations, remained porous until the end of François's life, for Vera and François Molnar were each other's principal interlocutors.

François Morellet, who met the couple in 1957, referred to the Molnars as *un peintre à deux têtes*, a two-headed painter.⁵⁵ Indeed, during their first decade in Paris, the Molnars made paintings and collages collaboratively. In 1954, at their first Parisian apartment on rue de Gergovie, Vera Molnar photographed her husband standing before one of their co-signed canvases (**Figure 0.11**). Her bird's eye view and the geometric light play from the windows recall the "new vision" of Bauhaus photography, which the Molnars admired in both aesthetics and ethos. François wears a bucket hat and an enormous overshirt—a painter's uniform—and gazes at the canvas hanging on the wall to his right: *Double mouvement giratoire, vert, noir, blanc*, an oil painting signed by both Molnars the year before. He holds not one, but three paintbrushes. Curiously, they all appear clean. There is no paint in sight, no palette, no easel. The painting is, in fact, finished, already hanging on the wall of their home next to a protractor swinging from a nail. François Molnar isn't painting. He is playing a painter, perhaps even caricaturing one. "Feri wanted people to believe that what we were doing was painting," Vera Molnar remembers, explaining that their pared-down, geometric abstract

⁵⁴ See Bibiana Obler's related discussion of artist couple Kandinsky and Gabriele Münter in *Intimate Collaborations: Kandinsky & Münter, Arp & Tauber* (New Haven: Yale University Press, 2014), as well as Whitney Chadwick's observation that there is a presupposition that collaboration, especially in a married couple, comes from a shared ideological or artistic project. ("Living Simultaneously: Sonia & Robert Delaunay," in *Significant Others: Creativity & Intimate Partnership*, ed. Whitney Chadwick and Isabelle De Courtivron (New York: Thames and Hudson, 1993), 33).

⁵⁵ Amely Deiss and Vincent Baby, "Entretien avec Véra Molnar," in *Véra Molnar: Une Rétrospective, 1942-2012*, ed. Sylvain Amic, Couleurs contemporaines (Paris: Chauveau, 2012), 18.

compositions were still met with suspicion, likely from Vera's extended family in France who had more traditional tastes. "So he dressed up as a painter."⁵⁶

We might read this photo of F. Molnar against another famous studio portrait of the decade: Hans Namuth's action shots of Jackson Pollock, taken in 1950, which catapulted the American painter to celebrity fame. Molnar's goofy getup, clean brushes, and stilted stance are polar opposite to Pollock's all-black workwear, pointed lack of traditional artist's tools, and body in motion. Both Pollock's ego and his paintings are dripping with postwar American machismo. Molnar, by contrast, keeps his hands clean and his brain sharp, embodying a more Western European postwar masculinity.⁵⁷ As Namuth's photographs demystified Pollock's drip technique, revealing a structured method behind the apparent randomness, Molnar's portrait—however tongue-in-cheek—aimed to place their practice in a longer tradition of painting, while also critiquing the dominance of expressionistic practices in postwar abstraction.

In reality, François Molnar had hardly touched a paintbrush since arriving in Paris. In this photograph, he surveys his own painting with the eye of an observer—a critic, even. The Molnars' co-signed canvases were typically executed by Vera, though she and François determined the compositions in collaboration. To make the painting in this photograph, they cut rectangles from paper, pinned them up on the wall as modular elements, and manipulated them until they decided it was finished; then, V. Molnar transposed the collage to oil on canvas. This division of labor seems to have been based not on skill but rather on interest: while he was more conceptually oriented, she derived joy from the physical act of painting, the sensory pleasures of smelling the turpentine and mixing the right shade of red. *To know and to know how*—when it came to their collaborative practice,

⁵⁶ Vera Molnar, conversation with the author, April 2, 2022.

⁵⁷ Kristin Ross, *Fast Cars, Clean Bodies: Decolonization and the Reordering of French Culture* (Cambridge, Mass.: MIT Press, 1995).

we might assume that François was the “know” and she was the “know how”—he did the thinking, she did the making. But such a reductive reading would undercut Vera Molnar’s own investment in questions of aesthetics and theory.

In another photograph from 1954, F. Molnar turns the camera back on his wife, photographing her sitting at a desk by a tall window (**Figure 0.12**). Her body language suggests a pause from work: she glances over her shoulder, her gaze soft, as if in thought. Her elbows rest on the table, possibly on top of a book, and she holds her glasses between her right hand and the corner of her mouth, which folds into a small smile. On the table, we catch a glimpse of pens and paper. Her large-scale collage *Douze rectangles* (1952) hangs on the wall behind her, along with some smaller works in progress, but from her clothing and posture alone we cannot assume that she is the maker of these pictures. She could be a writer or a poet. But an artist? Where are her brushes? Her smock? Her easel? Unlike the portrait of her husband, this one is sincere. Like Pollock and Piet Mondrian, V. Molnar preferred working on a horizontal surface—the table or the floor—rather than the easel, an inversion that Yve-Alain Bois has argued underpins all non-figurative art practices.⁵⁸ The table had another layer of significance for V. Molnar: she compares having a desk of her own—as opposed to having to work at the kitchen table—to Virginia Woolf’s “room of one’s own”—the basic necessity for a middle-class woman to be able to work.⁵⁹ And unlike an easel, a desk is multifunctional: it can provide a surface for drawing, painting, rolling dice, writing a letter, or writing a manifesto.

⁵⁸ Harry Cooper, “Looking into the Transatlantic Paintings,” in *Mondrian: The Transatlantic Paintings*, Cooper and Ron Spronk, 2001, 47.

⁵⁹ Vera Molnar in conversation with the author, December 2020; Jo Applin, “Generational Objects: Ida Applebroog’s History of Feminism,” *Oxford Art Journal* 40, no. 1 (March 2017): 147.

Writing would become a key part of Vera Molnar's practice in the 1970s and 1980s. Like many women in the media arts, she became the principal theorist of her own work, not only in the absence of critical interest, but also to document her project, which was not only technically groundbreaking but also theoretically ambitious. It was in her writing that Molnar tested out different theories and terms, many of them borrowed from the sciences, including her husband's field of experimental aesthetics, and the burgeoning field of computing. Her texts, which circulated in international journals, not only brought her an international viewership in print (her articles included reproductions of her computer-generated images) but were also an alternative route to showing her work. Molnar published in the Franco-American art-and-technology journal *Leonardo*, edited by the artist/engineer Frank Malina, and the American monthly *Computers and People* (later renamed *Computers and Automation*), among other venues. She also gave talks at conferences on computer art and artificial creativity. Publishing thus became an alternative means for Molnar to disseminate her ideas as well as her images, while also placing her theory and practice on equal footing. Through her writing, Vera Molnar contributed to the development of a language for a new art form that had not been previously described, a discourse that was largely developed by practitioners who came from a scientific background. Her texts demonstrate an attempt to marry aesthetic and scientific discourse in both theory and practice, legitimizing early computer art as an art medium as well as a sort of science in its own right.

Vera Molnar tackles painting with the mindset of a scientist. Composition, color, line, form, symmetry, intuition, order—she explores these scrupulously, one variable at a time, with a rigorous experimental method. And yet, it is never her intention to *solve* these problems. Her approach echoes that of Albert Szent-Gyorgyi, the Nobel Prize-winning biochemist who left Hungary for the United

States the same year as the Molnars, who wrote, “research means probing the unknown and, if one knows what lies ahead, then it is not research and is not worth doing.”⁶⁰

These two portraits of the two Molnars pose a deceptively simple question: what does an artist look like? And by extension, what should art look like? Officially, the Molnars’ collaborations ended in 1960 with their last co-signed canvas, *Effet esthétique de l'inversion des fonctions par la fluctuation de l'attention* (**Figure 0.13**), which was included, under the mononym MOLNAR, in Max Bill’s landmark exhibition *Konkrete Kunst: 50 Jahre Entwicklung*, held at the Helmhaus in Zürich that same year.⁶¹ However, I suggest that their collaborations continued unofficially, taking on different forms, from computer graphics to scientific articles.⁶² Their decades-long collaborations and conversations, across media and modalities, blurred and interrogated the boundaries between art and science.

Nowhere are the couple’s voices more muddled than in their unpublished, co-authored text “*Éloge de la non-figuration*,” likely written in the mid-1980s. This title might be translated as “In praise of non-figurative art,” though it is hard to ignore the funerary connotations of a eulogy, even as the Molnars insist, contrary to Guilbaut’s obituary, that geometric abstraction is alive and well.⁶³ *La science de l’art* returns as a solution to the problem of subjectivity in art, as a move “toward objective research” (*vers une recherche objective*). But what does it look like in practice? The description the Molnars offer—the

⁶⁰ Szent-Gyorgyi, Albert. “On Scientific and Artistic Creativity.” *Leonardo* 6, no. 1 (1973): 57–58. Szent-Gyorgyi shares in the pages of *Leonardo* an anecdote about having a traffic violation in Budapest forgiven when the police officer recognized his name as a Nobel Prize winner. “Had I been a millionaire or a leading industrialist, he would have fined me double!” In Hungary, he suggests, intellectual creation is valued over other forms of success.

⁶¹ Max Bill and Margit Weinberg-Staber, eds., *Konkrete Kunst: 50 Jahre Entwicklung* (Helmhaus Zürich, 8. Juni Bis 14. August 1960) (Zürich: Helmhaus, 1960).

⁶² Their earliest co-authored text, “Elements d’une composition stochastique,” (1966) published in Italian, proposed a “stochastic” method of composition that could be used with a computer. this was two years before V. Molnar would access a mainframe computer. Their final collaborative text “Noise, Form, Art” was published in 1989 (F., and V. Molnar, “Noise, Form, Art.” *Leonardo, Art and the New Biology: Biological Forms and Patterns*, 22, no. 1 (1989): 15–20.)

⁶³ Vera Molnar and François Molnar, “Éloge de la non-figuration,” no date (c. 1984); Archives Molnar : Carton 05: Textes: Français.

use of chance (*le hasard*) and the computer make small, successive modifications of an image by trial and error (*tâtonnement*)—sounds like the descriptions of Vera Molnar’s experimental process that she would refine in the following decade.

The text’s concluding line—*A single curiosity unites them: to see, to glimpse, to guess how art works, and how it is made*—“them” refers to “all painters,” but it could equally refer to the two Molnars, united in their quest to demystify painting, though through different means.⁶⁴ “That’s how we worked,” Vera Molnar recalls fifty years later, “Completely alike and completely different.”⁶⁵ While François Molnar worked hard to prove that there could be a science to art, Vera Molnar insisted on her own perspective: that the only point in applying scientific methods to the arts is to re-discover their fundamental humanity. By some accounts, this application of computing to systematic painting practices was almost too literal, stifling the productive tension between objective methods and subjective input. I argue, however, that Molnar’s work maintained that tension, making it a central object of her inquiry.⁶⁶

Critical Oral History

When I began this project, Vera Molnar was relatively obscure; five years later, she is something of a celebrity, an icon for the recent boom in the digital arts. Creative coders who came of age with the internet have embraced Vera Molnar as the *grande dame* of generative art, using twenty-first-century tools and programming languages to create *Hommages à Vera Molnar* and re-program her early works.

⁶⁴ Molnar and Molnar, « Éloge » final page. My translation from the French “Une seule curiosité les réunit : sa voir, entrevoir, deviner comment fonctionne et comment se fabrique l’art.”

⁶⁵ Vera Molnar in conversation with the author, December 31, 2019.

⁶⁶ Richard Wright, “From System to Software: Computer Programming and the Death of Constructivist Art,” in *White Heat Cold Logic: British Computer Art 1960-1980*, ed. Paul Brown et al., Leonardo (Cambridge, Mass.: MIT Press, 2008), 119–39.

Though she long resisted the label *computer artist*, identifying first and foremost as a painter, she has leaned into her role as a pioneer in the digital arts as a nonagenarian, even creating an NFT in early 2022.⁶⁷ In a scene dominated by men half her age, Molnar's image—a witty, tech-savvy, Eastern European old lady hunched over her graph paper—offers a welcome contrast. She is not the only woman artist to achieve international acclaim in the final decades of her life. From Louise Bourgeois to Geta Brătescu and Faith Ringgold, the contemporary art world has been hurriedly, belatedly, giving long-overdue recognition to postmenopausal women who were overlooked in their younger years. My scholarship is no different in this respect.

At the same time, I want to be mindful of what it means to write about a woman artist in her nineties. My study results from five years of close contact and conversations with the artist, beginning when she was nearly ninety-four. As I earned her trust, Molnar granted me access to her studio and to her archives, which have not been made publicly available. As a result, a major methodological question that underpins this dissertation has to do with writing art history about what our field calls, somewhat morbidly, *living* artists. I have encountered discrepancies between Molnar's word and historical 'facts,' between her living memories and the dusty archives. I have had to ask myself, what if the story I want to tell about Molnar does not align ideologically with the story she wants me to tell? How do I respectfully disagree with her own interpretation of the significance of her work? And how do I narrate her life alongside her practice without reading her work through a strictly biographical lens, a strategy that has disproportionately been applied to women artists? I call my method *critical oral history*, which means both acknowledging that the artist's words are one of the richest sources of historical documentation—especially in these cases where their work has been

⁶⁷ In recent years, Molnar has been lauded as a pioneer of not just computer art, but generative art more broadly. Her NFT, 2% *Désordre en coopération*, was created for the Sotheby's auction *Born Digital*, sold alongside one of her plotter drawings from 1976.

systemically marginalized or overlooked—and considering factors like self-mythologizing, aging, memory, and trauma, as well as the relationship between the artist and the historian and my own positionality as an interviewer.⁶⁸

It may seem paradoxical to write a monograph about an artist involved in a movement that aimed to deemphasize singular authorship. Molnar's practice, however, has not yet been given the critical attention it deserves. This dissertation is not only about Molnar—it explores the aesthetics of and discourse around early computer graphics in postwar Europe. But it is also about Vera Molnar, an artist whose life and work are distinctly idiosyncratic, and demand close looking and reading. Doubly marginalized as a woman artist and a media artist, Molnar has been excluded from conversations about postwar Western art and its dialogues with technology.

During my first conversation with Molnar, a phone call in August 2017, she told me that she was born in 1924 in Budapest, but had since been “reborn” twice: “once when I first set foot in Paris in December 1947, and again the first time I saw a computer screen.” This was her response to a question about the significance of the screen in her practice, something I had had an inkling about but that had not been discussed in relation to her work. I felt a thrill that my instincts were right and followed this thread, which led me to develop what became my qualifying paper, and then the second chapter of this dissertation. Our conversations must have stirred something in Molnar, too, for in 2020 she made an artist's book called *Main/machine (Hand/machine)* that features, on one side, a detail of Michaelangelo's *creazione di Adamo*, and on the other, a reproduction of the IBM 2250 CRT

⁶⁸ These ideas are further explored in my forthcoming essay “Herstory or Mine? Writing Feminist Histories of Art with Self-Mythologies in Mind,” in *Theorising the Artist Interview*, ed. Lucia Farinati and Jennifer Thatcher (London: Routledge).

graphics display unit, the same image I used for a birthday card I made her in early 2019 (**Figure 0.14**).⁶⁹

Molnar is a compelling storyteller with a sharp wit and gift for comedic timing, whether she is speaking her native Hungarian, her near-native German, or her adopted French. Her anecdotes alone could fill volumes. As I wrote this text, I had to resist the urge to quote her at length. The more I used her words, the more I found them merging with my own. I could feel myself slipping into the role of a mouthpiece, a ghostwriter of her autobiography, a position I had to quietly refuse in order to find my own voice. This is a dilemma faced by any monographer or biographer. When our subject is spellbinding, their voice so convincing, how do we break that spell?

In my case, the spell was broken in the archive. In late 2019, I visited Molnar's alma mater in Budapest in the hopes of finding her course lists and the names of her professors, only to be told that there was no student registered under Molnar or her maiden name, Vera Gács. The archivist paused as I looked at her in disbelief, before adding, "There is, however, a student under a different name, with the same birthday and matriculation dates." Before Paris, before the CRT, there had been another rebirth. This one came not from a place of wonderment, but from a place of survival. A year and a half before Paris, a young woman of twenty-two legally changed her name, and her religion, to protect herself in a country that was not safe for her to live in.

Back in Paris, leafing through a box of Molnar's family photos, I came upon a studio portrait of her at age fifteen, grinning just as she does today. On the back, her given name is signed in cursive, then

⁶⁹ The fact that Molnar does not recall receiving this card (she maintains that it was lost in the mail) only makes this connection more intriguing.

retroactively crossed out. *Gács*, she wrote defiantly, over the scribble (**Figure 0.15**). Two years later, she would take her husband's name, the "good magyar" name Molnár (Hungarian for miller), the accent dropped to appear less Eastern.⁷⁰ The assimilation of Jewish names is, of course, not unique to this situation, with legions of twentieth-century artists changing their names in the face of antisemitism. What posed a challenge, for me, was Molnar's decision to keep this part of her personal history quiet, buried under a compelling self-mythology that involved an unremarkable, bourgeois, Catholic upbringing. Coming from an American public school system where I had been thoroughly educated on the horrors of the Holocaust, it was hard for me to understand why someone would keep this aspect of their past a secret for seven decades. I am, unlike Molnar, a product of what oral historian Lynn Abrams calls American "confessional culture," which assumes that talking about traumatic events is necessarily therapeutic, when in fact, sometimes talking can re-traumatize, or create more trauma and leave it unresolved.⁷¹

"Forget it," she told me, waving her hand dismissively when I gently brought up the art school documents that marked her *Izraelita* upon her registration in the fall of 1942. László Moholy-Nagy was born László Weisz, she reminded me, and he never talked about it. Why should she?⁷² So I held my tongue, letting my questions hang in the space of the silence between us. Before changing the subject, I left a generous pause, as oral historians are trained to do. Just as I was ready to shift gears, she began to open up. Over the next two and a half years, she offered me bits and pieces of her story, always on her own terms—I made sure never to press her for information. As always, her

⁷⁰ In a 2019 interview, Molnar explains that since her name is spelled Vera Molnár in Hungarian and Véra Molnar in French, she prefers to use the diacritic-free Vera Molnar (*Vera Molnar* (Zurich: Museum of Digital Art (MuDA), 2019). This aligns with the pan-European identity she has alluded to in our interviews, citing Moholy-Nagy as a model for being not Jewish, not Hungarian, but European (Molnar in conversation with the author, December 13, 2019). This is the spelling I use in my scholarship.

⁷¹ Lynn Abrams, *Oral History Theory* (Routledge, 2016), 179.

⁷² Vera Molnar, conversations with the author, December 13, 2019; March 30, 2021.

stories were breathtaking—watching the airstrikes from the roof during the Siege of Budapest, crossing the frozen Danube on foot because the Chain Bridge had been bombed, throwing a tube of black paint in the river as soon as the war ended, making room for color. At first, she insisted we keep these stories between us, and when I asked for her permission to write about them, reminding her that art history *is* history, she expressed doubts about the relevance of her personal biography to the work she has done as an artist. *There must be someone pressuring her to write about me in this light*, she would whisper after I left her side. *It must be in vogue, like writing about women artists.*

After much back-and-forth, she granted me permission to state the “facts” of her early life in Hungary—names, dates—so long as I agreed not to read identity onto her work. Her position is not unique; writing about the artist Erzsébet Schar, Hungarian art historian Hedvig Turai writes, “[she] did not want to identify herself as Jewish; she wanted to forget a traumatic past linked to having Jewishness ascribed to her. This experience, partly still a secret, is both personal and connected to the war.”⁷³

Born Under Saturn

Where does biography belong in twenty-first century art history? Traditionally, these two went hand-in-hand, following the life-and-work model that Vasari put forth in his *Lives of the Artists*.⁷⁴ But as Gabriele Guernico observes, the monograph fell out of fashion by the end of the twentieth century, in large part due to the “driving force” of feminist art historians who sought to subvert this form that valorized singular “genius” and “greatness,” terms almost exclusively granted to men. Even as more women artists became the subjects of art historical study, their work was overshadowed by the

⁷³ Hedvig Turai, “Intersection of Erasures in Hungarian Art History: Erzsébet Schaár,” in *Women and the Holocaust: New Perspectives and Challenges*, ed. Andrea Pető, Louise Hecht, and Karolina Krasuska, 2015, 156.

⁷⁴ Gabriele Guernico, *Art as Existence: The Artist's Monograph and its Project* (MIT Press, 2006), 248.

attention paid to their personal lives. In 1989, Claudine Mitchell identified the “trivializing elision between art and biography which so frequently operates in accounts of women’s art,” indicating that historically, women artists’ work has been far more likely than men’s to be interpreted through a biographical lens.⁷⁵

Following in these historians’ footsteps, I am careful not to let Molnar’s work be subsumed by biographical interpretations. At the same time, I resist Heinrich Wölfflin’s call for “an art history without names,” not because I want to assert Molnar’s singular greatness, but because her name(s) and the names of the actors in her networks have not yet been given the (art) historical attention they deserve. And while Abrams cautions against confessional culture, she also suggests, “The outcome of silence is the possibility that an event will be forgotten or denied.”⁷⁶ By telling Molnar’s personal story, I want to rectify the silence and antisemitism that lingers, to this day, around discussions of the Holocaust in Hungary, the result of what Turai calls “systematic erasures” in the Cold War period imposed by the Kádár regime.⁷⁷

What’s in a name? When Vera Molnar was Veronika Grünfeld, the only child of assimilated, non-practicing Jewish businessman and property developer Jenő Grünfeld and his wife Erzsébet Pollacsek, it meant that before she was even born, she was subject to the first Antisemitic legislation in Europe, Hungary’s first *Numerus clausus* law (1920), colloquially known as the Jewish quota laws, which restricted the number of students from racial and national minorities entering universities to

⁷⁵ Claudine Mitchell, “Intellectuality and Sexuality: Camille Claudel, the Fin De Siècle Sculptress,” *Art History* 12 (1989): 419–47; Kristen Frederickson, ed., *Singular Women: Writing the Artist* (California, 2003).

⁷⁶ Lynn Abrams, *Oral History Theory* (Routledge, 2016), 179.

⁷⁷ Turai, “Intersection of Erasures in Hungarian Art History: Erzsébet Schaár,” 156. Daniel Véri adds that with “no broad, public discourse” around the Shoah in this period, “official memory politics painted Holocaust victims as anti-fascist heroes, in line with postwar politics,” in other words “instrumentalizing” their memories rather than taking accountability for the mass atrocities (Véri, “The Holocaust and the Arts,” in *Art in Hungary, 1956-1980: Doublespeak and Beyond*, ed. Edit Sasvári, Sándor Hornyik, and Hedvig Turai (London: Thames & Hudson Ltd, 2018).

be in direct proportion to their share of the national population.⁷⁸ With the territory of Hungary radically shrunk by the Treaty of Trianon, which put an end to the Austro-Hungarian empire, signed earlier that year, being born and raised in Hungary speaking the Hungarian language was not enough to make a child *Magyar* in the eyes of the law.

While the *Numerus clausus* officially only applied to universities, it was unofficially enforced in art school admissions.⁷⁹ After graduating from high school and a preparatory course at the Gallé Tibor Festőiskola (Tibor Gallé Painting School) in 1942, young Vera was admitted to the MKF as one of two Jewish students in her class.⁸⁰ At her matriculation ceremony, the rector aligned the institution with the nationalist values bubbling in interwar Hungary: “true creativity can become a universal human value only together with racial qualities and only through national traditions.”⁸¹ While it had been her dream to attend art school, the atmosphere was deeply unwelcoming to her. A racist comment from her prep school teacher about how she was only admitted *because* the school had to admit two Jews, seemed to foster, on the one hand, a fierce determination to prove him wrong and, on the other hand, a crush of self-confidence that only blistered over the years to come.⁸²

In March 1944, the semester after Vera declared her area of focus as art education—her father wanted her to choose a ‘practical’ major if she insisted on studying the arts—German troops arrived in Budapest. Adolf Eichmann established his headquarters in the Majestic Hotel on the Buda side,

⁷⁸ Katalin Fenyves, “When Sexism Meets Racism: The 1920 Numerus Clausus Law in Hungary,” *Hungarian Cultural Studies* 4 (2011).

⁷⁹ Judith Szapor et al., *Jewish Intellectual Women in Central Europe 1860-2000: Twelve Biographical Essays* (Lewiston: Edwin Mellen Press, 2012).

⁸⁰ Coincidentally, the other students admitted under the *Numerus Clausus* in her year was Péter Földes, who also went on to become a computer graphics pioneer, making computer-animated films in France and Canada.

⁸¹ “...mindeni igazi alkotóerő csak a faji tulajdonságokkal együtt s csak a nemzeti hagyományokon keresztül válhatik egyetemes emberi értéké.” (“Rektori Jelvényeket Kapott a Szépművészeti Főiskola: A Kultuszminiszter a Főiskola Hívatásáról,” *Nemzeti Újság*, October 27, 1942, Fővárosi Szabó Ervin Könyvtár, Budapest Gyűjtemény.)

⁸² Vera Molnar in conversation with the author, April 2, 2022.

designed by the architect Emil Bauer in a Bauhaus style, a property that Vera's father had developed between 1937 and 1941.⁸³ Her family's own weekend apartment in the nearby Hargita Hotel was also seized by the National Socialists, and eleven days later a host of antisemitic decrees were published, including an order for Jews to mark their clothing and their homes with a yellow star of David. The semester at MKF ended early, and between mid-May and early July, 437,000 rural Hungarian Jews, Roma, and disabled citizens were deported. Those living in Budapest would have a different fate. As the Hungarian regent Miklós Horthy suspended deportations in early July, families like Vera's were 'saved' from the concentration camps, instead forced to live in one of two ghettos, enforced by the newly formed far-right nationalist Arrow Cross (Nyilas) party. Those who held protection papers could stay in the "international" ghetto of Újlipótváros, where the Grünfelds already lived, while the larger, densely packed seventh district ghetto, only 2.2 kilometers away, was sealed off to the outside.

Most of the destruction to Budapest occurred between December 24, 1944 and February 13, 1945, during one of the bloodiest sieges of the war that ultimately resulted in Soviet victory. During this period, an estimated 15,000 Hungarian Jews were murdered by their own countrymen, on their own soil. As is the case with some governments allied with Germany during the Second World War, especially Poland, Hungary has been late to acknowledge, account for, and reckon with its own involvement in the atrocities of this genocide, the memory of which was swallowed up in the silence of the Cold War and the Soviet occupation.⁸⁴ Only in the last decade have visible monuments to the

⁸³ Randolph L. Braham, *The Politics of Genocide: The Holocaust in Hungary, Condensed Edition* (Wayne State University Press, 2000), 65

⁸⁴ See Susan Neiman, *Learning from the Germans: Race and the Memory of Evil* (New York: Farrar, Straus and Giroux, 2019). Neiman, a Jewish American philosopher living in Berlin, recounts how, in Germany, processes of *Vergangenheitsaufarbeitung* or *Vergangenheitsbewältigung* after the war were initiated by the children and grandchildren of National Socialists who were responsible for these genocides as well as non-Jewish Germans who had taken a more passive role during the war. For a more personal account, see Nora Krug's *Heimat* (Penguin, 2019), a graphic novel/memoir that confronts her grandfather's role in the Holocaust, not as a perpetrator but as a passive bystander.

murdered appeared in Budapest, including plaques along Maros street in Buda and a sprinkling of *Stoopersteine* or stumbling stones, small brass plates in the sidewalk inscribed with the names of victims of National Socialist deportation and extermination, a project initiated in Germany by the artist Gunter Demning in 1992. Only one such stone has been installed in front of Molnar's childhood home, commemorating the life of her young neighbor Vera Blau, aged six, who was dragged to the banks of the Danube by the Arrow Cross that December, her life cut short by a merciless bullet.⁸⁵

It was not until the spring of 1946, after the war had officially ended, that the paperwork for Vera's name change was filed. It seems more than coincidental that she made her first abstract drawings the same year that she took on this new identity. The sparseness of these drawings, their stark simplicity, remind us that they were made in the wake of the Second World War. Out of the rubble rose new forms, new ways of seeing the world.

My intention is not to find hidden meaning in Molnar's abstraction, to decipher her iconography to reveal something profound about the postwar Jewish experience. I do not want to suggest that behind every curved line is a Transdanubian hill, or that Molnar's lollipop trees actually symbolize the murdered Jews of wartime Budapest, lined up on the banks of the Danube.⁸⁶ Rather, I want to

While my own grandfathers were involved in the resistance to the Hungarian Arrow Cross Party, these accounts struck a chord with me as a non-Jewish (as far as I know) first-generation Hungarian-American. Reflecting the "systematic erasures" of Holocaust narratives in Cold War Hungary noted by Turai, I grew up in the United States hearing that the Holocaust was 'not as bad' in Hungary as it was elsewhere in Europe, its atrocities eclipsed by more recent memories of the violent 1956 revolution and the oppression of decades of Soviet occupation.

⁸⁵ Our Vera spent the last two months before the Soviet liberation across the river, where she had, serendipitously, gone to a Christmas party on the night of the siege. Friends helped her to a safe hiding place, from where she watched missiles flying overhead at night, a strange beauty amidst all the destruction. By the time the battle ended, the bridge she had crossed to reach the Buda side had been blown up, so she traversed the frozen river on foot, and in Pest was reunited with her parents, who had both survived. Her first love, however—the man she thought she would marry—did not (Molnar in conversation with the author, March 30, 2021; August 17, 2022).

⁸⁶ The artworks Dániel Véri discusses in relation to the Hungarian Holocaust and Roma Holocaust (Porajmos) are figurative, either picturing victims or addressing the genocide obliquely via parable or symbolism (Véri, "The Holocaust and the Arts"). While the works he discusses were explicitly in dialogue with the Holocaust, Molnar's work is not at all, so I want to explicitly avoid such a narrative reading.

critically examine this geometric abstract, rational turn in postwar European artmaking that she participated in. Whether implicit or explicit, artists' interest in rules, logic, and scientific exactness was a reaction to something. On the one hand, it was an attempt to democratize the art world, to show that anyone (or *anything*) could be an artist. Molnar's images and texts suggest that painting by numbers was an attempt to debunk the myth of singular artist genius that had dominated art historical narratives for centuries.

On the other hand, as Bense's writing suggest, this rationality offered an alternative response to fascism. Was this postwar rational turn also an attempt to wrangle the disorder of postwar Europe, to exert some small semblance of control in an otherwise out-of-control world? An impulse to make sense of the senseless? If there was any element of this to Molnar's work, she never admits it, and she would dismiss such an interpretation. But it is there, in the marks of her pen, in her grids, and in her constant play with order and disorder. It is also there in the work of her contemporaries. Like the *tachistes* and the abstract expressionists, they went through something, and they are working through something, by employing a different kind of abstraction.

The cold abstractionists embraced rationality at a moment when it represented something not only out of touch but also potentially dangerous. The 'neutral' tone of postwar geometric abstraction, with its resistance to emotion, psychology, metaphysics, and individualism, has been read as apolitical, irrelevant, a sort of "avant-garde lite."⁸⁷ There is a silence embedded in Vera Molnar's

⁸⁷ I thank Matthew Jesse Jackson for this term. It is important to note that following the "thaw" in the Soviet Bloc, Molnar's work would already be shown in Hungary in the 1970s, given that geometric abstraction, thanks to its 'neutrality,' was "tolerated." One of her earliest solo exhibitions, organized by the artist Dóra Maurer, took place in Budapest at the Fiatal Művészek Klubja (Young Artists' Club) in 1979. (András Szollosi-Nagy, Chronology, *Vera Molnar: kontextus és kronológia = context and chronology: [exposition, Eger, Kepes Intézet, 1er mars-27 mai 2012, 2012.*; Piotrowski, *In the Shadow of Yalta*; Cristina Cuevas-Wolf and Isotta Poggi, eds., *Promote, Tolerate, Ban: Art and Culture in Cold War Hungary* (Los Angeles: The Getty Research Institute, 2018)). In a similar vein, under Viktor Orbán, the Hungarian national bank made a large purchase of Molnar works in 2020.

computer graphics, a sense of timelessness and placelessness that echoes the silence in both France and the Soviet Bloc around the horrors of genocide in the Second World War. Upon their arrival to Paris in 1947, the Molnars were often mistaken for fallen Nazi sympathizers looking for a fresh start. For Vera Molnar, it was a misunderstanding not worth disputing; “Auschwitz is still standing,” she recalls her husband saying, “So we best stay quiet, since we never know when they’ll open those gates again.”⁸⁸ Exhausted of being reduced to a statistic beyond her control, Molnar just wanted to work in her studio, throwing dice and drawing squares in peace. Silence was, in part, erasure. But, like the bureaucratic gesture of the name change, it was also an act of survival.

While Molnar has never identified as a technophile, her approach to technology, while critical, is ultimately optimistic. Her work suggests that in the hands of artists, high technology need not be tools of mass destruction.⁸⁹ In the postwar years, the computer, with its mechanical arm and cybernetic brain, was already beginning to spark anxieties about the automation of labor.⁹⁰ In France, where arts and cultural heritage were so fundamental to national identity, the threat of the computer to the creative fields was felt even more acutely. Molnar embraced the computer with a critical enthusiasm, using it to investigate what was fundamentally human about creativity, to re-center the humanistic aims of the visual arts while also questioning the heroic status of the artist.

⁸⁸ Vera Molnar in conversation with the author, March 30, 2021.

⁸⁹ The British artist and holographer Margaret Benyon, writing in 1981, wrote of another military technology: “The laser is used for sinister purposes. If it is also used to make art, will this offer a countermeasure?” (“Unclear World I,” ed. Lyn Blumenthal et al., *Heresies* 4:1, no. 13-Earthkeeping/Earthshaking: Feminism&Ecology (1981): 35.)

⁹⁰ On automation vs. mechanization, see *Automation: its anatomy and physiology* by John Rose, which was in F. Molnar’s library (1967).

Media Archaeology

The archive plays a central role in this project, helping us trace the threads of not only Vera Molnar's life and work but also the parallel histories of early computer graphics. Molnar has never considered herself a computer programmer, seeing programming as only a means to an end, a necessary skill that enabled her to use a particular tool—the computer—which, she argues, was no different than using a ruler or a pair of dice. Molnar's tendency to downplay the technical or technological side of her prolific computational practice has shaped the literature on her work, which tends to applaud her role as a *pionnière* without engaging with the history of computer graphics. The question of *how* she used computers has been deemed, first and foremost by Molnar herself, secondary to her contributions to the history of geometric abstraction. This bias is also reflected in Molnar's own archive: she saved very few examples of code, threw away nearly all her errors, and inconsistently noted the hardware she was using through the decades. After all, Molnar wanted to be known as an artist, not a programmer; as a painter, not a computer artist.

Despite these efforts to cover her tracks, Molnar's greatest contribution to twentieth-century art is precisely in the way she married art and technology. The histories of computer graphics and abstraction intertwine in her work and cannot be peeled apart. Historically, the so-called new media arts have been sidelined in the history of twentieth-century art, siloed as a tendency happening separately from painting and sculpture. Artists who did not make a name for themselves outside of their experiments with computers, video, or holography, did not make it into museum collections or art history textbooks. Molnar's practice, and the way it has been received, reflect this bias. She, too, has been complicit in this: in the last thirty years, she has happily framed individual plotter drawings with her signature in the bottom-right corner, isolating individual images from greater series.

In many ways, it has worked to Molnar's advantage that she identifies first and foremost as a painter and has continued to make paintings and works on paper. It has, for one, allowed her work to be collected by museums more easily than software-based art. At the same time, however, her early computer graphics initially garnered interest only when they were disguised as handmade objects. Early on, Molnar recalls gallerists advising her to cover the sprockets of the computer plotter paper, hiding the automated timestamps marked on each 'drawing' behind a *passe-partout*. These days, however, the visibility of these technical details is precisely what makes the work valuable, to the extent that the authenticity of the work is questioned when the sprocket holes have been cut away with scissors, or when there is a signature but no timestamp.⁹¹

As art historians, it is our job to bring historical objects into the present. Normally, we do this through words: how the work looks today, what it might have looked like then, how it might have been made, why it mattered, and why it continues to matter. With Molnar's work, however, formal analysis only goes so far. What is most compelling about her practice is just that—her practice. The *process* is just as significant, if not more significant, than the products. By borrowing methods from media archaeology, I bring her work into the present not only through writing, but also through making.

Media archaeology is a vein of media studies that takes a hands-on approach to obsolete technologies. It views the history of media not as a linear, teleological progression, but rather as a nonlinear, networked system of obsolete machines and processes waiting to be reinvigorated. I

⁹¹ Conversation with Vera Molnar, October 31, 2019; conversation with ZKM curator Margit Rosen, November 28, 2019.

follow cues from the Berlin school of media archaeology, which focuses on making obsolete technologies—including early microcomputers—operational again and *using* them.⁹²

Simply *looking* at an old computer, its screen gone dark, through a museum vitrine or in the dusty corner of a collector's garage, gives us no sense of what it was like to use it. The media archaeologist touches the machine, dusts it off, fixes it up, turns it on, and plays around with it. Media archaeology is less concerned with the objects made with computers; instead, the focus is on the computational processes themselves—including what Wolfgang Ernst calls the “micro-temporalities” that are imperceptible to the human senses.⁹³ I draw on media archaeology to explore the relationship between computational processes and artistic processes, by studying computer-generated images in tandem with the processes that give rise to them. I show how the relationship between artist and computer, in these early days of computer graphics, was incredibly hands-on—intimate, even—with the computer seen as a kind of conversation partner.

Pulling Threads

In her nineties, Vera Molnar uses the Hungarian word *szővet* to describe her art practice. A noun, *szővet* refers to something woven—a textile, a tissue, a piece of fabric.⁹⁴ Its texture is the product of an underlying structure, a network of threads. Molnar is not a weaver in the literal sense. Nor is she

⁹² Wolfgang Ernst, “Media Archaeography: Method and Machine versus History and Narrative of Media,” in *Media Archaeology: Approaches, Applications, and Implications*, ed. Erkki Huhtamo and Jussi Parikka (Berkeley: University of California Press, 2011), 3. 9; Jussi Parikka, “Operative Media Archaeology: Wolfgang Ernst’s Materialist Media Diagrammatics,” *Theory, Culture & Society* 28, no. 5 (2011): 44; Ina Blom, “Introduction: Rethinking Social Memory: Archives, Technology, and the Social,” in *Memory in Motion. Archives, Technology, and the Social*, ed. Ina Blom, Trond Lundemo, and Eivind Røssaak (Amsterdam University Press, 2016), 15–18; Erkki Huhtamo, “Time Traveling in the Gallery: An Archaeological Approach in Media Art,” in *Immersed in Technology: Art and Virtual Environments*, ed. Mary Anne Moser and Douglas MacLeod (Cambridge, Mass.: MIT Press, 1996); Stefan Höltgen, *Shift Restore Escape: Retrocomputing Und Computerarchäologie*, 2014.

⁹³ Ernst, “Media Archaeography: Method and Machine versus History and Narrative of Media.”

⁹⁴ *Szővet* also carries a scientific connotation in the sense of biological tissue, a group of cells that function together as a unit.

a scientist, per se, though her tools and methods are borrowed from the sciences: rulers, computers, variables, hypotheses. Like many young women of her class and generation, she was raised with a proto-feminist value system that emphasized education over handiwork, intellect over dexterity, an opposition that was deeply, if covertly, gendered.⁹⁵ While Molnar's choice of materials and tools implicitly rejects the so-called feminine arts, *weaving*—the practice of interlacing threads—serves as an apt metaphor for her career, which spans the entire postwar period into the twenty-first century.⁹⁶

Like the weft—the thread that disappears behind the warp only to reappear again—the same themes have resurfaced in Molnar's seventy-decade career since her arrival in Paris in 1947. From the concentric square to the continuous line, or the progression from order to disorder, her oeuvre consists of a series of variations on a theme, often born from a dormant project, a yellowed sketch made decades ago. No work is ever quite finished; there is always room to improve, to start over, to remake it slightly differently.

In *Zeros and Ones*, a manifesto on the relationship between women and machines, feminist cultural theorist Sadie Plant writes, “As the frantic activities of generations of spinsters and weaving women makes abundantly clear, nothing stops when a particular piece of work has been finished off ... The

⁹⁵ Louise Bourgeois's proto-feminist mother told her to avoid needlework because women workers were exploited in the factory; if she got an education instead, she could escape this fate. Bourgeois also uses a weaving metaphor to describe her work in series, with themes revisited over a lifetime (« Tissée, tendue, au fil des jours la toile de Louise Bourgeois » produced by Jacqueline Caux. Atelier de création radiophonique. France Culture. Diffusion : December 1, 1996). On homecrafts and traditional expectations of female reticence, see Rozsika Parker, *The Subversive Stitch: Embroidery and the Making of the Feminine* (New York: Routledge, 1984, xi, xiv).

⁹⁶ How might a process as fundamentally material as weaving be relevant to early digital art? The connections between weaving and computing run deep: it was Jacquard's loom, the weaving machine, that inspired Charles Babbage's use of punch cards to operate his Analytical Engine, the prototype for the first electronic computer, which was operated by the first computer programmer, Ada Lovelace, in the mid-nineteenth century. During World War II, British and American women in the workforce who became known as “computers” used punch cards to program machines to perform complex calculations (see Sadie Plant, *Zeros and Ones*, 1997). By the time Molnar learned to program with punch cards in late 1960s France, computing had become a male-dominated space, while the fiber arts were seen as a feminine, and thereby inferior, domain. Though computers continued to be used for textile design, the similarities between computing and weaving were progressively erased.

only incentive to cast off seems to be the chance completion provides to start again.”⁹⁷ Plant suggests that the process of weaving is so inextricable from the textile it produces that “the finished cloth, unlike the finished painting or the text, is almost incidental to the processes of its production.” Not unlike these weaving women, Molnar uses the computer to cast off one image after another, ending the run of the program only to start again. Her computer graphics, with their deceptively simple geometric abstraction, are *almost* incidental to the processes of programming them. I argue that, for Molnar, programming was not only about making images. It was also about exploring creativity, subjectivity, and what it meant to make art after 1945.

The first monographic study of a computer artist—I use this term in respectful disagreement with the artist—this dissertation complicates understandings of computer art as a linear progression from input (code) to output (plotter drawing). My reading of Molnar’s practice demonstrates that early computational art practices were radically *nonlinear*. By tracing the material history of computer graphics, which has been overlooked in histories of both art and technology, I emphasize the iterativity, interactivity, and experimental nature of these processes, which had no concrete beginning, middle, or end.

While Molnar’s work is typically collected and displayed as framed works on paper, drawings that just happened to be made by computers, this dissertation flips the script, focusing instead on the dynamic and complex processes that gave rise to these images. Alongside Molnar’s plotter drawings, I look at her notebooks and her anecdotes, as well as ephemera from her early experiments with computers, to consider the *dialogue* between the artist and the computer, the machine and its user, long before the computer became a ubiquitous tool. I examine Molnar’s oeuvre not as a series of

⁹⁷ Sadie Plant, *Zeros + Ones: Digital Women + the New Technoculture* (London: Fourth Estate, 1997), 67.

completed works but rather as a continuous, constantly changing work-in-progress. In doing so, I propose a reading of early digital art that focuses on process over product. I thus trace a conceptual kinship between Molnar's process and the processes of computing, which are, according to media archaeologist Wolfgang Ernst (who, in turn, follows Henri Bergson), nonlinear and non-narrative. To study the history of computing, we must think in terms of a "calculating memory" rather than a "narrative memory," one based in counting rather than recounting.⁹⁸

To trace Molnar's threads, we must follow a nonlinear path. In the spirit of nonlinearity, this dissertation also moves recursively and thematically rather than chronologically like a traditional monograph would. Chapter one begins in the late 1980s, with Molnar's final foray into computer programming—her series *Lettres de ma mère*, which she describes as a "simulation" of her late mother's handwritten letters. In my first chapter, I trace what I call the 'continuous line' in Molnar's practice, referring to both a literal continuous line and a commitment to a certain line of aesthetic inquiry.

My second chapter goes back in time to the early 1970s, taking a deep dive into the history of technology, to the advent of computer screens, which introduced a new mode of computing called "interactivity." With the help of a screen, users could visualize the results of a program in real-time, instead of having to wait hours or days for output to paper. I take a close look at Molnar's artist's book *titled Love-Story (à l'Ordinateur)*, which she made from photographs of a computer screen that I call proto-screenshots. I consider how the screen transformed Molnar's practice, and, conversely, how Molnar's innovative use of the CRT screen expanded its applications beyond their intended use. Here, I put process—both creative and technological—at the center of art-historical inquiry—

⁹⁸ Wolfgang Ernst, "Media Archaeography," 10.

to emphasize how Molnar's experiments with the computer were also aesthetic inquiries into artistic subjectivity.

While questions of gender permeate the dissertation, they are centered in my third and final chapter. Here, I look at how women have been systemically excluded from spaces and histories of both abstraction and computing, as well as the more subtle ways in which materials, tools, and even modes of reasoning have been, and continue to be, gendered. Focusing on Molnar's writing practice over two decades, I look at her shifting relationship to the terms *intuition* and *randomness*, which I link to a wider debate between 'hot' and 'cold' abstraction in postwar France. I suggest that by combining these two approaches, Molnar diffuses the gender binaries underpinning these dualisms, even if her work is not rooted in a feminist consciousness. Even though she began her computational experiments just as Roland Barthes announced the "Death of the Author," Molnar's work demonstrates a quiet refusal to strive for total objectivity in her art-making, even as her male peers used randomness (whether computational or painterly) in an attempt to eliminate their own subjectivity from the creative process. Instead of trying to suppress her subjectivity, Molnar places it under a microscope, studying it with a pseudo-scientific rigor.

Finally, my epilogue brings us to Molnar's current studio practice, in her assisted living home—her most recent artist residency—where she continues to explore many of the same lines of inquiry that have occupied her since the 1940s—many of the same, continuous through lines. At a moment when the computer was threatening to replace the artist, Molnar was testing its limitations when it came to creativity, investigating what aspects of the artistic process could *not* be automated. "It may seem paradoxical," Molnar wrote in 1989, in a text titled "Leonardo da Vinci, if he had had a computer," that "the so-called inhuman machine helps to realize what is most subjective, what is

most profound in man.”⁹⁹ These questions remain very much relevant today, as art made with computers and artificial intelligence bots become more accessible, raising questions about the limits of artificial creativity. ■

⁹⁹ Vera Molnar, « Léonard de Vinci s’il eût eu un ordinateur », in + - 0, n° 52, février 1989. « *Cela peut sembler paradoxal: la machine que l'on dit inhumaine aide à réaliser ce qu'il y a de plus subjectif, de plus profond dans l'homme.* » My translation.

Chapter 1

The Continuous Line: From Paper to Computer and Back Again

Interactive computer graphics appear, then, to be the ideal tool for approaching a real symbiosis between Man and machine, because, employing a form of iconographic expression, it calls upon the only universal means of communication.
—Pierre Morvan and Michel Lucas, *Images et ordinateur: introduction à l'infographie interactive*, 1976¹

A tiny dot moves gently in one direction: the line is born.
—Vera Molnar, *Du point à la ligne*, 2002²

How do you draw a line with a computer? The answer to this question may be self-evident to twenty-first-century readers, who could name a handful of applications that would do the job with the click of a mouse or swipe of a finger. But this gesture has not always been so simple or intuitive. Though the last two decades of the twentieth century saw rapid developments in home computing, user-friendly software like Paint was not available until the mid-1980s. In the early days of computer graphics, if you wanted to ‘draw’ with a computer, you had to know how to program. Drawing with a computer entailed translating visual forms into alphanumeric instructions. These words and numbers had to be legible to the specific computer being used— that is, they had to be written in a programming language the machine could understand.

¹ “La Visualisation Graphique Conversationnelle apparaît alors comme l’outil idéal pour approcher d’une réelle symbiose entre l’Homme et la machine, parce que, employant une forme d’expression iconographique, elle fait appel au seul moyen de communication universel.” From Pierre Morvan and Michel Lucas, *Images et ordinateur: introduction à l’infographie interactive* (Paris: Larousse, 1976, 11). My translation.

² « Un tout petit point se déplace doucement dans une direction : naît la ligne. » From Vera Molnar, “Du Point à La Ligne” (“From the Dot to the Line”) (Kandersteg, December 2002), Vera Molnar Archives: Carton 05: Textes: Français. My translation.

In her twenty-five years of experimenting with electronic computers, Vera Molnar learned two programming languages: first Fortran, then BASIC.³ Neither language was specifically designed for programming *images*, but both had the capacity to produce vector graphics—images made from lines and geometric forms plotted along a Cartesian plane. These graphics could be saved in ‘hard copy’ form in a variety of ways, the most popular of which was the computer plotter. Also known as a drawing machine, the plotter followed instructions from the computer to trace lines on paper with a robotic arm, which held a small pen.

The programming style that Molnar learned in the late 1960s and early 1970s would shape her approach to coding in the decades to come. Even in the late 1980s, as the graphical user interface (GUI) evolved to look more like the ones we are familiar with today—with a mouse or stylus used to navigate ‘windows’ on a screen—Molnar stuck to what she knew, continuing to ‘draw’ her geometric shapes by typing alphanumeric instructions on a keyboard. Even as it became possible to show digital artworks in their native environments—on the internet or on a desktop computer screen—she continued to use plotters.

By the late 1980s, making digital art *on paper* was more of a deliberate choice than it had been in the 1970s. There were practical dimensions to this choice: internal computer memory was still a fraction

³ FORTRAN (later stylized as Fortran), short for IBM FORMula TRANslator, was a high-level programming language developed between 1954 and 1957. Designed for scientific users, Fortran was “a major step in making the computer useful in the real world” (Bardini, Thierry. *Bootstrapping: Douglas Engelbart, Coevolution, and the Origins of Personal Computing*. Stanford, Calif.: Stanford University Press, 2000, 3). Fortran facilitated “man-machine communication” by “permit[ing] the user to express mathematical concepts for computer processing in symbols and syntax close to ordinary language” (William H. Desmond *Conversational Graphic Data Processing System: The IBM 1130/2250* (Englewood Cliffs, N.J.: Prentice-Hall, 1969, 3). Molnar learned Fortran through a combination of formal and informal routes—lessons from the CIRCÉ lab attendant and a course (Molnar in conversation with the author, August 16, 2022); CIRCÉ offered courses on using the Benson plotter, the IBM 2250, and the Fortran language (Ministère de l’Éducation Nationale and Centre National de la Recherche Scientifique (CNRS). “Rapport au comité du Direction du CIRCÉ,” October 20, 1972. Archives nationales de France, 78). She learned BASIC, which I explore later in this chapter, in the late 1970s at the Centre Pompidou.

of where it is today, so it was simply easier and cheaper to save hard copies. Given that early desktop-based artworks were notoriously difficult to document, preserve, and collect, Molnar ultimately did her future self a favor in this respect. But her commitment to paper was also ideological: produced on a surface traditionally associated with the fine arts, these images were more legible as art, even if they were executed by a machine.

Even as she ventured into the new territory of computer-generated images, Molnar used this emerging technology to investigate existing art forms with long histories—the drawing, the handwritten letter, the book, and the series—which all used paper as their substrate. Molnar’s commitment to paper is exemplified in her final foray into hands-on computing, her series *Lettres de ma mère* (**Figure 1.01**) made between 1981 and 1991, in which she wrote a computer program to “simulate” her late mother’s distinctive handwriting.⁴ This series is the focus of this first chapter.

The problem of technological obsolescence, the ever-changing nature of hardware that makes it inevitably incompatible with the software of another time, means that the paper trail left behind by early computer graphics is, inevitably, also biased toward paper, all but erasing those aspects of computing that have no hard copies. The ephemeral, technological, and processual dimensions of programming abstraction are much more difficult to find in an archive, a library, or a prints and drawings collection. Though many of her fellow pioneers of computer art painstakingly recorded their programs, sometimes even publishing them alongside reproductions of their processes, not

⁴ Though Molnar still works with computers, since the mid-1990s she has used them only from a distance, with the help of assistants. After her husband’s death in 1993, Molnar has not owned a computer nor a smartphone, and has never had an email address. *Lettres de ma mère* was the latest work where she did was involved in writing the program, but it is important to note that she did not do this entirely by herself. Unnamed studio assistants, friends, and her husband François Molnar were all involved in the development of this computer program, which, according to Molnar’s notes, was called ANYAM, Hungarian for “my mother.” It was written for the Molnars’ home computer, the BFM 186, a Franco-Japanese clone of an IBM personal computer (Vera Molnar in conversation with the author, October 10, 2021; Vera Molnar, *Journaux Intimes*, June 27, 1988).

much material evidence remains of Molnar's experiments with computer graphics besides her plotter drawings, two or three printouts of code, and a few cryptic lines in her *Journaux Intimes*. Her notes are more like fragments, insufficient for actually reconstructing her process (or perhaps more accurately, *their* process, since she often collaborated with someone more tech-savvy than herself).⁵ These fragments do not tell us everything, but they offer a starting point for understanding how the drawings were made.

In the pages of these notebooks, we can see how she transformed her visual ideas into instructions for the computer, which in turn translated her code into images. Artist and educator Pierre Braun, who was Molnar's studio assistant from 1983 to 1985, observes that Molnar's notebooks are not a thorough documentation of a technical process, but rather a record of the interaction between the artist and the computer, as Molnar recorded her responses to the computer-generated images in notes and sketches, which she used to further transform these forms. Braun suggests that Molnar's notes are mere fragments, insufficient for faithfully reconstructing her artworks or her processes. Rather, the notes record her real-time reactions to the visualizations that were happening on screen.⁶ In other words, in the pages of her notebooks, there is an ongoing conversation between the computer-generated image and the hand-drawn image.

Tracing or uncovering the process behind Molnar's computer graphics might seem outside the bounds of art history, which tends to focus on the object at hand, not the process that gave rise to it. It is precisely in Molnar's process, however, that she makes her major contributions to twentieth-

⁵ An entry in her notebook from April 4, 1985 includes a pasted-in, hand-annotated printout of instructions written in BASIC, with its characteristic numbered lines, indicating she was still working in this language into the mid-80s; Molnar confirms that this was the final language she was willing to learn.

⁶ Pierre Braun, "Véra Molnar : Enquête sur le code et l'archive," in *Véra Molnar: Une Rétrospective, 1942-2012*, ed. Sylvain Amic, Couleurs contemporaines (Paris: Chauveau, 2012).

century art and aesthetics. Her deceptively simple graphics belie complex systems that can only be uncovered by attending to making.

Art historian Jennifer Roberts has spoken about “the gap between making art and writing about art,” which “remains one of the most stubborn blind spots in our discipline, one that we have barely begun to negotiate.”⁷ She advocates for the studio—in her case, the printmaking studio—as a site of art-historical knowledge, where the “misalignments between the expertise of the art historian and the expertise of the artist” produce productive frictions that she terms “mis-expertise.” Roberts suggests that by working in the studio, an art historian can develop not only technical knowledge but also a greater observational sensitivity and an awareness of invisible labor. Put simply, they can ask better questions. Her notion of the studio refers less to a specific physical space, and more to a hands-on familiarity with certain tools and practices of making. For historians of computational art, the “studio” may be a specific machine, or it may be a general approach to working with machines. In this chapter, I bring Roberts’s notion of “minding making” into dialogue with methods of media archaeology and retrocomputing, the current use of obsolete hardware and software, using historical computer hardware and programming languages to ‘re-enact’ Molnar’s work.⁸

My reenactment of *Lettres de ma mère* was a sort of meta-reenactment: I had to reenact Molnar’s marks, which were in turn a reenactment of her mother’s marks. In its divergence from Molnar’s usual repertoire of cold, hard geometric abstraction, the series is as idiosyncratic as it is undeniably

⁷ Jennifer L. Roberts, “On Mis-Expertise: The Art Historian in the Studio” (CAA Annual Conference, Los Angeles, 2018). I thank Max Boersma for bringing this important and incisive talk to my attention.

⁸ Reenactment is a word used in retrocomputing and media archaeology discourse. Stefan Höltingen, *Resume: Hands-on Retrocomputing*, Retrotopia (Projekt Verlag, 2016); Stefan Höltingen, “Fifty Years in Home Computing, the Digital Computer and Its Private Use(Er)s,” *International Journal of Parallel, Emergent and Distributed Systems* 35, no. 2 (2020): 170–84.

hers. Through computer-generated ‘handwriting’ that is entirely asemic—the lines *look* like handwriting but carry no semantic meaning whatsoever—*Letters de ma mère* interrogates the relationship between drawing and writing, looking and reading, and image and text, all while throwing authorship into question. By reenacting this work, I consider how Molnar learned how to program by instructing, or teaching, the computer to draw.

The line, the trace, the ambiguous status of authorship—this all drips of poststructuralist theory. Curiously, even though Molnar lived only a half-hour stroll from Barthes and worked at a computer lab twenty-five kilometers from Derrida’s house, these minds never met, and these thinkers were not on her bookshelf. Instead, her most-referenced texts were those of other artists, including a first-edition copy of Paul Klee’s *Notebooks* in the original German: *Band I: Das bildnerische Denken (Volume I: The Thinking Eye)*.⁹

While she does not phrase it this way herself, Molnar’s experience with programming was a process of simultaneous teaching and learning, one that recalled Klee’s own pedagogical strategies. It was also Klee who famously linked writing and drawing to a common basic element: the line. “The word and the picture, that is, word-making and form-building,” he wrote in 1925, “are one and the same.”¹⁰ Just as teaching “helped [Klee] become more aware of his own way of working,”¹¹ I suggest that the same could be said about Molnar’s computer programming: in the simultaneous process of teaching the computer and learning from it, she developed a greater awareness of her creative

⁹ Klee’s *Notebooks* were not translated into French until 2004 (the earliest translations were English and Italian), but thanks to a governess, Molnar has been fluent in German since early childhood. She borrowed the title of Klee’s book for a talk she gave (in French) titled “L’œil qui pense,” at the SIGMA contemporary art festival (*SIGMA 9: Art et ordinateur, Bordeaux, 19 novembre au 8 décembre 1973: Contact II*. Bordeaux: SIGMA, 1973).

¹⁰ Paul Klee and Jürg Spiller, *Paul Klee: The Thinking Eye: The Notebooks of Paul Klee* (London: Lund Humphries, 1964), 17.

¹¹ Klee and Spiller, 21.

process, and of the limits of artificial creativity. By following Molnar's lines alongside Klee's, her drawing lessons alongside his, I explore how her work engaged both modern and postmodern concerns of abstraction, from the atomization of form to the question of authorship.

Re-enacting, Retrocomputing

The word re-enactment may conjure images of American Civil War enthusiasts dressed in period attire, commemorating their heroes and fantasizing about what could have been had this or that battle ended differently. These kinds of practices, while claiming to be educational, can be dangerous because, as art historian Sven Lütticken argues, often this history is reenacted “in order to perpetuate the present order that sprang from it.”¹² But reenactment practices are not limited to Sundays on the battlefield. In the twenty-first century, reenactment has become a buzzword in contemporary art and museum practices as well, ranging from the immersive re-staging of landmark exhibitions to the recreation of historic performance pieces. Lütticken is critical of these practices, too, wary that they “threaten to digest history in favor of a mere productivist mobilization for the needs of current attention economies.” He reminds us of R.G. Collingwood's early twentieth-century philosophy of history, in which reenactment was understood as “a mental exercise aimed at understanding historical processes.”¹³

Media archaeological reenactment, too, is aimed at understanding historical processes, though its focus is mainly on the technical and the techno-philosophical. Unlike Collingwood's reenactment, it is not merely a mental exercise, but one that is hands-on. While battle reenactors value “authentic”

¹² Sven Lütticken, “From Re- to Pre- and Back Again,” in *Over and Over and Over Again: Reenactment Strategies in Contemporary Arts and Theory*, ed. Cristina Baldacci, Clio Nicastro, and Arianna Sforzini, *Cultural Inquiry* 21 (Berlin: ICI Berlin Press, 2022), 7.

¹³ Lütticken, 5.

historical details, media archaeologists often have access to far less historical documentation, akin to the sparse photographic documentation accompanying many significant performance artworks. Their reenactments are thus more open to the reenactor's interpretation. When reenacting a Molnar, for example, we have almost zero computer code to work from, perhaps only some notes or sketches that do not provide a straightforward plan of action. The process involves *reverse engineering*: working backwards from the final product to reconstruct the program. Since programming is a creative process, every programmer, regardless of their experience, will come up with a different way to achieve those results. In this sense, coding is a sort of handwriting.

By reenacting Molnar's computer art, the point is not to recreate the exact program she used, but rather to develop an understanding of the tools she used, the questions or challenges they raised for her, and the temporality of programming graphics in a particular language on a particular machine. This is the difference between re-programming a historical work of computer art and reenacting it: while the former focuses only on the relationship between code and image, the latter takes into account the physical, temporal, and phenomenological experience of working with a specific machine from a particular historical moment.¹⁴ Through a combination of reverse engineering, retrocomputing, archival research, and oral history, I stitch together an understanding of Molnar's computation as a hands-on, collaborative, iterative, and nonlinear creative process.

To understand Molnar's approach to programming, I use the specific model of computer on which

¹⁴ A major criticism of the Berlin school of media archaeology is that, in its focus on nonhuman agency and what Wolfgang Ernst calls "microtemporal processes"—those not perceptible to the human senses—the role of human agency is entirely overlooked, if not outright ignored. I am thus not claiming to be practicing orthodox media archaeology, but rather borrowing from its methods to conduct "hands-on theory" (in the words of media archaeologist Stefan Höltgen) that operates in between art history and media studies. My approach thus accounts for the role of both human and nonhuman agents in techno-art-historical processes.

she learned the language BASIC in the late 1970s: the Tektronix 4052 (**Figure 1.02**).¹⁵ I do not want to suggest, however, that this language or this hardware determined her mode of working. Rather, I use the Tektronix as a starting point to think about Molnar's general approach to programming computer graphics, which she began a decade before she accessed this specific machine and continued for another decade after. Typing on this clunky microcomputer, resuscitated from decades of hibernation, its fan whirring loudly, I am an amateur, learning to code in a foreign language, struggling to achieve the simplest task of 'drawing' a line. But Molnar, too, was an amateur programmer. She, too, struggled to problem-solve with this machine, to translate her pen-and-paper sketches into digital images. Just as I must figure out how to break a zigzagging line into series of instructions, so did she. In Roberts's terms, there is a mis-expertise that emerges between my use of this computer and hers, forty-five years earlier. But there is also a mis-expertise between her drawing and programming practices, where her expertise as an artist met her lack of expertise as a programmer.

Drawing Lessons

One of Molnar's earliest extended experiments with the computer involved an imaginary conversation with Paul Klee. *À la recherche de Paul Klee* (*Looking for Paul Klee*, 1970, **Figure 1.03**) translates Klee's painting *Variationen* (1927) into machine-readable instructions, a computerized grid of line segments executed with the mechanical arm of a plotter. This was not the first reference made to this Bauhaus master in early computer graphics. Frieder Nake, a mathematician-turned-

¹⁵ I first encountered a Tektronix 4052 microcomputer in the Centre Pompidou archives, where its screen had long gone dark and dusty. As a DAAD fellow at the Signallabor at the Institute for Media Studies at Humboldt University in Berlin the following year, Dr. Dr. Stefan Hölten connected me with a local computer collector who had the same model, which he lent us for our research. Hölten had the microcomputer repaired to be operational again, and it was on this model that I conducted my own media archaeological research, in collaboration with him. I am grateful to both Dr. Hölten and Rainer Siebert for their generosity.

artist working with a Zuse Graphomat “drawing machine” in Stuttgart, took Klee’s painting *Highbroads and Byroads* (1929) as its reference point for *Hommage à Paul Klee* (1965), one of the first significant works of computer art to be exhibited.

Though their paths never crossed, Molnar found a kindred spirit in Klee, who represented everything about the Bauhaus that she sought to emulate, even as it was deemed unfashionable and irrelevant in postwar Paris.¹⁶ Even if Klee did not make waves in France, his Swiss and Anglophone editors asserted that the *Notebooks* had “the same importance and the same meaning for modern art as had Leonardo’s writings [...] for Renaissance art.”¹⁷ Like da Vinci, Klee had a profound influence on Molnar, with his rigorous sketchbook practice and his proposal for a “science of art” that aimed to combine “exact research” with artistic “intuition,” terms that appear verbatim in Molnar’s own writing.¹⁸

It was not only the formal aspects of Klee’s geometric abstraction that resonated with makers of early computer graphics, though it helped that lines and circles were relatively easy to program. Klee’s theories also resonated with discussions of aesthetics in early computational art. Pierre Braun suggests that Klee’s approach to theorizing form has been relevant to computer art since its beginnings. To program artworks on a computer, artist-researchers like Molnar and Nake had to think about breaking down both forms and the creative process into smaller, discrete parts—a

¹⁶ Isabelle Ewig, “(Paul Klee + Art Concret) x France = Véra Molnar,” in *Polyphone Resonanzen: Paul Klee Und Frankreich; La France et Paul Klee*, ed. Gregor Wedekind (Berlin; München: Deutscher Kunstverlag, 2010), 187. In Ewig’s words, few people in France at this moment took the Bauhaus seriously. Following a conversation between Molnar and Jean-Pierre Arnaud in 2002, the dominant narrative (corroborated by Ewig) is that Molnar learned about the Bauhaus from Jean Leppien, a former Hungarian émigré and former Bauhaus student, who left Germany in 1933 because his wife, Suzanne Ney, was Jewish. (See “Une Hongroise à Paris: Entretien avec Vera Molnar.” In *Artistes hongrois en France, 1920-2000: autour de la collection Szöüllösi-Nagy-Nemes*: Angers: Présence de l’art contemporain, 2002.)

¹⁷ Spiller, *Paul Klee*, 11.

¹⁸ Spiller, 70.

process Braun calls “de-composition.”¹⁹ This reflexive process of aesthetic inquiry has characterized Molnar’s work since before she even had access to a computer.²⁰

To study the impact of Klee’s *Notebooks* on Molnar, it is important to understand what kind of text it was. Published posthumously, these volumes reconstructed Klee’s teaching activities at the Bauhaus from 1921 to 1922 through his notes and schedules.²¹ The *Notebooks* were pedagogical but not didactic. While it was the second volume in a series on the theoretical program of the Bauhaus, it did not fashion itself an instruction book for drawing or painting; rather, it offered a series of musings on the “theory of pictorial form” interspersed with reproductions of Klee’s own sketches and doodles (**Figure 1.04**).

Visual theorist Johanna Drucker aptly suggests that “Klee writes as a poet and draws as an artist. He is not creating didactic statements and then illustrating them. His language and sketches are generative, open, and suggestive.” She argues that Klee’s pedagogical approach challenged the early-twentieth-century Structuralist impulse to categorize and systematize in search of a “universal standard of form.” Unlike another book in this series, Wassily Kandinsky’s *From Point and Line to Plane*, Klee’s *Notebooks* provide what Drucker calls “provocations” rather than “fixed rules.” Even

¹⁹ Pierre Braun, ed., *Digital Klee: esquisses pédagogiques : enquête sur le futur de la forme* = *Digital Klee : pedagogical sketchbook : an inquiry into the future of form* (Rennes: Présent composé, 2020), 27. More recently, Braun has revived Klee’s pedagogical notebooks for “drawing” on contemporary devices (tablets and smartphones), inscribing their relevance not only for contemporary art and design pedagogy but also for the history of computer graphics. Braun’s argument about “decomposition” echoes art historian Christoph Klütsch’s point about the Stuttgart school—that working with a mainframe computer allowed the artist/programmer “to break down visual problems into small, elegantly designed pieces” (Klütsch, Christoph. “Information Aesthetics and the Stuttgart School.” In *Mainframe Experimentalism: Early Computing and the Foundations of the Digital Arts*, edited by Hannah Higgins and Douglas Kahn, 65–89. Berkeley: University of California Press, 2012, 65).

²⁰ Before she had access to an electronic computer, Molnar could only dream of using one. In the early 1960s, she developed a methodology that she called the *machine imaginaire*, borrowing terminology from her composer friend Michel Philippot, who wrote music with instructions that could be executed step by step like a computer program.

²¹ Part of these had already been published in 1925 as *Pädagogisches Skizzenbuch* (*Pedagogical Sketchbook*).

today, the book remains dynamic and open-ended.²² While Klee locates the shared origin of drawing and writing in the line, Kandinsky pinpoints it in the *point*: “the proto-element of painting and especially of the ‘graphic.’”²³ While both Bauhaus masters proposed a “science of art” in their own way and taught drawing by breaking it down into smaller elements, Klee’s theory seems to have appealed more to Molnar than Kandinsky’s. This is perhaps because Klee’s theory of form, like vector graphics, used the *line* as its basic element.²⁴

As Klee’s informal student, Molnar did not wholeheartedly adopt his approach to mark-making. Rather, Klee’s influence as a teacher is visible in Molnar’s own pedagogy: her approach to teaching the computer how to draw. Like Klee’s drawing exercises, Molnar’s drawing lessons, written for the computer, are playful, experimental, and generative. From the beginning, Molnar’s engagement with Klee—and her overall approach to computer programming—retains his experimental ethos. Her programs are not clear-cut, prescribed instructions for a predetermined result, but rather a series of commands in the form of what-ifs. They, too, are provocations that invite generative, open-ended results. They are constantly revised and adjusted, and their open-endedness is furthered by Molnar’s use of chance in the form of pseudorandom number generator algorithms (PRNGs) that produce unexpected outcomes.²⁵

By collapsing the distinction between writing and drawing, *Lettres de ma mère* makes a subtler but no less direct appeal to Klee than Molnar’s earlier plotter drawings. Perhaps Klee’s best-known

²² Johanna Drucker, “The Poetics of Dynamic Design: Klee’s Pedagogical Sketchbook Revisited,” in *Digital Klee: esquisses pédagogiques : enquête sur le futur de la forme = Digital Klee : pedagogical sketchbook : an inquiry into the future of form*, ed. Pierre Braun (Rennes: Présent composé, 2020), 100–102.

²³ Wassily Kandinsky, *Point and Line to Plane*, trans. Hilla Rebay (New York: Dover Publications, 1979), 32.

²⁴ Point-based or pixel graphics would be the basis of raster graphics, which are more common today.

²⁵ These are called pseudo-random because they generate a sequence of numbers whose properties approximate the sequences of random numbers, such as those obtained from rolling dice. I discuss PRNGs more in chapter 3.

provocation is his suggestion that the line, whether it is drawn or written, is a “mobile point,” a dynamic dot that “goes out for a walk.”²⁶ The line, Klee emphasizes, is *active*, either a “free” line (one that meanders, walking “aimlessly for the sake of a walk”) or a “hurrying” line that moves from point to point, “More like a series of appointments than a walk.”²⁷ The walk recalls Molnar’s first programming exercise: a “random walk,”²⁸ named for the statistical principle describing “the movement of something in successive steps, the nature of each step being governed by chance independently of the preceding steps.”²⁹ In computer graphics, a random walk program draws a line that travels along from one randomly determined x- and y-coordinate to another, and then another, moving only within the bounds of the screen or the sheet of paper, according to parameters determined by the artist-programmer. This relatively basic principle gave rise to many early computer artworks, such as Nake’s *Random Walk Through Raster* (1966) and Manfred Mohr’s *Random Walk* (1969). While Molnar’s own random-walk exercises have been long lost, she recalls the satisfaction it brought her to draw a picture from one continuous line, a formal principle that she had been exploring for as long as she could remember.

Lettres de ma mère

On January 5, 1981, her fifty-seventh birthday, Molnar used a blue ballpoint pen to draw two zigzagging lines in her sketchbook, each made from one continuous, dynamic mark (**Figure 1.05**). Invoking Klee’s “hurrying” line, she pulled the pen from left to right, letting it glide downward, then upward, then down and up again. The first zigzag reached across the quadrilled page; the second grew taller, traveling only about three-quarters of the way. In black ink, she scrawled a note: *network*

²⁶ Klee and Spiller, *Paul Klee*, 103, 105.

²⁷ Klee and Spiller, 109; Tim Ingold, *Lines: A Brief History* (London: Routledge, 2007), 73.

²⁸ Conversation with Vera Molnar, June 12, 2021.

²⁹ Oxford English Dictionary, third edition, “*random, n., Adv., and Adj.*”. (Oxford University Press, revised December 2008).

*of parallel lines without lifting the pen.*³⁰

In black ink, Molnar added a title for her sketch—*Écriture de ma mère* (my mother's handwriting). It had been exactly a decade since her mother, Erzsébet Pollacsek, known as Erzsi, had passed away. Erzsi's distinctive script, preserved in the weekly letters she had sent her daughter from Budapest, became an object of fascination for Molnar, and the source of a decade-long investigation into their form. While many of Molnar's series bear the names of others—*Hommage à Dürer*, *Hommage à Renoir*—this reference is her most personal. While Erzsi was not an artist, Molnar examines her handwriting with the same curiosity and admiration she held for the Renaissance drawings or impressionist paintings that inform her other works.

Two months later, Molnar returned to her sketchbook, stacking five zigzagging lines of uniform height to mimic the visual structure of a handwritten letter. This composition was, in fact, based on the weekly letters that Molnar, an only child, received from her mother, from 1947 when she left home until the end of Erzsi's life. Returning to Paris from her mother's funeral in Budapest, Molnar found one final letter in her mailbox, like a message from a ghost. Never one to believe in the occult or the spiritual, Molnar shrugged it off and packed it away. After that—she puts it bluntly—“there were no more letters.”³¹ Molnar saved a sheaf of these letters, mostly from the final years of Erzsi's life (**Figure 1.06**). In these pages, we can see how her hand was aging, growing tired, but was committed to producing a certain kind of form—much like Molnar's own hand in her advanced years. Her margins are narrow, her blue pen taking up every available centimeter on these precious

³⁰ Véra Molnar, *Véra Molnar: Journaux Intimes 1976-2003* (CD-ROM), ed. Gwenaél Bacle, 2009. My translation from French.

³¹ Vera Molnar, “My Mother's Letters: Simulation by Computer,” *Leonardo* 28, no. 3 (1995): 167. Manuscript received by editor Frank Malina on 26 May 1994.

sheets of paper, sometimes even trailing off the bottom of the page.³² Words spill over the front and backside of several pages. The letters' contents are fairly mundane—updates on Erzsi's health, meals she ate, family gossip, and pleas to hear more from her daughter—but they held this relationship together despite the difficulty of staying close on opposite sides of the Iron Curtain. Like a distant parent's love, the letters are imperfect, messy, and at times grating, but they are persistent.³³

It was not until 1984 that Molnar began translating the zigzags in her sketchbook into computer code. Even after that, her notebooks indicate that she continued shuttling back and forth between hand-drawn and programmed lines. She made dozens of different works on paper—some by hand, some by plotter, others utilizing both—titled *Ecriture* or *Lettres de ma mère*. Aside from maintaining Erzsi's distinctive horizontal format and blue ink, the computer-generated letters are anonymous.³⁴ While Molnar translates the title, *Lettres de ma mère*, to *My mother's letters* in English, the French *de* maintains more ambiguity in terms of both authorship and temporality. Who were these letters written by, and to whom?³⁵

The apex of the series are two versions made in 1988, one in black ink and one in blue, on long rolls of plotter paper that unfurl like scrolls (**Figure 1.07**). On each scroll we see a series of nine to eleven “letters,” moving from what Molnar calls “legibility to total illegibility,” both within each letter and in the series as a whole. This entropic progression from order to disorder was, by now, a distinctive hallmark of Molnar's abstraction. At the same time, this subject matter was a departure from her

³² In Molnar's first few years in Paris, amidst postwar financial distress and material shortages, her mother would mail her scrap paper—grocery lists, her father's old documents—on which Vera and François drew and painted.

³³ Special thanks to my own parents, Klára and Tibor Vályi-Nagy, who helped me decipher Erzsi's handwriting.

³⁴ Erzsi's stationery bore the name of her second husband—like most Hungarian women of her generation and generations to come, marriage subsumed her individual identity, as her legal name became Dr. Sajó Béláné, meaning wife of Dr. Béla Sajó, her maiden name lost to history.

³⁵ While she generally wrote her mother back every ten days, Molnar recalls her mother constantly writing that her daughter did not write her often enough.

usual repertoire of concentric squares and circles, the geometric vocabulary that had aligned her with the postwar revival of *l'art concret*, or Concrete art.

Molnar's *Lettres* follow many of these cardinal rules of Concrete Art, including simple and visually controllable elements and mechanistic mark-making. But, like her earliest abstract drawings of the Transdanubian hills, the *Lettres* also break these rules by abstracting *from* nature instead of focusing on pure formal relations.³⁶ This referent—the artist's mother and their relationship as it lives on in their abstract, imagined correspondence—is not only real, but highly personal, and carries much poetic potential—the kind of art rejected by her mathematically-oriented, scientific milieu.

Handwriting involves gesture, and gesture conveys emotion, which was to be avoided at all costs in both *l'art concret* and “information aesthetics,” a theory that had been embraced by her international circle of interlocutors since the 1950s. Information aesthetics aimed to bridge the gap between science and art by treating art—both its creation and its reception—as quantifiable processes.³⁷

Molnar was never a strict follower of *l'art concret* nor information aesthetics, but she was dismissive of emotional, gestural abstraction, and any exploration of the personal in her work. By emphasizing the formal qualities of the letters and their computational “simulation,” Molnar reassures us that this project is purely formal, only about pictorial composition. Reflecting on the making of *Lettres de ma mère* in the journal *Leonardo*, Molnar wrote,

Mother had a wonderful handwriting—somewhat Gothic, somewhat hysterical. She began each line regularly and strictly with Gothic letters, which toward the end of the line became more and more restless, nervous, almost hysterical. As she aged, the letters became quite

³⁶ Point number 2 of the *art concret* manifesto, signed in 1930 by Otto Gustaf Carlslund, Theo van Doesburg, Jean Hélion, Léon Arthur Tutundjian, and Marcel Wantz, reads, “L'oeuvre d'art [...] ne doit rien recevoir des données formelle de la nature, ni de la sensualité, ni de la sentimentalité.” (A work of art ... should not receive formal data from nature, nor from sensuality, nor from sentimentality.” *Art concret* 1 (April 1930).

³⁷ Information aesthetics was developed in the 1950s, theorized independently by Abraham Moles in France and Max Bense in Germany. Both men drew heavily on Norbert Wiener's cybernetics and Claude Shannon's information theory. I take a closer look at the influence of Moles on Molnar and her husband in the final chapter of my dissertation.

troubled, perturbed. Slowly the Gothic disappeared, leaving only the hysterical. Each week I received a letter, which meant a real experience for my visual world. The letters were more and more difficult to decipher but they looked very pleasant. [...] I started ‘simulating’ on computer her gothical-hysterical missives to myself.³⁸

Molnar seems to suggest that reading her mother’s letters had always been, above all, a *visual* experience, one in which the distinction between reading and looking was collapsed. Looking at the marks of her mother’s pen, Molnar saw diagonal lines, zigzagging across the page in horizontal rows, becoming more and more disorderly as the page went on, and from one letter to the next. Whether the aesthetic qualities of the letters really took priority over their contents, we will never know. But this is the sort of experience that Molnar sought to recreate. She seems to insist that the invocation of her mother is purely incidental. We shouldn’t read into it.

Abstracting Writing

Although Molnar’s refers to *Lettres de ma mère* as a “simulation” of her mother’s handwriting, the work is, in practice, far from a macabre reanimation of the dead. Her program was not ‘intelligent’ in the sense of today’s computer simulations, which respond to real-time input from users. By reverse-engineering her program, we can deduce that it was relatively simple, a series of loops for drawing zigzagging lines across the screen, which were then transposed to lines across the page. As in her earlier works, Molnar used a PRNG to introduce randomness into her algorithm, resulting in irregularities in line length and angle measurements that simulate the irregularities of hand-drawn marks. The writing is asemic, but the formal qualities of the lines invite the viewer to ‘read’ them as if they were text.

³⁸ Molnar, “My Mother’s Letters,” 167.

Asemantic writing operates by what literary scholar Peter Schwenger calls “a kind of cognitive dissonance: writing is evoked at the same time that we are estranged from it.”³⁹ It is, simply put, writing without language. In her exploration of asemantic writing, we might say Molnar was ahead of the trend. According to Schwenger, it was not until the late 1990s that an asemantic art movement emerged, at a moment when handwriting was in danger of disappearing, at risk of being displaced by “keyboarding.” Of course, the typewriter had already replaced the hand in many contexts, but with the rise of the World Wide Web and the ubiquity of the personal computer, the handwritten word was seemingly more at risk than ever before.⁴⁰ While writing in their native languages may have limited their audience, the very *illegibility* of asemantic writing is what made it universally legible as art. Finnish artist Satu Kaikkonen describes the potential of asemantic writing as “a kind of language that’s universal and lodged deep within our unconscious minds.”⁴¹ Abstraction as a potential universal language can be traced back to the 1930 manifesto of *l’art concret*, re-emerging in its postwar revival with a more political bent. But this appeal to the unconscious would be too Dadaist for Molnar’s taste and would make Max Bill roll over in his grave. For *l’art concret*, abstraction was commendable so long as it wasn’t personal.

Molnar’s brand of *art concret* has always been subtly, but poignantly, unorthodox. Molnar likes rules, but she also likes to bend them. Translating her mother’s private, Hungarian words into the visual language of geometric abstraction not only redacts the contents of the letters. This process of abstraction also renders their meaning irrelevant. Paradoxically, by abstracting her mother’s handwriting, she, too, makes these gestures more universally legible. Though the title refers to her

³⁹ Peter Schwenger, *Asemantic: The Art of Writing*, 2019, 7.

⁴⁰ Perhaps paradoxically, an artistic movement was able to emerge precisely *because* of the internet, which united artists from different corners of the world who could share their work on this relatively new platform.

⁴¹ Quoted in Peter Schwenger, 15.

mother, it leaves plenty of room for interpretation from the viewer, who might think of their own mother, or instead reflect on the question of handwriting and automation, or focus simply on the hyper-technical, the motherboard rather than the mother.⁴²

The Continuous Line

Drawing a picture from one continuous line—*une seule ligne*—had long interested Molnar. A small gouache titled *Une ligne*, made in 1954, fills an entire page with a squiggling red line painted from a single brushstroke. One of Molnar's earliest abstract drawings, *Collines géométriques* or *Collines de Transdanubie* (*Geometric hills* or *Transdanubian hills*, 1946, **Figure 1.08**), made while she was still living in Hungary, consists of two meandering lines, drawn in graphite, that travel across eight sheets of paper, stretching and at times interlocking to form a long, abstract landscape. She would return to these Hungarian hills—again, in the form of continuous lines—in the summer of 1978, when she and her husband spent the summer at their vacation home in Tihany, on the north shore of Lake Balaton (**Figure 1.09**).⁴³ This would not be the last time Molnar drew from the hills. Around 1989, Molnar would begin her prolific series *Variations sur le thème de la Montagne Sainte-Victoire*, which allegedly started from her observation that the mountain Paul Cézanne made famous had the same silhouette as a Gaussian bell curve. In other words, *Lettres de ma mère* was not Molnar's first divergence from the strict repertoire of *l'art concret*. From the beginning, her abstraction has been geometric, but not dogmatic. Molnar challenges the history of abstraction as much as she operates within it.

⁴² In "The Anatomy of a Motherboard," Marty Sems writes, "The mainboard, or motherboard, is the foundation of a PC. Everything connects to it—the processor, the memory, the storage drives—and the motherboard, in turn, keeps the CPU in communication with all of its subordinate devices" (2011).

⁴³ See Molnar's *Journaux intimes*, July 19, 1978. During these summers at Balaton, the Molnars encountered and befriended several members of the Hungarian neo-avant-garde, who found relative artistic freedom in these sleepy vacation towns. See *Törvénytelen avantgárd: Galántai György balatonboglári kápolnamuterte, 1970-1973*, ed. Júlia Klaniczay and Edit Sasváry (Budapest: Artpool-Balassi, 2003).

The Tihany sketch also recalls an earlier plotter drawing, *Horizontales* (1971), which served as a blueprint for a painting by the same name (**Figure 1.10**). Here, the pen travels from left to right, moving ever so slightly up and down the y-axis to create slight tremors, like the peaks of a seismograph. Starting with the second line, the pen does not pick up at the end but instead travels back toward the left, meeting at its starting point, creating a loop. The pen then lifts, moving down the y-axis to start a new line, and the motion repeats twenty-seven times, only with different variations and tremors along the way. While the format, with its horizontal array of lines, is similar to the *Lettres*, the marks of *Horizontales* do not read like writing—the peaks are far too spaced out to be letters—but more like an abstract landscape, like the earliest *Collines*.

While *Collines* involved stringing standard-size sheets of paper together, Molnar was later able to experiment with the scroll format in the 1970s using what was called a drum plotter, which used a cylindrical “drum” to feed a long roll of paper under the pen, which moved on a fixed track perpendicular to the paper’s movement (**Figure 1.11**). Compared to the more prestigious flatbed plotter or ‘drawing machine,’ the drum plotter had technical limitations: it required a very thin, nearly transparent paper, it had color limitations, and the width of the drawing was restricted to the width of the plotter. Moreover, the lateral pen movement *looked* less like the human motion of drawing than the flatbed plotter’s robotic arm, which could move in both the x- and y-directions.

For Molnar, however, the drum plotter had distinct advantages. Since she could plot one variation of an image after another without having to switch the paper, it was better suited for experiments in seriality, which I explore more in the next chapter. While she often cut the long rolls of paper into smaller pieces, either to rearrange the sequence of a series or to isolate certain moments as

standalone pictures, Molnar occasionally left the roll intact. The drum plotter was the perfect tool for making long, scroll-like drawings, works like *Crescendo/Decrescendo* (1976), which was alternately titled *Computer-Torah* and displayed in a scroll form like the Jewish holy text, with a roller on each end.⁴⁴

Molnar reprised the scroll form in the late 1980s, though she would not show it in such an interactive format; these days, these long-form drawings are typically shown in custom-built glass cases with only a fraction of the paper visible. Even still, they invite a dynamic mode of viewing. The viewer must follow the movement of the scroll to encounter the work, to see it unfold—or unroll—in time. The encounter again recalls Klee, who wrote, “The pictorial work springs from movement, it is itself fixated movement, and it is grasped in movement (eye muscles),” only with the added movement of the viewer’s body, which traces the movement of the paper through the plotter.⁴⁵ This is not necessarily a linear movement, since the unfurled scroll allows the viewer to move back and forth between different iterations of the image.

By the 1980s, Molnar no longer had to choose between the drum and flatbed plotter to make her scrolls. She acquired a small tabletop plotter, the Calcomp 81 (**Figure 1.12**), which combined, in Molnar’s view, the best of both worlds—the mechanical arm of the flatbed and the roll mechanism of the drum plotter.⁴⁶ This was the machine she used to plot *Lettres de ma mère* (**Figure 1.13**). In her home/studio, the continuous line combined with the continuously rolling paper had its distinct practical advantages: the plotter could run overnight without making the tap-tapping sound that kept

⁴⁴ *Crescendo/Decrescendo* is held in the FRAC Picardie collection but without the rollers/handles, and no mention is made in the catalogue record of the work’s alternate title. The *Computer-Torah* was only mentioned on Vera Molnar’s now-defunct website.

⁴⁵ Klee and Spiller, *Paul Klee*, 78.

⁴⁶ Conversation with Vera Molnar, October 24, 2021.

Molnar and her husband awake thanks to their modernist, open floorplan that lacked doors or sound insulation. It produced, instead, a more continuous whir.⁴⁷

How, then, did Molnar's continuous line meander into asemic writing? The answer to this question is not so linear. At age ninety-seven, in a conversation about her typewriter works from the 1970s and 80s, her memory suddenly wandered to her childhood in Budapest. Molnar often insists that themes in her work—like the continuous line—come and go, disappearing and then reappearing like a thread used in weaving a textile, the weft that peeks behind the warp only to reappear again.⁴⁸ She moves her wrinkled finger through the air in a sinusoidal wave motion to illustrate. The phenomenon piques a childlike curiosity in her, but she is hesitant to get *too* poetic about it. She mentions a memory that recently resurfaced, of learning cursive script as a child.

Young Vera first learned how to write at a French school, where she recalls learning a type of handwriting that leaned forward, its letters drawn using a thin upstroke and a thick downstroke. Then her parents switched her to a Hungarian school, where around age eight she learned the new style of handwriting that became standard in 1932: *Luttor-féle zsinórírás* (Luttor-style string-writing), *zsinor* being the word for a string, cord, or braid (**Figure 1.14**). *Zsinórírás* was invented by the craftsman and pedagogue Ignác Luttor (1898-1958), a graduate of the same art school the Molnars would later attend. *Zsinórírás* was developed using an “evolutionary-historical-theoretical (biogenetic) method” which claimed it was significantly easier to learn and use than *Kalligrafikus szépírás* (calligraphic handwriting), which had been taught in schools since 1906. Calligraphic handwriting—which is what Molnar's mother had learned—came under criticism around 1925 for its difficulty to

⁴⁷ Conversations with Vera Molnar, August 30, 2017 and July 11, 2018.

⁴⁸ Conversation with Vera Molnar, June 12, 2021.

read and learn, especially for children. Luttor's system replaced the tilted letters of calligraphic cursive with straight, upright letters that were closer in form to printed letters, thus arguably easier to both read and write, but strung them together without lifting the pen.⁴⁹ *Zsinorírás* was ergonomic, streamlined, and modern, and it fascinated young Vera, its principles creeping into her doodles.

Tracing Gestures

To reverse-engineer *Lettres de ma mère*, I began with a reproduction of the first 'letter' in Molnar's black-ink scroll from 1988, printed out on a sheet of paper (**Figure 1.15**). Armed with a pen, a ruler, and a protractor, I counted the number of lines and peaks and measured the lengths of the line segments, the distances between strokes, and the angles at which the 'handwriting' tilted to the right. In other words, I practiced what Braun calls "de-composition," the breaking down of a picture into smaller, discrete elements.

As I counted the rise and fall of the zigzagging line, I noticed the rhythmic rise and fall of my own pen. In fact, as I followed Molnar's line—the plotter's line—my own pen left a mark on the paper. I was inadvertently tracing the line, in order to figure out how it was made. I was reminded of the nineteenth-century Italian art critic and connoisseur Giovanni Morelli, who would attribute works of art by tracing reproductions of them, which would help him isolate and identify characteristic features. Philosopher Richard Wollheim suggests that for Morelli, the line was a "residue" or "trace" of the artist's "psychomotor activities."⁵⁰ A drawing was considered a record of a series of gestures that are unique to that artist. For Morelli's generation of connoisseurs, there was a belief that if we

⁴⁹ *Zsinorírás* was only taught in Hungarian schools until 1956, when it was replaced by an even more ergonomic cursive style. See "Luttor Ignác," *Magyar életrajzi lexikon* (Hungarian biographical dictionary), arcanum.com (accessed July 8, 2022). "Az írás története [The history of writing]," *Magyar Iskola*, <https://www.magyar-iskola.sk/2022/06/az-iras-tortenete/>, published June 10, 2022, accessed July 8, 2022.

⁵⁰ Richard Wollheim, *On Art and the Mind* (Cambridge, Mass.: Harvard University Press, 1974), 197.

reenacted the artist's gesture, we could imagine the idea motivating that gesture. In other words, tracing the artist's trace might give us some access to their psychological space.

Unlike Morelli, I am not working with an unknown artist, nor was Molnar. Rather, our goals are closer to the forger's: to understand someone else's style and to be able to mimic it. Molnar was no stranger to forgery; she recalls her mother asking her to alter her birth year on a document—"Is that *all my art degree was good for?*"—for a reason that she cannot recall or will not disclose.⁵¹ Historian Carlo Ginzburg reminds us that handwriting, even more than the signature, is nearly impossible to imitate.⁵² Of course, Molnar's goal was not to forge her mother's handwriting but to evoke it, to explore its formal qualities. Just as I had to decompose the lines into discrete elements and determine a repertoire of forms, she had to do the same with Erzsi's letters. Surely she could not do this without thinking about the psychology of gesture?

By using a plotter to execute these drawings, Molnar follows the fifth rule of *l'art concret* ("The painting technique must be mechanic"). In doing so, she thwarts any psychological reading of the "handwriting," the kind suggested by Roland Barthes when he writes, "the hand seems plugged directly into the mental."⁵³ The lines are not written—nor drawn—by a human hand, but instead programmed with a computer and executed with the mechanical arm of a plotter. With the hand displaced, any link between the mark and the unconscious of its maker is short-circuited. Even the "hysteria" that Molnar observes in her mother's writing—that nebulous, incurable mental state ascribed to so many women of her generation—is quantified, written into the program as random

⁵¹ Conversation with Vera Molnar, December 13, 2019.

⁵² Carlo Ginzburg, "Morelli, Freud and Sherlock Holmes: Clues and Scientific Method," *History Workshop*, no. 9 (1980): 24.

⁵³ Barthes, "The Preparation of the Novel" (265), cited in Peter Schwenger, 36.

noise. This is a characteristically cheeky move from Molnar that seems to mock the pseudoscience of graphology, the reading of psychology or personality from handwriting. We might even find a criticism of the patriarchal structures that held her mother suspended in the blasé existence of a hypochondriac housewife, writing mundane letters to her daughter on her husband's stationery, though Molnar would likely scoff at such an interpretation.

Whether a line was drawn by a human or a machine, tracing it allows us to identify patterns, and eventually determine a repertoire. Wollheim emphasizes that individual style is characterized not by consistently identical forms, but rather by consistent interrelations between forms. “It is not that the tails of the *g*s are always the same length, or the loops of the *l*s the same shape,” but that the way the *g*s and *l*s relate to one another is constant.⁵⁴ By tracing *Lettres de ma mère*, I find that there is always an indent on the first line, the inclination angle varies from twenty-two to forty-one degrees, and that each line has between seventy and eighty “peaks” (the up-down motion), the exact number seemingly determined by a random number that occasionally inverts the peak below the baseline. Once I had this repertoire in mind, I could think about how to translate the visual forms into alphanumeric instructions for the computer. This is where my approach most likely diverges from Molnar's, since no two programmers—even amateurs—think alike.

Drawing with the Computer

Despite the availability in the 1980s of drafting tools for computer-aided design such as the light pen, the stylus, and even the mouse, Molnar only made computer graphics with old-fashioned alphanumeric code.⁵⁵ While she *could* have used user-friendly software packages like Paint to “draw”

⁵⁴ Wollheim, *On Art and the Mind*, 198.

⁵⁵ While the IBM 2250 CRT display, Molnar's first computer screen (the subject of my second chapter) often came with a light pen that allowed the user to draw and manipulate graphics directly on screen, it is unclear whether the CIRCE lab

in a virtual environment. she stuck to what she knew: the programming language BASIC, an acronym for Beginner's All-Purpose Symbolic Instruction Code (**Figure 1.16**). Perhaps using a stylus would have been somehow *too* easy, too direct, for her method. Keyboarding (**Figure 1.17**) allowed her to use mathematical operations that left room for randomness, unpredictability, and surprise in her results.

BASIC was developed in 1964 at Dartmouth College by the Hungarian-born computer scientist John Kemény and his American colleague Thomas Kurtz.⁵⁶ By the 1980s, BASIC was built into the ROMs of most home computers, so anyone who grew up playing with computers in this decade is familiar with it. Of course, Molnar was already in her fifties in the 1980s, so her process of learning was not so easy, nor was it playful in the same way. Moreover, with each machine came a different dialect of the programming language, one that made use of the particular hardware capabilities of that model. This makes reading and re-programming BASIC programs challenging because the commands are contingent on the computer for which it was written.⁵⁷

Molnar learned BASIC in the late 1970s, as an artist-in-residence at L'Atelier de Recherches Techniques Avancées (ARTA), an interdisciplinary laboratory run by the Romanian-born artist/engineer Christian Cavadia at the Centre Pompidou in Paris. ARTA boasted an eclectic roster of collaborators, from painters to musicians to neuroscientists.⁵⁸ Here, Molnar worked on a Tektronix 4052 microcomputer (**Figure**), which, unlike the IBM system/370 mainframe computer

had one. It is not listed in their inventory of peripherals from 1972-76 (Archives Nationales, Paris), and the tool was likely too cost-prohibitive to buy herself.

⁵⁶ Mark Jones Lorenzo, *Endless Loop: The History of the BASIC Programming Language (Beginner's All-Purpose Symbolic Instruction Code)*, 2017.

⁵⁷ Stefan Höltingen, *Resume: Hands-on Retrocomputing*, Retrotopia (Projekt Verlag, 2016), 70.

⁵⁸ ARTA archives, Centre Pompidou, Paris.

on which she first learned to program, was a smaller, self-contained machine.

While *Lettres* was made on a PC, the BFM 186, in Molnar's home studio, for the reenactment I used this earlier Tektronix machine, to show that her programming style was not dependent on any particular hardware, nor on any particular computing language.⁵⁹ A short, unpublished text written in 1988 mentions an IBM computer and the program MOLNART, which Molnar developed in 1974 in Fortran along with her husband.⁶⁰ This suggests that rather than reinventing the wheel with each new machine and each new language, she was building on a foundation she developed in the early days of learning to program images. Despite the Tektronix machine's capabilities for vector graphics, this was not the primary function of BASIC, which was created more for mathematical and text-based operations. For example, the popular home-computer games that were written in BASIC were mainly word-based games like Hangman.

However, the Tektronix 4052 did have its own set of functions for drawing simple vector graphics, as did many dialects of BASIC. These commands were based on a Cartesian coordinate system. More accurately, the Tektronix screen only read positive x- and y-coordinates, with a maximum of x=130 and y=100. The user could direct the electron beam, like an invisible pen or cursor, to move to any specified location by defining the x- and y-coordinates and using the command MOVE. But

⁵⁹ By 1981, the same year Molnar sketched the first zigzag, she and her husband had their own microcomputer—a personal computer—at their home in Paris. It was called the IIT 2020, a French clone of the coveted Apple II (Figure 16). Unlike the Tektronix, the IIT 2020 had no built-in screen, so Molnar had to hook it up to a television screen, which rested precariously on top, a wooden board sandwiched between the computer and its terminal to keep the machines from overheating. To use the programs she had written for the Tektronix, Molnar had to translate them into the Apple II BASIC dialect. By the time she made *Lettres de ma mère*, Molnar had replaced the IIT 2020 with a BFM 186, which again had a built-in screen, though this one no longer used an oscilloscope. It still used vector graphics that unfolded over time, line by line, glowing green against a black background. But this screen was less “sticky” than the Tektronix's—there were no physical traces of previous lines, only a slight flicker as the image rendered.

⁶⁰ Vera Molnar, “Letters of [Sic] My Mother” (1988), Carton 05: Textes: Anglais, Vera Molnar Archives.

the “pen” would only *draw* a line if a command called DRAW was used.⁶¹ BASIC also had a built-in randomness function, which Molnar used to select random (x,y) coordinates.

Unlike the mainframe computers Molnar initially learned to program on, the Tektronix had a built-in screen, an oscilloscope design called a Direct View Storage Tube (DVST) that made it unique from other late-seventies computers. Now obsolete, storage tubes were a type of cathode-ray tube (CRT) that was designed to “hold” an image for a long period of time, at a time when built-in computer memory, especially for graphics, was costly and slow. Wendy Hui Kyong Chun writes of the multifaceted function of the CRT at this moment: “the television set is not just a computer screen, but was also once its memory.”⁶²

Tektronix’s DVST design, initially developed in the late fifties, used a special plate over the face of the CRT screen that glowed continuously. To display graphics on its screen, the computer processor had to physically move the CRT beam from one specified point to another.⁶³ As their name might imply, vector graphics are very much based on movement. The electron beam has to be quite literally moved, in space, to produce an image on the screen. As we hit RUN on the keyboard, we see the beam ‘draw’ the line in real-time, like a small comet zigzagging across the screen, guiding our eyes along from left to right, as if we were reading a secret message. The graphics appear like lime-green flashes of lightning—first very bright at first, then dimming.⁶⁴

⁶¹ This logic would be made more straightforward in later graphics-based languages like LOGO, which had a “pen up” and a “pen down” function. LOGO and its use in programming pedagogy is explored in Sherry Turkle’s *The Second Self: Computers and the Human Spirit* (Cambridge, Massachusetts: MIT Press, 2005).

⁶² Wendy Hui Kyong Chun, “Always Already There, or Software as Memory,” in *Programmed Visions: Software and Memory*, Software Studies (Cambridge, Mass.: MIT Press, 2011), 168.

⁶³ “The Tektronix 4052 System,” <https://www.electronixandmore.com/resources/teksystem/index.html>.

⁶⁴ The DVST was one of the few computer screens at the time that did not ‘flicker,’ thus was relatively easy on the eyes.

As long as the Tektronix computer was running, any vector graphics or alphanumeric characters that the user drew in that session (to use anachronistic language) were essentially stored on the surface of the display, until the power was switched off again. Even when the user cleared the screen, faint traces of their ‘deleted’ graphics remained visible on the surface of the tube. The DVST was thus similar to the surface of an Etch-a-Sketch toy, only the deceptively simple task of drawing a line was even less intuitive than turning knobs left and right. With no equivalent to the delete or backspace buttons of today, the Tektronix user had to correct mistakes in their code by hitting a button marked RUB OUT, which would mask a character with an opaque, rectangular shape, like a dab of white-out on a typewritten page.

For a twenty-first century programmer, what is particularly curious about the Tektronix is the way in which images and text may coexist on its screen (**Figure 1.18**). When you type in a program, the screen does not automatically clear to make space for the graphics; rather, the graphics share space with the code, often overlapping. Moreover, there is no distinction made between the ‘pen’ and what we would think of as a ‘cursor’ in a contemporary word processor. If we instruct the computer to move its ‘pen’ to a new (x,y) coordinate location, it will display alphanumeric commands in that location. In either case, there is no visible ‘point’ as Kandinsky would describe it, only a line that is created through dynamic movement, whether the result is textual or graphic or a bit of both.

In order to draw, on the computer, a zigzagging line like the one she sketched in her notebook to mimic her mother’s handwriting, Molnar had to break it down into smaller elements—to “decompose” or atomize it. She had to tell the computer to move its “pen” (the CRT beam) to a starting coordinate, which, as her notes indicate, she made sure to place not directly in the top-left corner but slightly to the right, mimicking Erzsi’s paragraph indent in the original letters. Then, she

wrote a loop (an instruction that repeats) that would draw a diagonal line upwards, and then another line back down, moving both the x- and y-coordinates by small, random increments, so that the zigzag was slightly irregular, as if hand-drawn. Programming the computer to make these marks—a series of ups and downs, moving from left to right without lifting the pen—was thus akin to giving it a lesson in handwriting. Here is a simplified version of what the code for the first *Lettres de ma mère* might have looked like (the numbers in the first column refer to lines of code; alternating colors are only for increased legibility).

	LIST	Starts the program
2	X=15	Sets x-coordinate of "pen" to 15
3	Y=90	Sets y-coordinate to 90
5	PAGE	Clears the screen
7	MOVE 15,Y	Creates "indent" on first line of "letter"
9	L=RND(1)*30+100	Creates variable L, which refers to the length of each handwritten "line." Sets it to a random number between 30 and 130 (the maximum width of the screen). This is so that the lines are not of equal length.
10	X=X+RND(1)*2+1	Moves x-coordinate by a random number between 2 and 3
20	DRAW X,Y+RND(1)*4+2	Draws line segment by moving the "pen" to a y-coordinate located at a random number between 4 and 6.
25	DRAW X-RND(1)*3,Y	Draws another line segment back to the "base line" (y=90) by moving the x-coordinate back to the left by a random number between 0 and 3.
30	IF X<L THEN 10	Loop: repeat movement along x-axis until L (see line 9) reaches its maximum value.

40	Y=Y-10	Moves y-coordinate down the screen, creating a new “line” in the “letter”
50	X=0	Resets x-coordinate of the new line to the start position (no indent)
55	MOVE X,Y	Moves “pen” to the coordinates set in lines 40 and 50 of the program.
60	IF Y>0 THEN 9	Loop: repeat until reach bottom of the screen.
	RUN	Executes the program. ⁶⁵

The lines Molnar programmed might be called, in Klee’s terms, “hurrying” lines—lines that move from point A to point B to point C and so on. Klee, too, wanted his students to think about movement in terms of coordinates on a plane, for “the treatment of *direction*” was, for Klee, “crucial in abstraction.” He also emphasized the role of duality or polarities in his theory of form; movement was always accompanied by counter-movement.⁶⁶ This logic is echoed in Molnar’s program, as the upstroke is always accompanied by a downstroke. What goes up must come down.

Viewing Writing, Reading Art

By exploring the ambiguities between reading and looking, Molnar’s research echoes that of her husband, a perceptual psychology researcher who was also using computers in his experimental aesthetics research in eye movement. Though François Molnar was measuring eye movement in the art museum, studying how viewers looked at a Manet compared to a Mondrian (**Figure 1.19**), he was

⁶⁵ A massive thanks to Dr. Dr. Stefan Höltingen at Humboldt University for sharing his BASIC knowledge and enthusiasm for retrocomputing to work on this “reenactment,” and to computer collector Rainer Siebert for lending us his Tektronix 4052.

⁶⁶ Klee and Spiller, *Paul Klee*, 41, 73, 76. Emphasis added.

in dialogue with scholars who studied the eyes' movement in the act of reading.⁶⁷ Vera Molnar, who accompanied her husband to countless experimental aesthetics conferences where she occasionally presented her own work, recalls a study about eye movement when reading the newspaper, the *Allgemeine Zeitung*. While her husband's studies of art viewers' gazes yielded results that were "wild and furious, not at all left-to-right," the latter showed a gaze that moved like zigzags, "stubborn, monotonous, redundant, recurrent."⁶⁸ It was the latter she wanted to emulate in her pictures.

It is important to note that even when Molnar used alphabetic letters in her work, she usually *drew* them, rather than typing them. In *Histoire d'I*, a series of colored plotter drawings that echo Klee's exercises in capital letters from 1922, Molnar used the Tektronix 4052 to "draw" a matrix of capital letter *I*'s, the roman numeral one (**Figure 1.20**). In Klee's *Notebooks*, *I* stands for "a composite unit" that he repeats in a matrix to explore structural rhythms.⁶⁹ These were output to paper on a small, tabletop flatbed Tektronix plotter (**Figure 1.21**); this drawing was then reproduced in the periodical *Computers and People*, edited by Molnar's American pen pal Grace Hertlein.⁷⁰ A closer look suggests that Molnar's *I*'s are not created by keyboarding but drawn from line segments, which are then repeated, distributed, and rotated at random, in a different sort of asemic writing. Molnar takes the letter—whether alphabetic or epistolary—and evacuates its meaning, focusing only on its form. But in doing so, she draws her viewer into a particular mode of looking that is somewhere between reading text and image.

⁶⁷ Molnar mentions these studies, without citation of her husband, in her 1995 Leonardo article, page 168.

⁶⁸ Guibert, Claude, Gottfried Honegger, Vera Molnár, and François Morellet. *Art concret*. Encyclopédie audiovisuelle de l'art contemporain. Chalo Saint Mars: Imago, 1998. Consulted at BnF, 5/18/21. My translation from French.

⁶⁹ Klee and Spiller, *Paul Klee*, 195.

⁷⁰ My media archaeological re-enactment was limited to the Tektronix 4052 screen only because, due to time constraints on my and Stefan Höltnen's time at the Signallabor in Berlin, we were not able to secure the hardware that would have connected the microcomputer to a plotter. This is research that I aim to continue in the future.

In *Lines: A Brief History*, anthropologist Tim Ingold tells us that the dichotomy between writing and drawing, like the dichotomy between technology and art, is “deeply entrenched in the modern constitution.” There is a widespread belief, he notes, that writing is more “technological” than drawing, that “art creates” while “technology can only replicate,” and that “You can write with a pen but you cannot draw with a typewriter.”⁷¹ Ingold urges us to look beyond this artificial distinction between writing and drawing, instead focusing on their common mark—the line—a relationship Klee emphasized a century ago, at the height of these modern dichotomies and systemizations. Barthes, too, pointed out that not only do writing and drawing share the line; they also share a rhythmic process.⁷²

What do we make, then, of a line drawn with a computer? Handwriting simulated with a computer, then executed by the mechanical arm of a plotter? There is a clear bias against the machine-drawn line when it comes to its transmission of feeling: compared to the pencil, “The typewriter,” Ingold writes, “neither attends nor feels, and the marks that are made by its means bear no trace of human sensibility.”⁷³ Of course, this very lack of humanity is what attracted artists to the plotter—the *traceur*, in French. It could leave traces without evoking feelings or emotions—everything *l’art concret* instructed them to avoid.

Schwenger suggests that artists turn to asemic writing for its “potential to restore elements that are obliterated in the technology of the alphabet” and, crucially, its potential to “do this more effectively and eloquently than is the case with computer technology.” Asemic writing has the potential to

⁷¹ Ingold, *Lines*, 127–28.

⁷² Peter Schwenger, *Asemic*, 13.

⁷³ Ingold, *Lines*, 143–44.

“recuperate” the “expressive aspects of language that are lost in writing” by emphasizing *gesture*.⁷⁴ But in order to do so, it seems the gesture has to be manual. Can asemic writing be programmed? Does it have the same effect—the same *affect*—as handwritten gibberish? Molnar’s asemic letters certainly come close. By simply naming her mother, evoking her in the discourse around the work, and even picturing her in an accompanying computer-generated portrait (**Figure 1.22**), Molnar constructs an imaginary around the work that is far more affective than her earlier works.

Molnar wants us to believe that the *Lettres* are about pure pictorial relations, the kind of abstraction Klee taught at the Bauhaus.⁷⁵ She writes in *Leonardo* that her mother’s handwriting was simply “a pretext for working out new principles of composition,” ones outside the comfortable bounds of Gestalt psychology’s “good form.” When seen as pictures, Erzsébet’s letters went against everything Molnar had been taught about good composition, which in turn was the basis of good abstraction: “There was no symmetry, no equilibrium, no transversal, no triangle.” In other words, she borrows this “bad” form from her mother in order to question her own ingrained aesthetic biases, which she calls “cultural readymades.”⁷⁶ In the end, Molnar tells us, the mission is unsuccessful, as “The cultural ‘readymade’ triumphed” and she veered closer to familiar territory. Perhaps there is some truth to Molnar’s conclusion. But to reduce the work to an exploration of composition is to overlook the areas in which the work is most provocative.

While Molnar assures us that *Lettres* are about form and composition, the works themselves seem to tell a different story. They invite us to read between the lines, if you will, searching for meaning in the asemic writing. The strokes of the pen draw us in, only to push us away again, reminding us that

⁷⁴ Peter Schwenger, *Asemic*, 13–14.

⁷⁵ Klee and Spiller, *Paul Klee*, 73.

⁷⁶ Molnar, “My Mother’s Letters,” 169–70.

they were drawn by a computer. Unlike Chantal Akerman's film *News from Home* (1977), in which the artist reads her own mother's letters from Brussels—"I'm very tired now and look awful, but otherwise I'm fine"—over long takes of Akerman's daily life in New York City, Molnar redacts the contents of Erzsi's messages. Just as the computer-generated letters carry no semantic meaning, Molnar reveals nothing about what the original letters said, diverting our attention by focusing on their formal qualities. By the 1980s, Erzsi's script was a dying art. To the untrained eye—not to mention a reader not literate in Hungarian—the letters are just a series of blue zig-zagging marks slanting towards the top right-hand corner of the page.

Molnar may obscure the contents of her mother's text through abstraction, but she does not obscure the simple fact that these zigzags came from a personal place. Nor does she hide her discomfort in revisiting her mother's memory in such a way; "Mother, darling, forgive me," she writes in the post-script to her *Leonardo* text, expressing her guilt for potentially insulting her mother's handwriting by calling it disorderly and hysterical. In her process of abstraction, there is also a process of withholding at work. By emulating the form of a letter, and assigning its pseudo-authorship to her mother, we cannot help but imagine what the letters might say if we could only read them. As much as Molnar wants us to believe that it's merely a coincidence she produced this work on the threshold of the *Rendszerváltás*, or the end of Communist rule in Hungary, this historical context cannot be ignored. For a quarter-century, this mother-daughter relationship, once strong, was strained by geopolitical circumstances, kept alive only through these letters which, due to practices of censorship, *could* not say much at all. We cannot help but read between these lines and wonder what was left unsaid. Such a reading might seem sentimental—heavy-handed, even. But I raise these questions precisely because Molnar does not.

A Hands-on Approach

Taking a media archaeological approach to *Lettres de ma mère*, and to Molnar's work more broadly, uncovers connections between Molnar's process and the form her work takes, which might otherwise go unnoticed. Just as the letters' meanings are open-ended, Molnar's programs are not deterministic; they are not a means to a pre-determined end. Rather, they are exploratory, experimental, and generative. Taking a hands-on approach to Molnar's working method, moreover, emphasizes two key aspects of her process: collaboration and trial and error.

Even the most skilled programmer rarely works in complete isolation. Like Jennifer Roberts's research in the studio, media archaeology draws attention to the invisible labor that goes into computational artworks, which often goes uncredited. My reenactment would not have been possible without the technical expertise of media archaeologist, retrocomputing enthusiast, and microcomputer collector Stefan Hölzgen, who collaborated on my project at the Signallabor at Humboldt University's department of media studies (**Figure 1.23**). Over the years, Molnar, too, had several interlocutors who helped her write and troubleshoot her programs, giving her feedback on the technical aspects as well as the aesthetic. Does this make her any less of a computer art pioneer? In the history of computer art, Molnar's credentials as such are sometimes questioned by critics who say she did not write her own code, which is not only false and gendered but also presumes solitary authorship, which is simply unrealistic given the collaborative nature of most scientific research.⁷⁷

⁷⁷ Pierre Braun, who worked in François Molnar's experimental aesthetics laboratory as a graduate student *and* as Vera Molnar's studio assistant in the mid-1980s, recalls F. Molnar's ambition to run the Molnars' home/studio like a laboratory, of which he was the principal investigator and lead author (Pierre Braun in conversation with the author, Rennes, France, December 1, 2021). The conceptualization of collaboration in art vs. science, and the ways in which these boundaries blurred in the Molnars' (unofficial) collaborations, is outside the scope of this dissertation but remains to be explored in my further research.

Just like her earlier work with computers, Molnar's 1980s graphics were made conversationally, in a process of back-and-forth between woman and machine. Rarely did she set out with a pre-conceived plan for a drawing; rather, it was very much a process of trial and error, of tinkering with the program or the parameters until she reached a desired outcome. As she continued to use the computer screen in her programming process, Molnar continued to intervene in the course of her programs and made adjustments to them as she went along—which not only set her apart from her contemporaries, but also broke the historic rules of *l'art concret*.

At the same time, working hands-on with these machines—even thirty or forty years after their heyday—raises the question of whether working strictly programmatically, with no intervention whatsoever, is even possible. It very well might be an idealistic model for generative or programmed art. It also raises a question that continues to come up in contemporary discourses on generative art: what is the difference between tinkering with a program, and tinkering with the parameters? Should we consider this tampering, or cheating, even? Studying Molnar's processes by reconstructing them attends to many of these questions, but of course does not provide answers.

But let us consider the concept of machine learning in artificial intelligence (AI): teaching a machine how to do something, and then letting it do that thing, and other similar things, on its own without further instruction. Molnar teaches the machine to write, or to draw, in pseudo-cursive, giving it just enough agency (through randomness) to generate unexpected possibilities. But does the machine really learn? By today's AI standards, it does not; in the end, Molnar does not cede her control, but continues to input, to tinker, to intervene in her programs. Again, we are prompted to wonder, who is the author of these letters? Who is the artist? Does it really matter?

Writing Back

In her many decades of correspondence with her mother, Molnar felt—like many adult children—guilty that she did not write to her mother often enough. Erzsi wrote weekly; Vera wrote back only once every ten days, at best. While Molnar’s letters to her mother are lost to history, we see a sort of response in what she calls the *contre-écritures* (counter-handwriting). In this version of the *Lettres*, two colors are used to draw alternating lines, their directions inverted. While this presents a sort of equal-sided conversation between two correspondents, another variation on the series, *Main et machine* (*Hand and machine*, **Figure 1.24**), involves Molnar’s hand-drawn interventions on top of the computer-generated “simulation” of her mother’s handwriting. Taking a blue pen of her own, Molnar adds her own zigzagging marks. Sometimes the two modes of mark-making are indistinguishable. Sometimes the hand-drawn line overpowers its computer-drawn counterpart, as the two entangle into entropic chaos.

Here, Molnar picks up a conversation that she began at least a decade earlier—a conversation between the plotter’s robotic arm and her own hand. *Which line is which?* she provokes us to ask. Is one inherently better than the other, more interesting, more aesthetically valuable? In her characteristically playful style, Molnar seems to suggest it doesn’t matter, poking fun at any sort of hierarchy between the handmade and the machine-made. Her pseudo-cursive is both recursive and discursive. It is a conversation with her mother, yes, but it is also a conversation between Molnar the artist and Molnar the programmer. It is in the misalignment of these approaches that Molnar’s own “misexpertise,” to return to Roberts, emerges. By simultaneously learning coding and teaching drawing, Molnar maintains an open-ended and experimental approach to programming abstraction.

Barthes declared the death of the author around the same time that Molnar began working with

electronic computers. Molnar's title ambiguously attributes the authorship of the letters to her late mother, while the actual draughtsman, the plotter, was never alive. Molnar's abstraction withholds certain information, but this withholding leaves room for a multitude of interpretations. Perhaps for her, *Lettres de ma mère* was an exercise in composition, but by bringing it into the present, by retracing those marks and rewriting those lines of code, a multitude of new meanings emerges. Without saying anything at all, Molnar's asemic writing makes porous those boundaries that separate art from science, writing from drawing, reading from looking, and East from West. It was not exactly the kind of "universality" that the Concretists imagined for their abstraction half a century prior, but it is not too far off, either. ■

Chapter 2

Love Story: Conversations with the Computer Screen

Stephen A. Coons: We're going to show you a man actually talking to a computer in a way far different than it's ever been possible to do before.

Television reporter: Truly not with his voice?

S.A.C.: No, he's going to be talking graphically. He's going to be drawing. And the computer is going to understand his drawings. And the man will be using a language, a graphical language.

—Co-director of the computer-aided design group at MIT demonstrating Ivan Sutherland's *Sketchpad*, c. 1962¹

Using the Tektronix 4052 was not Vera Molnar's first stab at computer programming. In 1968, after a decade of working with the *machine imaginaire*, executing algorithms by hand, she accessed a mainframe electronic computer through her friend Pierre Barbaud, a composer who was in residence at the Bull computer manufacturer in Paris.² Molnar's earliest "computer-aided" artwork, as she called it, was not a plotter drawing, but a handmade drawing, a square grid that was, like a game of Paint by Numbers, colored in by hand according to a list of numbers generated by the computer (called a *listing* in French) (**Figure 2.01**). Molnar had wanted to experiment with random color distribution, but soon realized that the Bull machine was not equipped to make color images, and was disappointed with this hand-colored image, which she found messy and ugly.³ Perhaps the

¹ *The Story of Computer Graphics* (ACM SIGGRAPH, 1999).

² Groupe Bull is a French computer company that between the 1960s and 1980s had ownership relations with General Electric, Honeywell, and NEC Corporation.

³ Vera Molnar in conversation with the author, Paris, October 21, 2021; conversation between Vera Molnar and Wolf Lieser, director of DAM Projects, about Molnar's artwork "1 des premieres images d'après listing – BULL 1968" during Lieser's visit with the artist in Paris, October 2021, <https://dam.org/museum/discoveries-vera-molnar-audio/>.

image looked *too* handmade, not having the crisp, clean-cut aesthetics associated with computing technology.

Shortly thereafter, Molnar sought out a computer lab with better graphics resources: the Centre inter-régional de calcul électronique (CIRCÉ) in Orsay, just south of Paris, which had a partnership with the Sorbonne and the Centre national de la recherche scientifique (CNRS), with which her husband's laboratory was affiliated.⁴ Unlike Barbaud or the American computer art pioneers such as Lillian Schwartz who had formal positions at Bell Laboratories, Vera Molnar never had an official role at CIRCÉ. She negotiated with the laboratory director, who allowed her to come in on weekends and weeknights to use any leftover time in the time-sharing system without paying the steep costs.⁵ In fact, her 1970s plotter drawings have timestamps that give the hour of calculation, specified to the millisecond, which mostly indicate they were made on Wednesday evenings and Saturdays, while most of the engineers were out of the office.⁶

Over the course of the following decade, the computer lab at Orsay became Molnar's studio.

CIRCÉ had both a flatbed plotter and a drum plotter, allowing Molnar to experiment with different

⁴ Originally called the Centre Interdisciplinaire régional de calcul électronique d'Orsay, CIRCÉ was renamed Centre Inter-régional de Calcul Électronique on July 16, 1973 (Ministère de l'Éducation Nationale and Centre National de la Recherche Scientifique (CNRS). "Textes Constitutifs : Centre Interdisciplinaire Régional de Calcul Électronique," June 5, 1969. Orsay, Centre inter-régional de calcul électronique (CIRCÉ). Archives nationales de France).

⁵ Vera Molnar in conversation with the author, Paris, France, 27 February 2021. It was not until the late 1970s that Molnar had an official role at a computer lab: the ARTA at the Centre Pompidou, which I explored in Chapter 1. Molnar frequently tells an anecdote about the first time she asked for permission to use the computer lab: "I explained to the head of the [CIRCÉ] centre that I wanted to try to make art with a computer. He gave me a look and I had the feeling that he was considering whether he should call for a nurse to sedate me or lock me up or something. Later, when I got to know this man, he told me: 'I said yes to you because I thought of a famous quote by Voltaire, the one where he says: "I completely disagree with everything that you are saying but will defend until my death your right to do or say or write what you have in mind"', and so he said yes." ("Vera Molnar in Conversation with Hans Ulrich Obrist." In *Bookmarks: Revisiting Hungarian Art of the 1960s and 1970s*, edited by Hans Ulrich Obrist and András Szántó, Koenig Books, 2018: 78).

⁶ I would like to thank Florent Paumelle of ONIRIS Gallery in Rennes, France, for drawing my attention to these timestamps, which I deciphered using EpochConverter.com.

paper sizes, inks, and algorithmic methods over the course of the following decade. It was in late 1972 that the lab acquired a new piece of peripheral hardware that would transform Molnar's practice: an IBM 2250 CRT display unit, or an early computer screen (**Figure 2.02**).⁷ Using this CRT display and a program called MOLNART, which she wrote in Fortran in collaboration with her husband, Molnar used the mainframe computer to 'draw' two perfect squares, which appeared on the screen in acid green lines against a black background.⁸ Molnar used the computer to manipulate these shapes, giving it instructions to displace each corner of the squares until their forms were no longer recognizable as such. With slight adjustments to the parameters of her program, she made the two squares twist and turn, converging and diverging in a sort of dance for two. Molnar captured these movements in over six hundred plotter drawings (**Figure 2.03**), entitled *Love Stories*, as well as a set of photographs she took of the computer screen, which I anachronistically refer to as 'screenshots,' following architectural historian Matthew Allen. As Allen observes, the word screenshot did not appear in print before 1983. The term is derived from *snapshot*, an informal photograph. Unlike screenshots today, Molnar's photos were taken not with the computer itself, but with an external photographic camera pointed at the CRT screen.⁹

Molnar selected a handful of these screenshots to appear in one of her earliest artist's books, *Love-Story (à l'ordinateur)* (1974, **Figure 2.04**) which she described as a "computer-picture book" or a

⁷ Ministère de l'Éducation Nationale and Centre National de la Recherche Scientifique (CNRS), "Rapport au comité du Direction du CIRCÉ," October 20, 1972, Archives nationales de France. This was the same year that the institute replaced their mainframe computer, an IBM system/360, with an IBM system/370.

⁸ Molnar specifies the program used in the August 1976 issue of *Computers and People*, page 19. Cécile Welker cites Molnar as one of the earliest computer programs made for image generation in "Early History of French CG," *Leonardo* 46, no. 4 (2013): 380. The programming language Fortran was, like the graphics display, considered an essential step forward in facilitating "man-machine communication," for it "permitted the user to express mathematical concepts for computer processing in symbols and syntax close to ordinary language" (William H. Desmond *Conversational Graphic Data Processing System: The IBM 1130/2250* (Englewood Cliffs, N.J.: Prentice-Hall, 1969, 2-3).

⁹ Matthew Allen, "Representing Computer-Aided Design: Screenshots and the Interactive Computer circa 1960," *Perspectives on Science* 24, no. 6 (2016): 637–68.

“*livrimage*,” a portmanteau of *livre* (book) and *image* (picture).¹⁰ While Molnar made several *livrimages* over the course of her career, *Love-Story* is unique in that it is made up of photographs rather than plotter drawings or silkscreen prints. The accordion-fold book includes no text other than its provocative title, which anthropomorphizes the squares and invites a narrative reading of its images. The rumpled corners of the squares seem to gesture like hands, reaching towards each other. The squares bend in and out of shape, bowing and spinning around one another like dance partners. The shapes twist, tangle, and intertwine, only to pull apart again. Unlike the gendered, heteronormative love stories between geometric shapes in Edwin Abbott Abbot’s *Flatland* (1884) or Norman Juster’s *The Dot and the Line: A Romance in Lower Mathematics* (1963), Molnar’s protagonists are both squares, cut from the same cloth but behaving in different ways, sometimes erratically, never leaving one another’s side.

Molnar’s title prompts us to wonder: whose love story is this? One interpretation might be that the two squares represent the artist and her husband François Molnar, who was her primary interlocutor and collaborator until his death in 1993 (**Figure 2.05**). François, who met Vera at art school during the Second World War in Budapest and collaborated with her in the 1950s, stopped making paintings around 1960 to devote himself to “the science of art,” specifically experimental psychology research. He became an expert in eye movement, studying phenomena such as how the gaze moves around paintings, whether abstract or figurative. The Molnars’ practices were divergent but

¹⁰ Turning these images into a book might be read as an art historical reference to El Lissitzky’s *About Two Squares* (1922). Molnar’s title, *Love-Story*, however, was a tongue-in-cheek reference to the pulp novel by American author Erich Segal, that was all the rage in Paris after its French translation was published in 1971 (Molnar in conversation with the author, November 14, 2020). Molnar made another *livrimage* the same year titled *Out of Square*, which focuses on the transformation of a single square using semi-transparent tracing paper that allows the viewer to see multiple iterations of the image, layered upon one another. Art historian Rheagan Martin observes a similar technique, which he terms *transfoliate* images, used in fifteenth-century books printed in Venice (Rheagan Eric Martin, “Printed, Painted, and Illuminated: Visual Culture at the Dawn of Print,” Ph.D. dissertation, University of Michigan, 2023).

intertwined, mutually influential and always bearing traces of one another's thinking. We might say, then, that the two squares represent their two domains, science and art, converging in their shared interest in abstract computer graphics.

Another interpretation, which I entertain in this chapter, is that this book tells another love story: that of the artist falling in love with the computer screen. By capturing these ephemeral on-screen images, *Love-Story* registers a pivotal moment in Molnar's career, and in early computer graphics more broadly, which has been overlooked in both art history and the history of technology: the advent of the computer screen and the shift that it signaled from "blind" computing to interactive computing. In this chapter, I look at the material traces of this shift in Molnar's oeuvre, focusing on her most prolific years of 1974 to 1976, when she was experimenting with the IBM 2250.

I pay particular attention to the computer graphics that Molnar organized into book formats, namely *Love-Story* and the catalogue from her first solo exhibition, *Transformations* (1976), at the Concourse Gallery of the Polytechnic of Central London, an exhibition space within an academic institution. Reading these books alongside Molnar's writings about her practice, I consider how the computer screen and interactivity transformed her process. This chapter meditates on Molnar's "conversational" method, her neologism for describing a controlled mode of working with a mainframe computer, a plotter, and a CRT screen.

Molnar first introduces the term "conversational" in her article "Toward Aesthetic Guidelines for Paintings with the Aid of a Computer," written in 1974 and published in 1975 in *Leonardo*. Molnar often borrowed terms from science and technology to describe her processes, and this one was likely loaned from computational discourse. I argue that "conversational"—an imperfect translation of the

French term *conversationnel*—referred to interactive computing. She leaves the term in scare quotes throughout her writing, maintaining its foreignness to the domain of art while also using it to name a new way of making pictures. “Conversational,” I suggest, is another word for interactivity, a key term in computing as well as in postwar art practices. I argue that by embracing the interactive possibilities of the early computer screen, Molnar developed a new method of working iteratively that reshaped approaches to generative art and led to new insights about the creative process.

At the same time, Molnar’s “computer-aided” painting practice remains engaged in themes central to postwar geometric abstraction, namely questions of seriality, systems, and subjectivity. Interactivity transformed not only Molnar’s painting practice but also her *aesthetic* practice, as it allowed her to conduct controlled, systematic experiments about artistic decision-making.¹¹ Drawing on feminist science and technology studies, I also suggest that Molnar extended the usage of the computer screen beyond its intended purposes, using it to not only create graphics but also to investigate the process of making pictures. She used the tools of early interactive computing not to glorify technological advancements, but rather to point to the limitations of computer-generated art and those aspects of the creative process that could *not* be automated. By centering Molnar’s process, specifically her conversations with the computer, this chapter proposes an expansion of what is traditionally considered the art object or the object of inquiry in art history.

Programming in Real-Time

As I discussed in my introduction, Molnar’s art was already programmed even before she had access to a computer. In the artist’s words, her process has, since the late 1950s, hinged on two key actions:

¹¹ I use the term *systematic* to maintain consistency with Molnar’s own descriptions of her method. Whereas *systemic* more generally describes something relating to a system (as opposed to a particular part), *systematic* means “done or according to a fixed plan or system; methodical.”

comparison and evaluation. She works systematically and serially, producing multiple iterations of the same image, modifying only one variable at a time, and comparing successive images. In the 1975 *Leonardo* text, Molnar describes her systematic process as follows:

I develop a picture by means of a series of small probing steps and each step is followed by evaluation. [...] I alter in a stepwise manner the dimensions, proportions and arrangement of the shapes. [...] By comparing the successive pictures resulting from a series of modifications, I can decide whether the trend is toward the result that I desire.¹²

When Molnar first began using the computer to make her series, she couldn't see what she was doing. At that time, computing was a 'blind' process, meaning that programmers had to give instructions to the computer using the numbers on a punch card (**Figure 2.06**). She had to wait hours—sometimes days—to see the results of her programs, which had to be output to paper using a plotter. Often the programmer was far removed from the material process of computer graphics, simply dropping off their instructions via punch cards and picking up the plotter drawings from a lab technician the next day. This mode of computing was called *batch processing*, meaning programs (or jobs) could be run in batches automatically. Once users submitted their jobs, no user interaction was required to process the batch. This period was characterized by long periods of waiting around, during which the computer was often *en panne*, or out of order.¹³ In other words, Molnar's process of comparison and evaluation was slow, its timing very much

¹² Vera Molnar, "Toward Aesthetic Guidelines for Paintings with the Aid of a Computer," *Leonardo* 8, no. 3 (1975): 186.

¹³ Molnar recalls that when she first started working at the Orsay computing center, the computer was almost always *en panne* or troubleshooting; she spent most of her time at the lab waiting, drinking coffee out of an automatic coffee dispenser (Vera Molnar and Atelier de création radiophonique sur le Festival des arts électroniques de Rennes, *Entretien Avec Vera Molnár, Enregistrement de l'installation de Alain Fleischer, de Valère Novarina*, 1988, Fonds d'archives Klonaris/Thomadaki, Bibliothèque nationale de France, Archives et manuscrits.). A student film made at Stanford in 1967 satirized the amount of time spent waiting in these early days of computation (Ellis D. Kropotchev "Silent Film," Computer History Museum, <https://www.computerhistory.org/revolution/punched-cards/2/211/2253>). While time-sharing decreased these waiting times, there were still 9 hours 40 seconds of "*pannes*" recorded in CIRCE's February 1974 report. (Ministère de l'Éducation Nationale and Centre National de la Recherche Scientifique (CNRS). "Rapport au comité du Direction du CIRCÉ," October 18, 1974. Archives nationales de France, 37)

out of her control.

This all changed with the advent of time-sharing systems in the 1970s, which replaced batch processing as the dominant mode of mainframe computing. Multiple users could interact concurrently with the same central computer by using individual terminals. Prior to the advent of personal computing in the mid-1980s, computers were still massive mainframe machines, only available to military complexes, well-funded private corporations, and public research institutions like CIRCÉ. Initially developed in the 1950s in the United States, time-sharing aimed to optimize the frustrating delays in batch processing by relying on a group of users to make efficient use of the same computer. While one user idled about, another could take advantage of the ‘free’ computer to input their instructions. Historian of technology Thierry Bardini argues that time-sharing was “a necessary step toward interactive computing.”¹⁴

Interactive computing, as theorized by psychologist J.C.R. Licklider, referred to “real-time, two-way exchanges across the interface between user and machine.”¹⁵ While real-time processes may refer to the microtemporalities of computers, which are black-boxed—that is, not visible or perceivable by the user—the notion of real-time programming introduced through time-sharing was, in practice, very visible.¹⁶ For what is often left out in conversations about time-sharing is the role of *visualization*. While the history of art has been biased against computers, the history of

¹⁴ Thierry Bardini, *Bootstrapping: Douglas Engelbart, Coevolution, and the Origins of Personal Computing* (Stanford, Calif.: Stanford University Press, 2000), 29.

¹⁵ Bardini, 19.

¹⁶ Building on the media archaeological concept of microtemporalities and “the free, measureless consciousness that Bergson called ‘duration,’” Ina Blom notes that “Real-time technologies operate on the single plane of the present as mechanisms that receive and return movement, contracting and dilating time matter by transforming asignifying flows into signifying flows (signals and code): these are then also the key machineries at work in the industrial organization and exploitation of memory” (Blom, Ina, Trond Lundemo, and Eivind Røssaak, eds. *Memory in Motion. Archives, Technology, and the Social*. Amsterdam University Press, 2016, 17).

computing has been equally biased against the visual. According to media historian and theorist Bernard Geoghegan, media theory and visual culture scholars widely believe that “the computer is not a visual device,” following Friedrich Kittler, who famously stated that computers were “not designed for image-processing at all.”¹⁷

Geoghegan disputes this narrative by pointing to the military roots of computer screens, locating their origin in the radar screen, which was developed for naval artillery control systems. He shows how systems like the Semi-Automatic Ground Environment (SAGE), the computerized radar defense system developed by the US Navy, relied on real-time feedback from human observers who responded to what they *saw* on screen, giving rise to “a new kind of interactive image.”¹⁸ By looking closely at Molnar’s response to interactive images, I suggest that her practice is intertwined with the history of computer graphics, just as it is in dialogue with the history of geometric abstract painting.

The CIRCÉ laboratory’s switch to a time-sharing system in the early 1970s coincided with their acquisition of an IBM 2250 CRT graphics display, a computer graphics terminal or *écran de visualisation* in French.¹⁹ Made of the same hardware as a television set, minus the antennae for

¹⁷ Bernard Dionysius Geoghegan, “An Ecology of Operations: Vigilance, Radar, and the Birth of the Computer Screen,” *Representations*, 2019, 60–61. Geoghegan shows how the plotter, too, had naval origins, in a machine called the Battle Tracer (68). Computer art is not the only screen-based medium that has its origins in radar equipment. Christine Mehring also locates the origins of Karl Otto Götz’s abstract paintings in his wartime work with radar screens, in “Television Art’s Abstract Starts: Europe circa 1944-1969,” *October* 125 (2008): 29–64.

¹⁸ Geoghegan, “An Ecology of Operations.”

¹⁹ An October 1972 report is the first to mention “l’unité de visualisation” labeled « 2250 » (“Rapports au comité du Direction du CIRCÉ,” October 20, 1972, Archives Nationales de France). Molnar’s first mention of the *écran cathodique* is in her 1973 lecture “L’œil qui pense,” written for the SIGMA festival in Bordeaux). CIRCÉ mentions implantation of its time-sharing option for use of “conversational terminals (*terminaux conversationnels*)” in 1973 (Ministère de l’Éducation Nationale and Centre National de la Recherche Scientifique (CNRS). “Rapport au comité du Direction du C.I.R.C.É,” October 23, 1973. Archives nationales de France, 11).

receiving signals, it could be hooked up to a mainframe computer, in this case an IBM System/370, along with other peripheral devices such as a plotter. As its French name indicates, the CRT screen was used to visualize the results of a program, to translate instructions in alphanumeric code into the visual language of vector graphics.

Like the screen of the later Tektronix 4052 microcomputer, which we explored in the previous chapter, the IBM 2250 was a vector display, which meant it had electron guns that could draw lines between two points using an electron beam. The display could generate images of straight lines, points, and characters on a surface of about 30 x 30 centimeters.²⁰ Most promotional images of the IBM 2250 show users manipulating images directly on screen with a stylus called a light pen or light gun. Curiously, Molnar never used this tool, opting to instead ‘draw’ forms by inputting alphanumeric commands or instructions with a keyboard. Perhaps the light pen was too direct for Molnar, as it would not have left room for the semi-autonomous input of random numbers the way ‘keyboarded’ instructions could. In other words, it would not have been as generative. Given that the IBM 2250 was developed for “problem-solvers” like “structural analysts, electrical engineers, systems programmers, and social scientists,” it was not only the hardware that transformed Molnar’s process; she, too, pushed the capabilities of this technology beyond its intended use.²¹

The CRT screen was a game-changer for Molnar, and the most amazing thing about it was its speed. While a plotter took minutes or hours to output an image, depending on its complexity, the CRT did this in seconds. Although these screen-based graphics were slower to render than those we are accustomed to viewing today (the user still had to watch a square being ‘drawn’ in real-time), they

²⁰ “IBM 2250 Display Unit,” accessed March 31, 2018, <http://www.ibm1130.net/functional/DisplayUnit.html>.

²¹ IBM and Pacific Productions, *Frontiers in Computer Graphics*, 1967; Judy Wajcman, *Feminism Confronts Technology* (University Park, Pa.: Pennsylvania State University Press, 1991).

were comparatively lightning-fast. She could preview images on screen and, crucially, make adjustments to them, before committing anything to paper. This shift in the temporality of programming graphics catalyzed a new method of working with computers, which Molnar named the “conversational” method:

[I]nstead of making a parameter change and then waiting for a drawing to be plotted [...] I make the parameter changes *quickly* while viewing the images on the CRT screen. [...] I select only a few of the images shown on the screen for recording by the plotter.²²

This seemingly small technological shift was not only transformative to Molnar’s creative process. By encouraging users to develop one-on-one, interactive relationships with the computer, the advent of time-sharing and the visualization screen gave rise to the independent, active user as we conceive of them today. The CRT screen gave users a newfound sense of subjectivity vis-à-vis the computer. Instead of waiting around for results, users received feedback in real-time. The user could also intervene during the course of a calculation—that is, rather than having to wait for the program to finish running, they could stop it mid-run to make changes.²³ While this is not unlike erasing and re-drawing using traditional materials, Molnar emphasizes here that her conversational method allows for a *systematization* of this traditional process and, crucially, permits her to “go back”—that is, to repeat drawings that had appeared before certain modifications were made.”²⁴ To use more anachronistic language, Molnar could use the conversational method to ‘toggle’ back and forth between different iterations of an image, comparing and evaluating successive versions of a picture.

²² Molnar, “Toward Aesthetic Guidelines for Paintings with the Aid of a Computer,” 187. Emphasis added.

²³ Le Trésor de la Langue Française Informatisé, “CONVERSATIONNEL,” Centre National de Ressources Textuelles et Lexicales, 2018, <http://www.cnrtl.fr/definition/conversationnel>. An engineering thesis by Nguyen Trung Nhu (1973) refers to the IBM 2250, used in the computer-aided design of a circuit, alternately as “*un dispositif* [device] *conversationnel*” and “*une console de visualisation*.”

²⁴ Molnar, 188.

While the advent of the CRT screen looms large in Molnar's experience of early computing, it has been largely overlooked in the history of digital art and in the history of technology more broadly. Though other artists have noted this shift to "immediate feedback" brought on by the CRT, none were as impacted by it as Molnar was.²⁵ Manfred Mohr and Jean-Claude Marquette, both based in Paris in the 1970s, used computers to make art but admit the screen changed nothing for them.²⁶ Frieder Nake also claims he never used the screen when it was an optional terminal.²⁷ By contrast, Vera Molnar remembers the first time she used a computer screen like it was yesterday. Since she seemed to be the only one at the lab who was interested in using it, she was convinced it had been invented for her. The moment has come to loom large in her personal mythology, a "rebirth" akin to the day she moved to Paris.²⁸

Conversational Computing

If batch processing felt like snail mail, time-sharing was like a face-to-face conversation. However, in the 1970s, human-computer interaction was far more rudimentary than the graphical user interfaces (GUIs) we use today, where we navigate windows with a mouse, tablet, or finger. By 1993, video game designer Brenda Laurel observed that the "human-computer interface" had already become synonymous with the computer screen. But this was not always the case. Laurel draws on user interface designer John Walker to sketch a history of human-computer interaction:

In the beginning, [...] there was a one-on-one relationship between a person and a computer through the knobs and dials of on the front of massive early machines like the ENIAC. The advent of punch cards and batch processing replaced this direct human-computer interaction

²⁵ A. Michael Noll, an American researcher at Bell Labs, mentions the "possibility of "[almost] immediate [visual] feedback" with the graphics console and the artist's use of this feature ("Art Ex Machina," *IEEE Student Journal* 8, no. 4 (1970) 12-13).

²⁶ Manfred Mohr in conversation with the author, New York City, August 3 and 7, 2018; Jean-Claude Marquette in conversation with the author Paris, July 2, 2021.

²⁷ Frieder Nake in conversation with the author in Bremen, Germany, February 9, 2022

²⁸ Vera Molnar, phone call with the author, August 30, 2017.

with a transaction mediated by a computer operator. Time-sharing and the use of ‘glass teletypes’ reintroduced direct human-computer interaction and led to the command-line and menu-oriented interfaces...²⁹

This last iteration is what became known as “conversational” computing, as a metaphor of conversation or dialogue was used to describe the interaction between the computer and its user. Laurel is quick to point out that this was a very simplistic understanding of conversation, a “tit-for-tat” interaction of “linearized turn-taking.”³⁰ It was a far cry from conversation in natural language. Still, the conversation metaphor became the basis of marketing campaigns that painted the screen as not just the interface of human-machine communication, but also the face of the computer itself. Users were already encouraged to conflate the screen with the computer, even prior to the black boxing of computer processes as we know it today. And in so doing, they were encouraged to think of the computer as a conversation partner.

IBM’s promotional footage for the 2250 CRT display (1967) boasted that this new terminal could bring “man and computer into a more active partnership.”³¹ In his book *A Conversational Graphic Data Processing System: The IBM 1130/2250* (1969), William H. Desmonde noted that while “intimate communication between ourselves and these machines” was already required to harness the “enormous processing power of computers,” advances in “graphic-input-output devices constitute[d] a further advance in the capacity of man to converse easily and fluently with computers.”³² The first computer to use a CRT (more precisely, an oscilloscope) as a graphical output device was the American vacuum tube computer called the Whirlwind, in late 1949. While

²⁹ Brenda Laurel, *Computers as Theatre* (Reading, Mass.: Addison-Wesley Pub. Co., 1993), 2–3.

³⁰ Laurel, 3.

³¹ IBM and Pacific Productions, *Frontiers in Computer Graphics*, 1967, <https://youtu.be/6bI164G26dg>; Bardini, *Bootstrapping*.

³² William H. Desmonde, *A Conversational Graphic Data Processing System: The IBM 1130/2250* (Englewood Cliffs, N.J.: Prentice-Hall, 1969), 2–3.

CRT screens became a fixture of American computer labs by the mid-1960s, there was typically at least a two-year lag in bringing these technologies to Western Europe.³³ A French manual of interactive computer graphics published in 1976 presented the CRT screen as an “ideal tool” for approaching “symbiosis between Man and machine,” suggesting that this partnership could produce results beyond anything that neither human nor machine intelligence could achieve on their own.³⁴

The notion of “man-computer symbiosis,” this biological re-framing of the relationship between computer and user, following Linklider, who worked on SAGE and was part of Norbert Wiener’s cybernetics circle at MIT, was a major departure from previous discourse, which had compared this relationship to that of a slave and master—language that the field of computation is still in the process of rewriting.³⁵ Ideologically, the architects of interactive computing, including Linklider and Douglas Engelbart, aimed to level the hierarchy between humans and machines, instead suggesting they were equal players in a greater ecosystem.³⁶ This was, unsurprisingly, a very cybernetics-influenced model.

The advent of interactivity raised an important question: was the computer a *tool* for artists, in the way of the paint tube or the camera obscura, or was it more like a collaborator? Discussions of human-computer interaction ran parallel to early research in artificial intelligence (AI), which made

³³ A. Appel, T.P. Dankowski, and R.L. Dougherty, “Interactive Graphics in Data Processing,” *IBM Systems Journal* 7, no. 3/4 (1968): 178; Richard A. Guedj, “The Challenge of Computer Graphics in Continental Western Europe,” in *Proceedings of the IEEE*, vol. 62, 4, 1974, 421–28.

³⁴ « *La Visualisation Graphique Conversationnelle apparaît alors comme l'outil idéal pour approcher d'une réelle symbiose entre l'Homme et la machine, parce que, employant une forme d'expression iconographique, elle fait appel au seul moyen de communication universel.* » Pierre Morvan and Michel Lucas, *Images et ordinateur: introduction à l'infographie interactive* (Paris: Larousse, 1976), 11. My translation. See also “Man-Computer Symbiosis,” in *IRE Transactions on Human Factors in Electronics* (March 1960), 4-11.

³⁵ For a discussion of biological metaphors for computing, especially as they relate to memory, see Wendy Hui Kyong Chun, “Always Already There, or Software as Memory,” in *Programmed Visions: Software and Memory*, Software Studies (Cambridge, Mass.: MIT Press, 2011).

³⁶ Bardini, *Bootstrapping*, 19–21; Geoghegan, “An Ecology of Operations: Vigilance, Radar, and the Birth of the Computer Screen,” 86.

many scientific and public imaginations run wild. As soon as the computer had a face, it was only a short leap to think it would soon have a mind of its own. Molnar's writing shows a resistance to this new understanding of computers. Though her husband's bookshelf was filled with books on AI that anthropomorphized these machines (**Figure 2.07**), Molnar distanced herself from the idea that computers were electronic brains who could think for themselves.³⁷ She entertained the idea at conferences and dinner parties, but she maintained that it was silly to attribute intelligence to a series of large containers with tapes whirring inside them. If the computer was a person, Molnar would dryly joke, it was merely a subhuman artist's assistant, a "slave" that would do whatever she wanted without complaint. In a 1981 television interview, Molnar daydreams in her living room/studio about "a robot called Vera Molnar." Robot Vera Molnar, she tells the camera with a sly grin, would "work all night like a slave doing whatever I want."³⁸ Perhaps unintentionally, she invokes the master-slave model that maintained her power over the machine. She insists that for her, the computer was always merely a tool, no different from a ruler or a pair of dice.

Molnar's screenshots, however, tell a different story. There is an intimacy, a softness that is missing from the artist's plotter drawings with their crisp, machine-drawn lines. There is also a sentimentality to these images. While Molnar does not consider the 'screenshots' to be works of art, she has held onto them over the years, tucking them away in her archive alongside snapshots of family and friends, suggesting that she embraced the advent of interactive computing more than she has let on. After all, Robot Vera Molnar could not work alone; she was always in dialogue with her human

³⁷ Even Morellet swallowed these ideologies, writing, in 1965, "increasingly powerful new machines, electronic brains, are appearing, which could replace the artist in a considerable part of his work." François Morellet, "Le choix dans l'art actuel [1965]," in *GRAV, Groupe de recherche d'art visuel, 1960-1968: stratégies de participation: Horacio Garcia Rossi, Julio Le Parc, François Morellet, Francisco Sobrino, Joël Stein Yvaral: 7 juin-6 septembre 1998, Magasin--Centre d'art contemporain de Grenoble*, ed. Yves Aupetitallot (Grenoble: Le Magasin, 1998), 168.

³⁸ Fabienne Wiazemski, *Un Peintre et Son Robot*. Expressions, 1981 (INA, BnF).

counterpart.

By embracing interactivity, Molnar moved in a different direction from her peers in both digital art and system(at)ic painting. For Molnar, the computer was not human, but it could bring us closer to understanding human creativity. Though Molnar saw the computer as no more than a tool, I argue that, for her, the computer's *peripheral* devices—especially the CRT display—took on a different role: the more active role of interlocutor.³⁹ Molnar could not complete her pictorial experiments, nor her series of images, without having these on-screen visualizations to respond to in real-time. The screen allowed her to visualize what she would soon name “unimaginable images,” echoing Max Bill’s notion of using mathematics to visualize “almost unimaginable hypotheses.”⁴⁰

Molnar’s embracing of interactivity extended beyond the computer. Once she had a series of plotter drawings, she would lay them on the floor and make further comparisons, deciding on a sequence to show the images and occasionally going back to the computer to make more, repeating parts of the process until she was satisfied.⁴¹ In the artist’s writing, we learn that the image(s) Molnar selected to

³⁹ While Molnar never explicitly refers to the computer as an interlocutor, her attitude is not drastically different from that of Manfred Mohr, who in 1971, also in Paris, wrote, “Accepting that creative work is an algorithm which represents a human behavior in a given situation, it is natural to ask: how is such an algorithm built up, and which precise mathematical laws could be extracted for later use in different circumstances? If one is now curious enough to look for his own aesthetical parameters, he is ready to engage in an interesting line of research. These considerations led me to use the computer as a PARTNER in my work.” Manfred Mohr, *Computer Graphics: Une esthétique programmée (exposition du 11 mai-6 juin 1971, a-r-c musée d’art moderne de la ville de paris)* (Paris: A-R-C Musée d’Art Moderne de la Ville de Paris, 1971), 36. Emphasis in original.

⁴⁰ Vera Molnar, “Unimaginable Images” (Paris, February 8, 1977), Carton 05: Textes: Anglais; Vera Molnar, “Elképzelhetetlen Képek / Inconceivable Images (Artist’s Statement),” in *Vera Molnar. Lignes, Formes, Couleurs, Cat. Exhib. Vasarely Múzeum, Budapest* (Budapest: Vasarely Múzeum, 1990), 16, <http://dam.org/artists/phase-one/vera-molnar/artist-s-statement>; Max Bill, “The Mathematical Approach in Contemporary Art (1949),” in *Theories and Documents of Contemporary Art: A Sourcebook of Artists’ Writings*, ed. Kristine Stiles and Peter Selz (Berkeley: University of California Press, 1996).

⁴¹ The floor was Molnar’s preferred surface for arranging series of images, not only plotter drawings but also collages and other works on paper. In her archive, there are over a dozen photos of her from 1988 onward using the floor to arrange images, though this was a practice she developed much earlier. To this day, she continues to use the floor at her assisted living home to determine sequences in her series.

document, whether with a plotter or a camera, were those compositions that “pleased” her. The pivotal role of aesthetic pleasure here seems paradoxical to Molnar’s methodical, systematic process. There is a tension between the construction of an ‘objective’ experiment and the role of the artist’s subjective preferences in their decision-making process. I suggest that this paradox or tension is precisely what Molnar’s aesthetic experiments seek to investigate. We will return to this paradox in the next chapter.

Looking closely at her process, documented in writing and in material traces, we see an endless stream of iterations and permutations. Her ideas move from sketches to verbal instructions to on-screen visualizations to hard-copy outputs. This process is rarely linear. She shuttles back and forth between screen and paper, between words and pictures. Her process has no distinct beginning, middle, or end, and her forms linger between distinct mediums and formats, always in the process of becoming something else, in the generative space between the objectively systematic and the subjectively pleasing.

Transformations

The nonlinearity of Molnar’s work is evident not only in her writing and the material traces of her work with the CRT screen. It can also be found in her unique approach to seriality. Like many geometric abstractionists, Molnar works in series, but her conversational method allows for a mode of working that is serial but not necessarily linear. Her conversational method is best illustrated by a series of plotter drawings titled *Transformations* (1976), which appear in *Leonardo* as well as a small, self-published catalogue for Molnar’s first solo exhibition that same year (**Figure 2.08**).⁴² To make

⁴² Vera Molnar, *Transformations – Vera Molnar (The Concourse Gallery, London, 10 June – 2 July, 1976)*, 1976. Original text is in English.

Transformations, Molnar used a computer program of her own design called RESEAU-TO.⁴³ She began by inscribing an array of concentric squares on the CRT screen. Like a sound scientific experiment, Molnar adjusted just one variable at a time—in this case, the displacement of individual squares—as she moved from one image to the next.

In the catalogue, a short artist statement proposes the following: “in order to make the necessary comparisons in developing series of pictures, one must execute a huge number of pictures, all alike, except for a small transformation.”⁴⁴ Molnar is quick to reference her art historical precedents in employing seriality, from the Mount Athos painters to Monet’s haystacks.⁴⁵ Serial painting was also in vogue in Molnar’s postwar Paris milieu, where fellow geometric abstract painters François Morellet and Ellsworth Kelly worked in methodical series in an attempt to eliminate subjective decision-making from the painting process.⁴⁶ Computation, however, took the possibilities for seriality to new heights. With the help of the plotter, one could execute hundreds more variations than possible by hand alone. The screen, in turn, allowed for a seemingly endless exploration of variations on an image. Seriality remains a hallmark of generative art practices to this day.

Transformations exemplify a common theme in Molnar’s serial work: a linear progression from order to disorder. Her DIY catalogue for the exhibition featured reproductions of series of eighteen

⁴³ Molnar, “Toward Aesthetic Guidelines,” 188. Molnar compares RESEAU-TO to music composition programs. See also Molnar’s unpublished text “Pour Los Angeles et Canada” dated January 1975 (archives of Vera Molnar: Carton 05: Textes : Anglais).

⁴⁴ Vera Molnar, *Transformations*, 1976.

⁴⁵ Vera Molnar, “Toward Aesthetic Guidelines for Paintings with the Aid of a Computer,” *Leonardo* 8, no. 3 (1975): 186.

⁴⁶ Yve-Alain Bois, “Ellsworth Kelly in France: Anti-Composition in Its Many Guises,” in *Ellsworth Kelly: The Years in France, 1948-1954*, ed. Mary Yakush, trans. Gregory Sims (Washington, D.C.: National Gallery of Art, 1992). Bois also comments on how Morellet and Le Witt approached seriality differently. Whereas Morellet aimed to use the simplest systems possible, such that the process was traceable from the resulting image, LeWitt was interested in the exhaustivity of his systems. Yve-Alain Bois, “François Morellet/Sol LeWitt: A Case Study,” in *Artistic Exchange: Acts of the 28th International Congress of Art History, Berlin, July 15–20* (Berlin: Akademie Verlag, 1992); Yve-Alain Bois, “François Morellet/Sol LeWitt: A Case Study Revisited,” *October*, no. 157 (2016): 161–80.

computer drawings by the same title that were also exhibited. As with *Love Story*, each page of *Transformations* contains one image, which holds a five-by-five matrix of concentric squares. In the first image (**Figure 2.08.02**), the matrix is perfectly ordered, the lines vibrating visually like a work of Op art. In the second image (**Figure 2.08.03**), this sense of monotony is broken, as Molnar has displaced the four corners of each sixth concentric square, transforming the square into an irregular trapezoid. Each of the twenty-five trapezoids takes a different form, giving a sense of movement to the picture, as if these trapezoids were swinging on their hinges, ready to fly off the page.

By the third page (**Figure 2.08.04**), Molnar has displaced the corners of every square in the matrix. While there are no longer any perfect right angles, the shapes are still legible as squares, as if they were drawn freehand without a ruler. In the subsequent pages, Molnar continues to move the x- and y-coordinates of the concentric squares. The shapes progressively lose their sense of squareness, and by the fourteenth page (**Figure 2.08.05**), we begin to lose sight of the grid that had originally structured the image. On the seventeenth and penultimate page (**Figure 2.08.06**), the few discernable polygons that remain are swallowed into a disordered web of line segments. By the eighteenth and final page (**Figure 2.08.07**), we see only a noisy scribble of line segments, meeting in sharp angles but with no sense of order whatsoever.

While the catalogue presents an entropic progression from control to chaos, a closer look at the original plotter drawings reveals that Molnar's sequence does not correspond to the order in which she made them. Their timestamps suggest that Molnar programmed *Transformations* on Saturday, April 24th, 1976, making at least twenty-five different plotter drawings total that she considers part of the series, though not all made it into the catalogue. When organized chronologically according to these timestamps, it becomes clear that the first image in the catalogue was in fact made eighth, and

the ‘second’ image was made last. The first image Molnar calculated corresponds to the third page in the catalogue. In other words, Molnar determined the sequence of display *after* outputting the entire series to paper.⁴⁷ This is true not only for *Transformations*, but also other series, including *Love-Story* (1974) and *Hommage à Barbaud* (1974). In other words, Molnar’s series question the relationship between seriality and linearity. Her linear narratives belie nonlinear processes.

This slippage between serial and linear sequence also has to do with the viewer’s experience of these works. Art historian Briony Fer has suggested that viewers may *impose* linearity onto a series of images that share certain elements, such as squares, in the process of looking. By way of example, Fer considers how Kazimir Malevich’s book *The Non-Objective World* (1926) presents a “staged” series of images, a sequence that does not correspond to the order in which they were made.⁴⁸ It is no coincidence that Molnar and Malevich’s books both stage narratives about squares; Malevich is a major reference point for Molnar throughout her career. For both artists, the square is a “zero of form” to which everything circles back. In fact, while these books are printed and bound with their pages in a particular order, their medium also allows the reader to flip back and forth between iterations, much like Molnar’s toggling between images on the CRT screen.

⁴⁷ Molnar had to remake *Transformations* twice, the second time using a thinner plotter pen, because the original line thickness proved difficult to replicate for the catalogue (Vera Molnar in conversation with the author, December 19, 2017; Allen, Richard, Letter to Vera Molnar, May 6, 1976. Archives of Vera Molnar (Carton 09: Correspondence)). There are thus two versions of *Transformations*, a series of twenty-one drawings (now belonging to the Tate collection, London, acquired 2020) and a series of twenty-three (Thoma Art Foundation collection, Chicago, acquired 2015). The original plotter drawings, too, are numbered, indicating the sequence in which they are meant to be shown (if exhibited together, which venues rarely have the space to do). The Tate series is numbered 1-21, following instructions provided by the artist to her Hungarian gallery around 2017. This sequence is followed whenever the drawings are displayed or reproduced (Email correspondence with Attila Pocze, Vintage Galéria, Budapest, 1 April 2021). The London and Chicago series bear the same time stamps, suggesting that the calculations were somehow saved and could be reproduced. Molnar has remarked that the two series are ever so slightly different, due to her use of a pseudo-random number generator (PNRG) to determine the exact coordinates, but that this difference is imperceptible to the naked eye (Conversation with the author, December 19, 2017).

⁴⁸ Briony Fer, *On Abstract Art* (New Haven: Yale University Press, 1997), 12.

Instructions

The relationship between seriality and linearity is also significant because it challenges the idea that if an artist works with instructions, then these instructions must be followed in order. In the second half of the twentieth century, instructions were used not only by painters and computer artists, but also by conceptual artists. The analogy between early computer art and conceptual art, with Le Witt's aphorism "The idea is the machine that makes the art" used to illustrate the relationship between algorithm (input) and computer-generated drawing (output), also helped put early computer art on the map of twentieth-century art history.⁴⁹ The artist need only hit "run" and the machine could make the picture without further artistic intervention.

Comparing an algorithm to a recipe that can be executed by someone—or *something*—else may be fitting for a certain kind of postwar European computational art practice.⁵⁰ The "Stuttgart school," a group of mathematicians-turned-artists that formed around the philosopher Max Bense, were interested in the potential of algorithms to demystify the creative process, to question subjectivity and individual creativity. Manfred Mohr, who worked with computers in Paris at the same time as Molnar, voraciously read Bense and took his theories "literally," even creating a system to emulate and automate his own painting style.⁵¹ Frieder Nake summed up the principle of Bensian generative art in a later article: "Once [a program] is described, entire series can be generated."⁵² This sounds a

⁴⁹ Grant D. Taylor, *When the Machine Made Art: The Troubled History of Computer Art*, International Texts in Critical Media Aesthetics (New York: Bloomsbury Academic, 2014).

⁵⁰ As curator Tina Rivers Ryan points out, for American computer art pioneer Roman Verostko (b. 1929), "A recipe for baking bread is an algorithm. Follow the recipe faithfully and you will duplicate the kind of bread made by the person who wrote the recipe." (Roman Verostko, "Algorithmic Art: Composing the Score for Visual Art," 1994 (with edits in 1996 and 1998), <http://verostko.com/algorithm.html>)

⁵¹ Christoph Klütsch, "Information Aesthetics and the Stuttgart School," in *Mainframe Experimentalism: Early Computing and the Foundations of the Digital Arts*, ed. Hannah Higgins and Douglas Kahn (Berkeley: University of California Press, 2012), 65–89.

⁵² Frieder Nake, "The Semiotic Engine: Notes on the History of Algorithmic Images in Europe," *Art Journal* 68, no. 1 (2009): 82.

lot like Le Witt.

However, drawing this parallel between Le Witt and early generative practices runs the risk of presenting computer art as a two-part object: a drawing and the corresponding algorithm. This analogy oversimplifies early computer art as a linear progression from input to output, and, as Victoria Salinger rightly notes, leads to a reductive understanding of both computer art and conceptual art.⁵³ Molnar's practice, and my reading of it, complicate this simplistic understanding of early digital practices, instead demonstrating that they were radically *nonlinear*. These processes were, in fact, iterative, interactive, experimental, and had no concrete beginning, middle, or end. Molnar's practice involved shuttling back and forth between drawing, code, and image—her eyes, and her attention, would move back and forth between paper and screen, as her images transformed from ideas into words into images and back again.

While Molnar has been categorized as one of Bense's followers, often considered an "Algorist"—a term coined by Roman Verostko in 1995 to describe "anyone who works with algorithms"—her approach to programmed and generative art is different from that of the Stuttgart school or her contemporaries across the Atlantic.⁵⁴ Rather than avoiding the artist's intervention in the *déroulement* or execution of a program, she foregrounds this act of intervention. She humbly notes this difference in methodological approaches in *Leonardo*: "Whereas they begin with an initial set of rules (a grammar) specifying the way parameters are to be varied, I try to elaborate the rules as a work develops."⁵⁵

⁵³ Victoria Salinger, "'Writing Calculations, Calculating Writing': Hanne Darboven's Computer Art," *Grey Room*, no. 65 (Fall 2016): 37–61. See also Rachel L. Vogel, "The Machine That Makes the Art: Printmaking and Conceptual Art, 1965–1975," Ph.D. dissertation, Harvard University, 2023, which explores mediation in early North American conceptual art.

⁵⁴ Roman Verostko, "The Algorists," <http://www.verostko.com/algorist.html>.

⁵⁵ Molnar, "Toward Aesthetic Guidelines for Paintings with the Aid of a Computer," 187. Molnar notes that her process

Unlike her contemporaries Morellet and Kelly, Molnar uses seriality not to eliminate subjectivity from the creative process, but rather to pin it down. She makes a somewhat perplexing point about why she focuses on only one variable at a time in her pictorial experiments: “This control over the stages in the development of a drawing permits me to decide when the picture that I wish to realize is being approached or departed from.”⁵⁶ She sets herself apart from other computer artists by insisting that the rules of her program are not set in advance, that she elaborates these rules as the work develops. While there is an element of improvisation here—the *rules* are not pre-determined, nor set in stone—Molnar suggests that she does have an idea of what she wants to see. Rather than pre-determining her end result, she works with visual theme in mind, such as the progression from order to disorder.

Molnar’s screenshots complicate the question often asked of early digital art: is the art the algorithm or the drawing? These images draw our attention to what happens in-between, emphasizing the temporal processes of early computing and computer graphics. They highlight the experimental nature of this art form, which was evolving along with developments in the technologies that it employed. Molnar’s playful process, her back-and-forth with the computer screen, complicates the linear input-output model that is so often attributed to computer-generated art and other forms of programmed art that employ instructions. Her conversational method indicates that artists were not necessarily detached from the execution of their programs, but in fact played an active role.

is most similar to Czech postwar constructivist painter turned computer artist Zdeněk Sýkora and American collaborators Collette and Charles Bangert, who both published articles in previous issues of *Leonardo*. Note that the term “grammar” was suggested by *Leonardo* editor Frank Malina (Manuscript, second draft, annotated by F. Malina; archives of Vera Molnar: Carton 05: Textes: Anglais).

⁵⁶ Molnar, “Toward Aesthetic Guidelines for Paintings with the Aid of a Computer,” 188.

Process in Action

If the artist did not intend for her screenshots to be viewed as works of art, where do they fit into an art historical account of her work? I suggest comparing them to a photograph documenting an experimental television broadcast by Lucio Fontana in Milan in 1952 (**Figure 2.09**). This image shows flecks of light that have been mediated several times over: a spotlight was projected through the holes in one of Fontana's Spatial Projects; the resulting light projections-in-motion were filmed and broadcast on TV; and finally, the fleeting, glowing marks on the TV screen were photographed. Art historian Stephen Petersen, invoking Italian scholar Silvia Bordini, discusses Fontana's "experiment" as exemplary of the "changing function of the art object, which becomes not an end but a means to a different sort of artistic product." In Bordini's words, "the work is dynamized and is given no longer as the final and complete end of a process but as a process *in action*."⁵⁷ Molnar's experiments were performed in a much more private mode than Fontana's were. Since the computer lab was closed off to the public, she was the only one privy to these different steps of translation and mediation. By conceptualizing Molnar's practice as a "process in action," we can better understand the role of iteration in her creative process.

In that same vein, we might compare Molnar's screenshots to contemporary photographic documentation of performance art, which art historian Martha Buskirk describes as "the *outcome* of a procedure, emerging from *within* an activity rather than existing as an externally produced record."⁵⁸ For many performance artists, these photographs are not the work itself, but they are how viewers encounter the work, how they enter into the artist's headspace, into a process they could not witness. As with many performance photographs, these screenshots—along with Molnar's plotter

⁵⁷ Stephen Petersen, *Space-Age Aesthetics: Lucio Fontana, Yves Klein, and the Postwar European Avant-Garde* (University Park, Pa.: Pennsylvania State University Press, 2009), 90.

⁵⁸ Martha Buskirk, *The Contingent Object of Contemporary Art* (Cambridge, Mass.: MIT Press, 2003), 225.

drawings—are all that remain of a private process in the past. They provide glimpses into transitory moments of the artist’s process, inviting us to look for patterns in their method, to begin reverse-engineering their system from their output. Unlike the performance works Buskirk discusses, however, Molnar’s process had no fixed duration. While she is no longer working directly with computers, Molnar continues to explore many of the same visual and aesthetic themes in her current work, often opening up old projects. Whether at the level of the picture, the series, or her lifetime oeuvre, Molnar’s work resists a linear narrative.

Screenshots from the Seventies

Historian of technology Cécile Welker notes that histories of computing, especially in France, have neglected the sub-history of computer graphics, meaning there is very little documentation of these early days.⁵⁹ The advent of the CRT display in Molnar’s career has also been overlooked in art history, with more historical attention paid to her switch from the *machine imaginaire* to the *machine réelle* in 1968. This has to do not only with history’s fixation on firsts—attempts to show that Molnar was among the pioneers of computer art—but also the sheer fact that the screen is simply less visible in her oeuvre than the plotter. The material difference between a handmade cut-paper collage and a machine-drawn picture labeled “JOB FROM MOLNAR” is immediately noticeable. Molnar’s post-screen computer work, however, looks indiscernible from her pre-screen work. This is because after the screen entered her practice, she continued to make plotter drawings. The final product, so to speak—the work that was shown in her occasional exhibition, and the work that continues to be collected today—was always either a computer drawing on paper or a painting or collage based on a computer drawing. The screen, by contrast, is only rarely pictured in her oeuvre. While it was not

⁵⁹ Welker, “Early History of French CG.”

always visible, the screen was always there, behind the scenes. In other words, the screen transformed Molnar's *process* rather than her pictures. Molnar's 'screenshots' convey her fascination with the screen—not only how it looked, but also how it transformed her way of working.

Love-Story, with its screenshots organized into book form, is not the only example of Molnar taking a camera to the computer screen, but it is the only one she has shown in an exhibition context.

Molnar's earliest extant screenshot is from 1973, the same year she first mentions the *écran cathodique* in her writing (**Figure 2.10**).⁶⁰ The square screen shows an iteration of Molnar's *(Dés-)ordres*, a five-by-five array of concentric squares. The white lines seem to glow, their edges soft and sometimes haloed, like a long-exposure photograph of a shape drawn in the dark with a flashlight, recalling Man Ray's *Space Writing* (1939). The photograph, as an object, is not so precious—in fact, Molnar has taken a marker to it, scrawling black lines around some of the concentric squares, perhaps to balance out the overexposed areas of the snapshot. The imperfections of the photo, its informality, and the artist's annotations give it a transitional quality; it is somewhere between a screen image and a drawing, but also somewhere between two iterations of the same program.

The bulk of Molnar's screenshots from the seventies are from 1974, including black-and-white photographs of the IBM 2250 displaying her series *Inclinaisons* and *Molndrian*. While Molnar does not consider these photographs, on their own, to be artworks, I suggest taking them seriously nonetheless, for two reasons. First, though Molnar did not exhibit these screenshots in traditional art venues,⁶¹ she did publish them in various publications: for example, a *Molndrian* screenshot appeared

⁶⁰ Vera Molnar, "L'oeil qui pense [talk given at SIGMA]" (Bordeaux, 1973), 6, Carton 05: Textes: Conférences. This screenshot was documented by Vincent Baby in the early 2000s for Molnar's catalogue raisonné, but its current location is unknown.

⁶¹ In the 1980s, Molnar would photograph the computer screen in color and exhibit these. More on this in chapter 3.

in the August 1974 issue of *Computers and People*, while another graced the cover of *Computer Graphics and Art* in February 1977 (**Figure 2.11**). Second, Molnar's attitude toward the images suggests that they served as more than just documentation for documentation's sake. There is a sentimentality to these photographs, particularly in how they factor into Molnar's storytelling of her career narrative, that is echoed in their informality. Hanging onto these photographs suggests that the advent of the screen was such an unforgettable moment for her, that she wanted to commemorate it, even if she did not know what exactly to make of the images that would result. Moreover, by documenting her process, she emphasized the very significance of that process, and specifically the role the CRT played in it.⁶²

Molnar was not the first nor the only artist to point her camera at a CRT display. In the 1950s, the German scientist, writer, and computer graphics pioneer Herbert W. Franke used a camera to capture the abstract visualizations on his oscilloscope display, which he called "oscillographs" (**Figure 2.12**). In the United States, Mary Ellen Bute used the oscilloscope at Bell Laboratories to visualize electronic signals, photographing them on cinematographic film,⁶³ while mathematician Ben Laposky used a similar method to create his "oscillons." Unlike Molnar's IBM 2250, these oscilloscopes were analog displays that created dynamic images not unlike Nam June Paik's later video synthesizers. A click of the shutter turned these dynamic visualizations into static images.

The image known as the first computer screenshot was captured in 1959 by a young American military officer who snapped a Polaroid of the SAGE computer interface (**Figure 2.13**). On a

⁶² Molnar's resistance to accepting these photographs as artworks may also be related to the delay in accepting photography as a "fine" art in Western art intuitions and her own commitment to "painting" in the sense of *disegno*, which only encompassed painting, sculpture, and architecture (with drawing at the root of each practice), which I discuss in my introduction.

⁶³ Wall text in *Elles font l'abstraction*, exhibition at Centre Pompidou, Paris, 2021.

circular oscilloscope display glows the outline of a pinup girl, an image used to test the computer system. It was not until the 1960s that screenshots became valuable objects in computer-aided design and architecture. As Allen notes, designers soon developed a set of conventions for screenshots, such as the white-on-black aesthetic, to specifically differentiate these images from computer-aided *drawings*, which, like Molnar's plotter drawings, were black-on-white. Ivan Sutherland, architect of the famous computer graphics program Sketchpad (1963), utilized screenshots in promoting his work, suggesting that they could capture the "twinkle" of the CRT, to give the "impression" of a screen in the image. By developing these aesthetics, Allen argues, their aim was to emphasize the *screen-ness* of these images, in order to promote this new way of interacting with computers.⁶⁴ A screenshot from the seventies is a rare find, not only in Molnar's oeuvre but also more generally in the history of computing. As Matthew Allen observes, these photographs were often as ephemeral as the on-screen images they captured.⁶⁵

Molnar was not in dialogue with architects or designers in the 1960s and 70s, since her introduction to computers was through music composers like Barbaud and Michel Philippot, who were not so interested in the visual. However, she recalls similarly wanting to capture what she calls the "fugitive" image on screen, an image that would soon disappear.⁶⁶ The on-screen image was not only ephemeral but also elusive, difficult to capture exactly as it appeared due to lighting conditions. The camera's shutter released at a different speed than the lines rendered on screen, which refreshed every few seconds. Moreover, the glass surface of the screen could create glares in the photograph (Figure 2.14.01).

⁶⁴ The relationship between early computer-generated animation/moving images made with computers and the still images that I refer to as 'screenshots' is beyond the scope of this chapter, and remains to be investigated further.

⁶⁵ Allen, "Representing Computer-Aided Design."

⁶⁶ Conversation with the author, 19 December 2017, Paris, France.

In all these cases, however, the screenshot served a practical function that would become particularly relevant for artists: sharing computer graphics beyond the computer lab. While later computer-based art could be consumed in its native environment, i.e. on the same desktop machines on which it was produced, early users of computer graphics relied on more traditional methods to preserve, document, and share their work. There was no way to ‘save’ the image exactly as it appeared on screen, so in order to be seen by a broader audience, screen-based graphics had to be transposed to ink on paper. Hard copies could be made using plotters or display copiers, neither of which was entirely faithful to what appeared on screen, since both of these processes entailed flipping the light and dark values, like printing a photograph from a negative (**Figure 2.14.02**).

Molnar thus chose to photograph the screen herself, pointing a camera at its glass surface. As the term screenshot implies, there is an informality to Molnar’s images, even a sense of presence of the artist behind the lens, a shakiness attributable to a handheld camera. At the same time, these screenshots were not taken by accident. There is also an intentionality to Molnar’s photographs, particularly in her translation of the green-on-black screen to the black-and-white modality characteristic of her own visual language.

Love-Story à l’ordinateur

By using screenshots to construct *Love-Story*, Molnar inverted the black-on-white paradigm of computer plotter drawings, instead showing white squares on a black background. Each page of the book bears one image, which shows two squares in different configurations. The light appears more blurred or smeared in certain images, suggesting either the slight movement of the camera in the artist’s hand, or perhaps the rendering of the image on-screen happening faster than the camera’s

exposure time (**Figure 2.15**).

Molnar's interest in flipping black and white values predates the computer, and remains a part of her practice even after computer screens were capable of displaying full color images in the 1980s. An untitled 1952 cut-paper collage (**Figure 12.16.01**) features a seemingly orderly matrix of nine white squares on a black background—upon closer examination, it becomes apparent that the bottom central square is, in fact, light gray, and leans to the left. Even after turning to the computer, Vera Molnar did not abandon analog methods. Often her computer drawings give way to handmade drawings, collages, or paintings; the inverse is also true. A later collage, *Computer-icône 12* (1975, **Figure 12.16.02**), not only echoes the 1950s collages, but also explores the white-on-black paradigm of Molnar's screenshots made the year prior.⁶⁷ In fact, the inversion of black and white was a theme the Molnars had explored together, co-producing a diptych collage in 1955 entitled *Double mouvement giratoire* (**Figure 2.17**) that explored the same composition of rectangles with the values inverted. Juxtaposing Molnar's screenshots with their corresponding plotter drawings produces a strikingly similar visual effect. However, there is an obvious difference between these inverted collages and the computer works, a difference that lies in material. While the plotter is, materially speaking, a work on paper, the screenshot is undeniably a photograph. Molnar's screenshots are printed on cheap, glossy photo paper that sharply contrasts the fragile, matte plotter paper that was once white but has yellowed with age.

The artist's book *Love-Story* consists of glossy photographs that Molnar glued to cardboard pages in an accordion fold (also known as a leporello or concertina fold). Molnar's first complete edition of

⁶⁷ Note that the use of *icône* or icon in these works refers not to icons in computer graphics, which would be a product of the late 1980s development of the GUI, but to a larger theme in Molnar's oeuvre that explores geometric shapes, including the capital letter M, in pairs of complementary colors, such as red and green.

the book, which has unfortunately been lost, consisted of thirty-one photographs glued to thirty-one cardboard pages.⁶⁸ The first and last page of the accordion were joined, so that the book formed a loop, with the photos mounted only on the outer side of each page. By contrast, an extant maquette (**Figure 2.04.02**) is made up of only eight pages, with a photo mounted to the front and back of each page. Both the maquette and the first edition can be propped upright on a flat surface, so that the darkness and glossiness of the paper has a reflective effect, similar to the computer screen.

The accordion fold of *Love-Story* suggests that, despite the title, there is no clear linear narrative, no discrete beginning, middle, or end to the story. The viewer must manipulate the folds, experiencing them through time and making comparisons between compositions just as Molnar herself did on the computer screen. Although the book is a physical object, it maintains characteristics of Molnar's computer-based work, including the nonlinear nature of her series and processes, and this emphasis on comparison. By introducing spatiality with the accordion fold, Molnar also introduces a process of *interaction*, creating a dialogue between the reader/viewer and the book/object that mimics that of the artist and the computer screen.

In a short film made in 1981, the artist sits on the floor of her home/studio, unfurling the accordion fold of *Love-Story* and shifting its pages around to reveal how the book can be manipulated spatially by hand (**Figure 2.18**). She seems to invite the reader/viewer to compare the different configurations of the two squares, just as Molnar once compared these images on the computer screen. The invitation is not just to read a storybook, or to look at a series of pictures. It is also an invitation to participate in a visual experiment.

⁶⁸ The original artist's book was last seen around 2000, when Galerie Linde Hollinger reproduced it as an artist's edition using silkscreen prints instead of photographs.

Aesthetic experiments

Sometime in the early seventies, Molnar scrawled the following quote on the back of an unused IBM punch card from the CIRCÉ computer lab:

Le tableau, avant d'être un cheval de bataille, une femme nue ou une quelconque anecdote, est essentiellement une surface plane recouverte de couleurs en un certain ordre assemblées.

The painting, before being a warhorse, a nude woman or some anecdote, is essentially a flat surface covered with colors assembled in a certain order.

It was a quote from the French painter and writer Maurice Denis, written in the late nineteenth century, and it would appear again and again in Molnar's writings over the next few decades. The fact that she recorded it on a punch card could not have been better aligned with her theoretical interests. Like many pioneers of computer art, Molnar was interested in how pictures could be broken down into small, modular elements: zeroes and ones, yeses and nos. But as an artist, she was especially curious to know: at what point do these elements become a work of art?

Molnar's conversational method was not merely a systematic painting process. It was also a design for an aesthetic experiment. In the controlled environment of the computer lab, the CRT screen allowed Molnar to conduct systematic experiments about her own artistic subjectivity, examining the ways in which she made aesthetic decisions. The idea was not to generate a preconceived, pre-programmed composition. Rather, she used the conversational method to investigate the *process* of composition, a common line of inquiry in postwar geometric abstract painting.

Molnar laid out her aesthetic stakes in writing throughout the 1970s and 80s. Some of her texts, like the *Leonardo* article and *Transformations* statement, were published, while others were given as talks at multidisciplinary conferences about the role of computers in the arts. Some were never circulated. In

these texts, she raised questions about aesthetic choice and judgement: Did the image on screen please her? Was it sufficiently different from the previous image? Did it look like a picture, or was it just visual noise? When did that shift take place, and how? Molnar moved through these questions in a process of trial and error (she uses the words *essai/erreur* and *tâtonnement*), which she also borrowed from her husband's field of experimental psychology.⁶⁹ With one variable isolated, little external stimuli, and her attention focused on the screen in front of her, Molnar could concentrate on the parameter change that occurred before her, as well as her response to it. Like a participant in an experimental psychology study, Molnar could make a split-second judgment about the image appearing on screen before her eyes.⁷⁰ In an unpublished text from 1977 describing her painting *Computer-icône / 3 – 100 carrés*, made that same year based on a series of computer drawings, we see how, for Molnar, these aesthetic inquiries are inextricably tied to her use of the computer:

Using simple forms makes it possible to control step by step the genesis of the image and to locate the moment when “the fact of art” (*le fait d'art*) emerges. To track down this unknown using a clear approach, I often make use of a computer.⁷¹

What is the “fact of art”? This elusive moment in the creative process is something Molnar seems to be constantly searching for. She tests out different names for it over the years. In an undated, unpublished text called “Description du programme MOLNART (1974-76),” which was likely written at the turn of the millennium, Molnar describes the process of searching for the “threshold” at which a “sudden mutation” causes her to perceive a “qualitative change” in the composition.⁷²

⁶⁹ Vera Molnar, “[La Presse Informatique]” (December 5, 1972), Archives Vera Molnar: Carton 05: Textes: Français.

⁷⁰ Molnar cites her husband's article “Experimental Aesthetics or the Science of Art” (*Leonardo* 7, no. 1 (1974): 23–26) in her own *Leonardo* article published a year after his. In chapter 3, I discuss Molnars and their collaborations; here, I will further explore this intersection of perceptual psychology and geometric abstraction in early computer graphics.

⁷¹ Vera Molnar, “Computer-Icônes [Les éléments de base...]” (1977), Carton 09, Archives of Vera Molnar. My translation from the French: “*L'emploi de formes élémentaires permet de contrôler pas à pas la genèse de l'image et de localiser l'instant où 'le fait de l'art' émerge. Pour traquer cet inconnu avec une démarche claire, je me sers souvent d'un ordinateur.*”

⁷² Vera Molnar, “Description Du Programme « Molnart, 1974-1976 » (Unpublished, undated). Judging from a fax

While I want to be cautious about anachronistically applying Molnar's texts to decipher her earlier work, it is clear that the search for a "threshold of aesthetic satisfaction" had characterized Molnar's practice since at least 1967. That year, in a radio interview with art critic Georges Charbonnier, Molnar discussed this moment that painters experience when "*tout d'un coup, quelque chose se passe*" (suddenly, something happens): that moment when what was merely a set of marks suddenly becomes a picture, a work of art.⁷³

With the peculiar phrasing *le fait d'art*, Molnar invokes Gestalt psychology, which grounds this phenomenon in the scientific facts of visual perception, in the physiological constitution of the eye. This phrase first appears in Molnar's talk "L'oeil qui pense," which she gave as part of a series on artificial creativity at the SIGMA festival in Bordeaux in late 1973. Here, Molnar distances herself from the "metaphysical" theories of Paul Klee (from whom she borrows her title) and Wassily Kandinsky, aligning her abstraction and her aesthetics more with cold, hard science based in facts and controlled experiments. Following her husband's call for a *science de l'art*, she argues that it is the painter's job to organize forms on a surface based on the scientific facts of vision.⁷⁴ This talk is pivotal not only because it unites the two Molnars' theories. It also ties in Vera Molnar's aesthetic concerns with the systematization of process that is catalyzed by the computer, and it introduces many of her key terms that would not appear in print until the following decade, such as this idea of *l'état esthétique satisfaisant* (a satisfying aesthetic state) as another term for *le fait d'art*. It is also the first

Molnar sent on October 25, 2002 to art historian Vincent Baby, who was writing his doctoral dissertation on Molnar at the time, it seems this text may have been written at Baby's behest. There are no earlier drafts of it in Molnar's archive of manuscripts.

⁷³ Georges Charbonnier, "Dix ans de création dans les lettres et des arts – Vera Molnar: État présent des recherches dans les arts plastiques," *France Culture* (Radio France, 2016 1967). Molnar also mentions this phenomenon in our conversation from 17 August 2017, citing Gestalt psychology, which comes up in some of her writings as well. I intend to explore this avenue of thinking in my next draft.

⁷⁴ Molnar, "L'oeil qui pense [talk given at SIGMA]."

time Molnar explicitly discusses the significance of the CRT screen.

With the instantaneous visualization of the CRT display, Molnar could isolate the window in which *le fait d'art* emerges and study it systematically. The kind of focused attention the CRT allowed can also be traced back to naval radar screens, which, as Geoghegan recounts, encouraged human operators to “focus their attention on decision making in situations of uncertainty.”⁷⁵ Molnar’s aim with the CRT was not to generate a particular, preconceived composition, but rather to investigate the process of getting there. Working with the CRT, Molnar compared iterations of her program, taking intermittent pauses to make comparisons and evaluations of her work-in-progress, and to make decisions about how to proceed.

Unlike her contemporaries François Morellet or Sol Le Witt, she was not interested in using systematic methods to suppress her own subjectivity. Nor did she follow the Stuttgart School’s inclinations to use the computer to eliminate the subjectivity inherent in decision-making. Instead, Molnar used computational, systematic methods to place subjectivity—her own subjectivity—under a microscope. That is, she used the conversational method to attempt to locate her aesthetic preference and artistic choice in the course of the creative process.

The First (and Only) Viewer

Molnar’s move from ‘cold’ abstract painting to even colder computer-aided painting was, in her words, a “systematization of the traditional approach” to making art.⁷⁶ The computer allowed her to execute series much faster and with greater exhaustiveness. But the introduction of the CRT screen

⁷⁵ Geoghegan, “An Ecology of Operations: Vigilance, Radar, and the Birth of the Computer Screen,” 82.

⁷⁶ Molnar, “Toward Aesthetic Guidelines for Paintings with the Aid of a Computer,” 188.

also accelerated the processes of viewing, comparing, and evaluating images. Removed from the process of physically executing these images herself, Molnar was able to view each iteration with the fresh eyes of a new viewer: the first viewer of the work.

We begin by generating a series of images that satisfy some simple psycho-physiological rules. We then modify them ‘step by step’ until we reach a satisfactory ‘aesthetic state’, at least for a spectator who is, in this case, the painter himself.⁷⁷

Both visual perception and interaction were important to Molnar’s project, but these interests manifested quite differently in her work than in that of her contemporaries. Her former CRAV collaborators, who became known as GRAV for their opto-kinetic art, also maintained an interest in Gestalt, but they used it to explore participation—how art could promote collectivity, moving bodies and encouraging viewers to interact with each other. Molnar’s work from this period was far more solitary.

This is in part because she simply did not have an audience. Following François Molnar’s resignation letter from CRAV, which signaled the departure of Vera Molnar as well as their friend and colleague Servanes, the Molnars’ practices took a rather different direction. While F. Molnar turned his attention to scientific research, V. Molnar continued making art, but appeared to follow her husband’s declaration in his resignation letter that “our works should not be exhibited.” He had suggested that art practice should instead be a serious, ascetic, quasi-scholarly endeavor conducted with scientific rigor, not oriented toward the shallow and capitalistic art world.⁷⁸ She kept her head

⁷⁷ Molnar, “L’oeil qui pense [talk given at SIGMA],” 8. “Nous commençons donc par générer une série d’images qui satisfont à quelques règles psycho-physiologiques simples. On les modifie ensuite ‘pas à pas’ jusqu’à arriver à provoquer un ‘état esthétique’ satisfaisant, au moins pour un spectateur qui est dans ce cas le peintre lui-même.” My translation.

⁷⁸ François Molnar, “Lettre de démission / Letter of resignation, 30.11.1960,” in *GRAV, Groupe de recherche d’art visuel, 1960-1968: stratégies de participation: Horacio Garcia Rossi, Julio Le Parc, François Morellet, Francisco Sobrino, Joël Stein Yvarak: 7 juin-6 septembre 1998*, *Magasin—Centre d’art contemporain de Grenoble*, ed. Yves Aupetitallot (Grenoble: Le Magasin, 1998), 59–61.

down throughout the 1960s, not having a solo exhibition until 1976, and even then choosing to show her work at a non-profit, university gallery in London.

This abstinence from exhibiting, which I address more in the next chapter, cannot be entirely chalked up to a husband who was unwaveringly anti-establishment. While Vera Molnar was no doubt influenced by her husband's ideologies, she had reasoning of her own, some of which she outlined in the final paragraphs of her *Leonardo* piece:

I do not make drawings and paintings with the aid of a computer solely for personal satisfaction; I hope that others will also enjoy them. I do not agree with the notion of art for art's sake and of science for the sake of science. Sartre convincingly explains why this notion is untenable. I, personally, know of no artist who refuses to let people see his work. On the other hand, I do not believe that an artist should go to the extreme of ignoring his own taste and convictions in order to please others. There should be an intermediate ground where aesthetic satisfaction is experienced mutually. [...] , I subscribe to the belief that the underlying principles for giving aesthetic satisfaction to viewers of drawings and paintings can be found and I hope that my studies will help to verify my conviction.⁷⁹

At the root of it all, Molnar was studying, researching, searching for precisely this: the “underlying principles for giving aesthetic satisfaction to viewers.” Why, then, did she not design experiments that included more participants than herself? I suggest this had partly to do with the material limitations of early interactive computing, the sheer fact that the mainframe computer and its terminals had very limited accessibility. As an artist, and a woman, who had no formal role at CIRCÉ, she was at the bottom of the food chain. It was hard enough for her to get a foot in the door of the computer lab; how could she bring a whole art audience with her without getting laughed out the door?

Molnar's solitude also had to do with the very nature of early interactive computing. Time-sharing

⁷⁹ Molnar, “Toward Aesthetic Guidelines for Paintings with the Aid of a Computer,” 189.

and the CRT screen gave rise to a new kind of user, whose relationship with the computer became a dynamic, intersubjective one. The computer screen, with its glowing green lines and its real-time responsiveness, captivated Molnar, but it did not blind her. Her newfound subjectivity as a user heightened her awareness of her subjectivity as an artist, and as a viewer. While other systematic or programmed art practices were designed to minimize the influence of the artist's subjectivity, conversational computing was designed to do the opposite.

Since her 1970s experiments were confined to the laboratory, the only way Molnar could share her process with an audience was through her writing. By the 1980s, however, it became possible to bring the computer to the outside world. In 1983, Molnar was invited to participate in *ELECTRA: L'électricité et l'électronique dans l'art au XXe siècle* (*Electricity and Electronics in the Art of the Twentieth Century*) organized by art historian and critic Frank Popper at the Musée de l'art moderne de la ville de Paris.⁸⁰ Her submission was a live demonstration of her process: a workstation equipped with her personal computer and a tabletop plotter, on which she produced small, colored plotter drawings for spectators, which she then signed and dated for them to take home (**Figure 2.19**). This demo was reprised at the Festival of Electronic Arts in Rennes five years later, where visitors could watch Molnar visualizing squares in technicolor on two different screens and outputting variations of these images to a seemingly endless scroll of plotter paper that spilled over the edge of the table onto the floor (**Figure 2.20.01**). "Vera Molnar will be at the festival with her computer to present a live real-time reflection of the theme of the square and its transformations by the machine," the festival program announced, with a quote from the artist:

⁸⁰ Popper, Frank, ed. *Electra : MAM Musée d'art moderne de la ville de Paris, 10 décembre 1983-5 février 1984 : l'électricité et l'électronique dans l'art au XXe siècle : electricity and electronics in the art of the XXth century*. Paris: Les Amis du Musée d'art moderne de la ville de Paris, 1983. In addition to her live demo, Molnar collaborated with composer Janine Charbonnier on a performance at *Electra* (Fonds Frank Popper, Archives de la critique d'art, Rennes, France ; Vera Molnar in conversation with the author, May 1, 2022.

This reflection is a kind of excursion whose point of departure is a classic visual phenomenon, clear and transparent—the terrain I prefer—and which leads into baroque regions of dense confusion: from Apollo to Dionysos [sic]. The computer, which can calculate and materialise this kind of voyage, is an ideal travelling companion.⁸¹

The image Molnar selected to accompany her text was not a plotter drawing, nor a collage, but a screenshot: a photograph of the screen of her personal computer, showing a tangle of squares in technicolor (**Figure 2.20.02**).

In the spirit of *real-time*, a radio interview with the artist recorded the soundscape of her installation, the plotter mechanically whirring like R2-D2, a voice announcing the arrival of a new color each time the plotter switched its pens according to the artist's instructions.⁸² A photograph of Molnar's demo was included in Frank Popper's seminal book *Art and the Electronic Age* (**Figure 2.21.01**)—the book where I first encountered Molnar's work—highlighting the active role of hardware in her practice.⁸³ While Molnar was still committed to producing works on paper, these demos suggest that she felt compelled to exhibit the complex system of machines and the process behind her graphics, to invite viewers to watch—and perhaps even participate in—her visual experiments.

The Participant Observer

When computers were first used to make art, they were met with resistance from a public that feared art was losing the one quality that made it worth caring about: its humanity. The computer seemed to threaten the very definition of art, as it had been understood for centuries. This was, like many anxieties around computing, an anxiety about automation—a fear that computers might eventually replace humans altogether.

⁸¹ Catherine Delalande, ed., *Festival des arts électroniques: Rennes, 28 mai-5 juin 1988*, trans. Servilingue (Rennes, France: La Ville de Rennes et le Grand Huit, 1988). Original in English.

⁸² Molnar and Atelier de création radiophonique sur le Festival des arts électroniques de Rennes, *Entretien Avec Vera Molnár, Enregistrement de l'installation de Alain Fleischer, de Valère Novarina*.

⁸³ Frank Popper, *Art of the Electronic Age* (New York: Harry N. Abrams, 1993).

Molnar resisted engaging in discourse that gave the computer agency or personhood. But we have seen how her process—*how* she worked with computers—contradicted her words. Her method subtly, but radically, transformed once the CRT screen came into play. Time-sharing and interactivity gave the computer a face—an interface—and constructed a one-on-one relationship between the machine and its user. Molnar embraced the screen’s function to visualize her programs and thereby entered into a dynamic, intersubjective conversation with the computer, in a back-and-forth that had not been possible when computing was blind.

Molnar’s relationship with the computer screen provides a useful case study for examining how humans can work *with* computers to produce results that neither could make on their own. I propose that we understand Molnar’s practice as a cybernetic system, one that constantly feeds back into itself and thus produces no end-state, no finished product. More specifically, I suggest framing her practice as a *second-order* cybernetic system, one that accounts for the role of the person who set up the system, the “participant observer”—in this case, the artist, who is also the first viewer of the work. The artist’s perception becomes a crucial step in the process, a moment of interaction that creates feedback.⁸⁴

Of course, there is nothing novel about using the words cybernetic and computer art in the same sentence. As ZKM curator Margit Rosen has observed, we cannot discuss Cold War-era artworks made with computers without noting the profound impact of cybernetic and information theory on

⁸⁴ Andrew Pickering, *The Cybernetic Brain: Sketches of Another Future* (Chicago: University of Chicago Press, 2010), 344–45; Roy Ascott, “Is There Love in the Telematic Embrace?,” *Art Journal* 49, no. 3 (1990): 244. Steve Goodman and Luciana Parisi, “Machines of Memory,” in *Memory: Histories, Theories, Debates*, ed. Susannah Radstone and Bill Schwarz, 1st ed. (New York: Fordham University Press, 2010), 348.

a generation of artists and critics alike.⁸⁵ Molnar was immersed in this discourse, particularly the language of information aesthetics through her husband's research and their friendship with Moles. I do not want to suggest that Molnar consciously constructed a cybernetic system. Rather, I propose using second-order cybernetics as an art-historical framework, as a framework for understanding the artist as just one node in a complex web of agents, both human and nonhuman, that work together to make art.⁸⁶ The nonhuman agents in Molnar's case include not only her screenshots and plotter drawings, but also, crucially, the mainframe computer and its terminals, including the CRT graphics display and the plotter.

In my second-order cybernetic model, the system also includes the artist herself, whose subjective evaluations feed back into the system. By looking closely at Molnar's process, we see how her early computational art was nonlinear and iterative—not unlike computational processes themselves. This framework also resonates with noncomputational artistic processes, such as William Kentridge's drawing for projection, which he describes as a “combination between drawing and seeing, between making and assessing.”⁸⁷ Rosalind Krauss characterizes Kentridge's “choreography of process” as following no predetermined plan, but rather “shutt[ling] back and forth” between sites of evaluation and execution until a “plot” emerges from the interconnections between the individual images Kentridge produces.⁸⁸ Molnar similarly dances from drawing to seeing to evaluating to drawing again, comparing images until something like a narrative emerges in her results. In *Transformations*,

⁸⁵ Margit Rosen, “The Secret Revolution,” in *Facing the Future: Art in Europe 1945-1968*, ed. Mari Shields, Eckhart Gillen, and Peter Weibel (Tiel: Lannoo Publishers, 2016), 398.

⁸⁶ Ronald R. Kline, *The Cybernetics Moment: Or Why We Call Our Age the Information Age*; Edward Shanken, “Introduction/Systems Thinking/Systems Art,” in *Systems*, ed. Edward A. Shanken, Documents of Contemporary Art (London: Whitechapel Gallery, 2015), 14; Julieta González, “Beyond Technology: Juan Downey's Whole Earth,” *Afterall: A Journal of Art, Context and Enquiry*, no. 1 (2014): 20; Goodman and Parisi, “Machines of Memory.”

⁸⁷ Kentridge quoted in Rosalind Krauss, “‘The Rock’: William Kentridge's Drawings for Projection,” *October* 92 (Spring 2000): 9. I thank Sean Keller for this comparison to my reading of Molnar's process.

⁸⁸ Krauss, 6.

concentric squares dissolve from a tidy grid to a scribble of lines. In *Love-Story*, two perfect squares begin to distort, intersecting and intertwining as they dance around each other, until they are no longer distinguishable or recognizable as the neat geometric forms they once were.

By understanding art practices as second-order cybernetic systems, we can, in turn, broaden our understanding of the *object* of art historical study. Molnar's work invites us to radically re-think what we consider to be a work of (digital) art. Early computer art was not a two-part object made up of an algorithm and a static image that ends up in a museum collection. It was a time-based process, a network of human and nonhuman actors in conversation, a complex web of materials, languages, machines, and processes that were in constant transformation, translation, and states of becoming. By attending to the archive, the anecdote, and the ephemeral objects that remain from Molnar's computational practice, we can imagine what these conversations looked and sounded like. But like a real love story, we will never know exactly what was said behind closed doors. ■

Chapter 3

Programmed Intuition: Beyond the Binary

“An intuitive robot,” someone muttered. “A girl robot?” A smile made its way about the conference table.

—Isaac Asimov, “Feminine Intuition,” *The Magazine of Fantasy and Science Fiction*, October 1969

Whether they are gathering information, telecommunicating, running washing machines, doing sums, or making videos, all digital computers translate information into the zeros and ones of machine code. [...] The zeros and ones of machine code seem to offer themselves as perfect symbols of the orders of Western reality [...] And they make a lovely couple when it came to sex. Man and woman, male and female, masculine and feminine: one and zero looked just right, made for each other: 1, the definite, upright line; and 0, the diagram of nothing at all: penis and vagina, thing and hole... hand in glove. A perfect match.

—Sadie Plant, *Zeros + Ones: Digital Women + the New Technoculture*, 1997, 34

In Vera Molnar’s *Carrés concentriques* (*Concentric Squares*, 1977, **Figure 3.01**), forty concentric squares, tightly nested, vibrate optically. Unlike the large scale of an Op painting, however, Molnar’s work is subtle, unassuming—black ink on standard A4-size paper that has slightly yellowed with time. It beckons the viewer closer, to notice that the concentric squares were, in fact, drawn with two alternating pens. One pen’s ink is a starker black with consistent thickness, with ruler-straight lines turning corners in perfect 90-degree angles. By contrast, the lighter black lines waver with a whimsical imprecision. Their waviness serves to disrupt the machinic stacking of the concentric squares, so that the picture still vibrates but stops just short of hurting the eyes.

This modest work, which Molnar rediscovered in her studio in 2019, retroactively adding her signature in the confident but similarly wavering lines of a ninety-five-year-old hand, is a microcosm

of her concerns as an artist. The pin-straight, systematic squares were programmed on a computer and output to paper using a plotter, drafting lines with a robotic arm holding a tiny pen. Molnar then intervened with her own hand, introducing organic lines in the spaces between the programmed concentric squares. With this simple gesture, Molnar invokes a major debate in postwar French painting discourse, the arm-wrestling match between *la main chaude*, the hot hand, and *la main froide*, the cold hand.

La main chaude was the hand behind a lyrical and expressive abstraction, a gesture laden with emotion. By contrast, *la main froide* represented methodical rigor, a foil to the “genius” traditionally located in the painter’s brushstroke. It was the hand behind *l’abstraction froide*—cold abstraction—which was mechanical, precise, systematic, and devoid of emotion.¹ The further removed the line was from the artist’s hand, from their subjective decision-making, the better. *La main froide* was the tool of choice for the programmed abstractionists. Whether they were working with paint, computer code, or both, they had a common goal: to demystify the artistic process and to debunk the myth of the artist-genius who followed his [sic] “blind intuition” by removing subjective choice from the artistic process. This position is best articulated in an article by François Morellet entitled “*Le choix dans l’art actuel*” (“Choice in contemporary art,” 1965), included in Anthony Hill’s anthology *DATA: Directions in Art, Theory and Aesthetics*, to which François Molnar also contributed. Intuition was associated with Romantic ideas of genius and unconscious decision-making; artists could circumvent “intuitive choice” by following systematic programs that used only “cybernetic choice,” decisions

¹ James Meyer observes a related dichotomy in American minimalism, which he traces back to “Greenberg’s division of two minimalisms – a ‘cold,’ conceptual male activity versus a handmade, emotive female art.” The work of Anne Truitt, for example, was “constructed as either a warm antidote to ‘cold’ minimalism, or as a kind of minimalism ‘lite,’ lacking the theoretical substance of Judd or Morris’s work” (*Minimalism: Art and Polemics in the Sixties*. New Haven [CT]: Yale University Press, 2001, 227).

made by machines who were “theoretically objective.”² In the 1970s, the agenda of cold abstraction aligned with that of Anglo-American Conceptual art, which also decried the process of self-reflection in art. After Roland Barthes declared the death of the author in 1967, artists and critics on both sides of the Atlantic were increasingly less interested in the subjectivity of the artist.

Little did these cold abstractionists, including Molnar, realize that by challenging these narratives of singular genius in art history, they were asking many of the same questions as feminist art historians like Linda Nochlin. In 1971, while Molnar was learning to program in Fortran, the American art history Linda Nochlin published her seminal essay “Why Have There Been No Great Women Artists?” which confronted the tradition of wonderment at singular masculine mastery and the “unstated domination of white male subjectivity” in the history of art. Nochlin, too, aimed to debunk the myth of artistic genius, which she defined as an “atemporal and mysterious power somehow embedded in the person of the Great Artist,” who was the “subject of a hundred monographs.”³

Neither the Western European project of programmed abstraction, nor Anglo-American conceptual art discourse, shared this feminist consciousness. Gender was rarely a part of their conversations about genius; in fact, conceptual art discourse was often actively hostile to artists interested in bringing feminism into their work. As feminist art historians like Jayne Wark have pointed out, this

² François Morellet, “Le choix dans l’art actuel [1965],” in *GRAV, Groupe de recherche d’art visuel, 1960-1968: stratégies de participation: Horacio Garcia Rossi, Julio Le Parc, François Morellet, Francisco Sobrino, Joël Stein Yvaral: 7 juin-6 septembre 1998*, Magasin–Centre d’art contemporain de Grenoble, ed. Yves Aupetitallot (Grenoble: Le Magasin, 1998), 167–69; Anthony Hill, *DATA: Directions in Art, Theory and Aesthetics: An Anthology* (New York: Graphic, 1968). In *DATA*, a figure by Vera Molnar, *Quatre éléments au hasard* (page 211) is erroneously (?) attributed to François Molnar. The same figure, attributed to Vera Molnar, appears in Abraham Moles’s *Art et ordinateur* in 1971 (Abraham A. Moles, *Art et ordinateur*, Synthèses contemporaines ([Tournai]: Casterman, 1971), 125.).

³ Linda Nochlin, “Why Have There Been No Great Women Artists? (1971),” in *Women, Art, and Power: And Other Essays*, 1st ed., Icon Editions (New York: Harper & Row, 1988), 88.

“death of the author” moment happened precisely when women were just beginning to claim their agency and subjectivity.⁴ The debate over hot and cold abstraction was also blind to its own perpetuation of gender stereotypes. It was predicated upon highly gendered Western dualism—the opposition between hard and soft, intellect and instinct, rationality and intuition, objectivity and subjectivity—binary codes like the zeroes and ones that make computers operate. Programmed abstraction implicitly dismissed instinct and intuition as unscientific, at the same time that these modes of reasoning were being culturally stereotyped as feminine, and thereby undesirable.

This chapter examines Molnar’s position between these binaries by looking at her idiosyncratic approach to intuition. Through close readings of her published and unpublished writings from this period, alongside more recent interviews, I examine Molnar’s understanding of intuition as well as how intuition has been historically gendered in both abstraction and computing. As with most postwar art that employs technology, we encounter a slipperiness between the domains of art and science, made evident in their shared vocabularies. In fact, art/science becomes a sort of meta-binary, with art encompassing all that is soft, intuitive, warm, feminine, and science being hard, logical, cold, methodical, and more serious. I suggest that Molnar shared many concerns with the programmed abstractionists, even harboring some internalized misogyny as a result. But she also diverged from her peers by acknowledging the inevitability of artistic subjectivity, even in highly ‘objective’ systems.

Her hand-drawn intervention in *Carrés concentriques*, which we also find in *A main levée et à la machine* (*Freehand and by machine*, also 1977, **Figure 3.02**), is simultaneously serious and playful, invoking these

⁴ Jayne Wark, “Conceptual Art and Feminism: Martha Rosler, Adrian Piper, Eleanor Antin, and Martha Wilson,” *Woman’s Art Journal* 22, no. 1 (Spring-Summer) (2001): 46.

binaries while also poking fun at their rigidity. The sly humor of Molnar's work, this conversation between *la main froide* and *la main chaude*, invites a queer feminist reading, one that subtly pokes fun at the heteronormative, patriarchal structures underpinning the discourses of both abstraction and computing in postwar Europe. By using *both* the cold and warm hand, Molnar offers a subtle feminist critique, even if she did not self-consciously align herself with feminism. She brought the human and machine into dialogue while also poking fun at the suggestion that art could be completely cold, rational, and objective just by using mathematical tools and methods.

The Stay-at-Home Artist

After participating in Max Bill's *Konkrete Kunst: 50 Jahre Entwicklung* in 1960, Vera Molnar exhibited very little until 1973, when she began participating in group shows of computer art, mostly in France. After her first solo show in 1976 (at age fifty-two), she would not have a major museum exhibition until the early 1990s. After her husband's death in 1993, she strengthened her relationships with galleries and began building an impressive exhibition record; by then she was already in her seventies. A frequent question asked about Molnar: why didn't she show her work sooner? Wasn't she eager to demonstrate that she was a pioneer, that she was one of the first artists to work with computers? Rumor has it that her husband was behind it all. A controlling man, the rumor goes, he held her back from exhibiting for ideological reasons.⁵ The commercial art world was frivolous, shallow, and artists weren't making art for the right reasons. Besides, she didn't *need* to work. While her family fortune had all but dissolved since the war, his income supported them both. And so, Molnar has dryly joked, it was in the role of a "housewife" that she could make art for art's sake—or perhaps more accurately, for science's sake.

⁵ This legend is perpetuated in Ulrike Groos and Eva-Marina Froitzheim, eds., *Zwischen System & Intuition: konkrete Künstlerinnen*, 2021, 77.

While the Molnars opted to never have children, around 1981 they brought home a different bundle of joy: their first personal computer. From this moment, Molnar's studio shifted from the computer lab back to her living room, which allowed her to experiment with programs in between household tasks. "There were actually two machines that helped me: the computer and the dishwasher," Molnar has quipped.⁶ While her husband was the sole breadwinner, Vera Molnar was always working.

Of course, no one understands the dynamics of a relationship other than those who are in it. This is not the only rumor that haunts the legacy of their relationship: since François worked as a scientist while his wife was a stay-at-home artist, there is an assumption that he wrote her computer programs, when, in reality, neither of them were particularly skilled at programming; they often fumbled through lines of code together.⁷ Vera Molnar insists that her husband never forced her to do anything, that it was her own residual communist thinking that made her resistant to participating in any sort of art market.⁸

⁶ Vera Molnar in conversation with the author, November 14, 2020, Paris. Her anecdotes about drawing squares in between loads of laundry recall the "double burden" faced by Soviet women, who, though equal under the law, were expected to be successful in both the workforce and the domestic sphere. See Robert Bird, Christina Kiaer, and Zachary Cahill, eds. *Revolution Every Day: A Calendar*. Mousse, 2017.

⁷ In the 1980s, once the Molnars had their own personal computer, they 'employed' assistants (rumor also has it that they were unpaid), including F. Molnar's graduate students, to help with the technical side of their aesthetic experiments and artworks.

⁸ As a young woman, Molnar had been a staunch supporter of communism, but in her old age she recalls her confidence waning when, after graduating from art school, she briefly worked as an art teacher in the Hungarian countryside and witnessed tremendous and hopeless poverty there. West of the Iron Curtain, the Molnars continued to support leftist politics back home and locally, though François remained more idealistic than his wife. Nevertheless, forty-year-old Vera Molnar proudly declared her politics in a pair of photographs taken on the first of May, 1964, where she poses on a rooftop with the April 29th issue of *L'Express*. The tabloid bears the face of François Mitterand and his polemical article "Coup d'état permanent," which established his position as a left-wing opponent to Charles de Gaulle. Smiling and posing from two different angles, this is no casual snapshot but a conscious signaling of her values. Perhaps coincidentally, this same issue contained a feature on François Morellet in the arts section.

As late as 1989, she defended her resistance to the commercial art world in favor of a commitment to a quiet, systematic practice, in one of her most subversive essays, “Leonardo da Vinci, if he had had a computer” (Figure 03.03):

The use of the computer can help to build a bridge between micro and macro-aesthetics; it can help in the joint implementation of research in art and research on art ... This is even more true today when there is a conspiracy of silence surrounding this kind of work. We must face the facts: the systematic search for art disturbs the peaceful and blissful purr of the lucrative art industry. That art remains a reserve jealously guarded in ignorance; is it in its own interest? Only the direction of history is irreversible; the science of art has already been born.⁹

At the same time, there was more than politics to Vera Molnar’s shyness from the spotlight. There was also an element of self-consciousness, a lack of confidence in her work with the computer, which was so new at the time. “No one cared about what I was doing,” she has repeatedly stated when reflecting on her work from the early 1970s.¹⁰ This narrative, however, seems to suggest that Molnar was toiling alone in her studio for decades, showing her work to no one, which is simply not true. Though she did not frequently exhibit in traditional art museums and galleries prior to 1990, she did show her work through alternative routes: lectures and artist talks, and articles in journals and magazines that circulated internationally. Molnar’s writing is the focus of this chapter, which investigates her exploration of the enigmatic concept of *intuition*, a deeply gendered notion that lingers in the languages—verbal and visual—of both computing and abstraction.

⁹ Vera Molnar, « Léonard de Vinci s’il eût eu un ordinateur », in + - 0, n° 52, février 1989, 21. « L’emploi de l’ordinateur peut aider à constituer un pont entre micro et macro-esthétique, peut aider à la mise en oeuvre conjointe d’une recherche dans l’art et d’une recherche sur l’art ... C’est encore plus vrai aujourd’hui où il y a toute une conspiration du silence qui entoure ce genre de travail. Il faut se rendre à l’évidence: la recherche systématique en art dérange le ronronnement paisible et béat de l’industrie si lucrative de l’art. Que l’art reste une réserve jalousement gardée dans l’ignorance; serait-ce son intérêt? Seulement le sens de la marche de l’histoire est irréversible; la science de l’art est déjà née » (translation mine).

¹⁰ Conversations with Vera Molnar, December 19, 2017; March 30, 2021; April 27, 2021. In Hungarian the expression is “a kutyát sem érdekelte,” or “not even the dog was interested in it.”

As feminist philosopher Genevieve Lloyd notes, in Western thought, intuition has, since the seventeenth century, come to be associated with a specifically “female” thought style, whereas *reason* became associated with educated men.¹¹ This gendering of thought styles—associating intuition with femininity and rationality with masculinity—is rooted in gendered Western dualisms, the same ones that haunt the debate between hot and cold abstraction. Molnar’s work actively diffuses these boundaries, showing us how intuition and rationality, the masculine and the feminine, are not mutually exclusive, but can work in tandem.

‘Feminine’ Intuition

The term intuition (the same word in both French and English) first appears in Molnar’s writing in August of 1975, in her contribution to the American computer artist Ruth Leavitt’s book *Artist and Computer*, published the following year:

My final aim, in common with so many painters of history, is to be able to create valuable works of art *in a conscious way*. Conscious way does not mean in my opinion the suppression of intuition, but its reinforcement by a cognitive process; it does not mean, that painting becomes a matter of logic. Art at its inception is essentially intuitive, it is in its elaboration that intuition needs control and aid by cognition.¹²

This passage reappears almost verbatim in her artist’s statement for her first solo show, *Transformations*, the following summer. In December of 1975, Molnar penned a short text that gives us a better sense of what intuition meant to her, and how loaded this term was at that moment:

¹¹ Genevieve Lloyd, “The Man of Reason,” *Metaphilosophy* 10, no. 1 (1979): 18–37.

¹² Vera Molnar, “Vera Molnar,” in *Artist and Computer*, ed. Ruth Leavitt (New York: Harmony Books, 1976). This mention of intuition echoes François Molnar’s 1960 text for LATINOAMERICA where he also decries “sacred geniuses” and writes, “It would seem, indeed, that all forms of creation, including science, contain their share of intuition. But we try to control our intuition” (Yves Aupetitallot, ed., *GRAV, Groupe de recherche d’art visuel, 1960-1968: stratégies de participation*; Horacio Garcia Rossi, Julio Le Parc, François Morellet, Francisco Sobrino, Joël Stein Yvaral: 7 juin-6 septembre 1998, *Magasin--Centre d’art contemporain de Grenoble* (Grenoble: Le Magasin, 1998).). While she and her husband were clearly both interested in this problem, it is Vera Molnar who repeatedly returns to this point in her writing.

The painter who “creates” in a sacred trance, like a prophet guided only by his blind intuition, is a phenomenon that belongs to a bygone era. In my opinion, painters today must experiment, measure, compare, calculate, program, and be equipped with the greatest possible knowledge and know-how.¹³

Reading these two passages together suggests that Molnar’s aim is not to rid her painting process of intuitive reasoning altogether. Rather, it is to move past a traditional conception of artistic intuition, which she names “blind” intuition (*l’intuition aveugle*), which had become inextricably tied to the myth of artistic genius. As Molnar’s second passage suggests, this concept of intuition had been rejected by many postwar painters, particularly those working systematically. It also carried a religious connotation, which was unsustainable in secular postwar France. By working first with combinatory mathematics, and then electronic computing, Molnar joined this new rank of painters operating on knowledge and know-how. But while many such artists sought to escape intuition altogether, Molnar recognized the necessity of using it in combination with measured, rational methods. Her approach echoes Henri Bergson’s, who insisted that intelligence and instinct—one mechanical, the other organic—are opposite *and complementary*. Neither could be found in a pure form, and in fact the two were bound to mingle.¹⁴ It also recalls Paul Klee, whose own proposition for a “science of art” involved a cooperation of sides: “exact research winged by intuition.” Klee, however, offers not much explanation of what he means by intuition, saying that it “remains indispensable” while also equating it with “genius,” which simply “cannot be taught.”¹⁵

¹³ Vera Molnar, “[Texte Pour Gentilly]” (December 3, 1975), Carton 05: Textes. Original text : « Le peintre “créant” dans une transe sacrée, tel un prophète, guidé uniquement par son intuition aveugle, est un phénomène d’une époque révolue. A mon sens, le peintre d’aujourd’hui doit expérimenter, mesurer, comparer, calculer, programmer, et être muni d’un savoir et d’un savoir faire les plus grands possibles. » (Translation mine)

¹⁴ Henri Bergson, *Creative Evolution*, trans. Arthur Mitchell (Random House, 1944), 149–50.

¹⁵ Jürg Spiller, ed., *Paul Klee: The Thinking Eye: The Notebooks of Paul Klee*, trans. Ralph Manheim (London: Lund Humphries, 1964), 69–70.

The rejection of artistic intuition in postwar painting cannot be divorced from broader gender dynamics in French society at large, especially as women's magazines began encouraging their readers to harness their 'feminine intuition.' But when did intuition become feminine? In *The Sex of Knowing*, French philosopher Michèle LeDœuff traces the history of intuitive thinking and how it came to oppose discursive thought, which refers to "mediated knowledge achieved through reasoning, discussion, internal debate, dialectic, experimentation, deduction," etc.¹⁶ LeDœuff traces the origins of this dualism to Jean-Jacques Rousseau, whose writings effectively discredited intuition as a legitimate mode of knowledge production, though he did not go so far as to project this dualism onto the sexes. The gendering of intuition, she suggests, likely happened when the duality of the sexes was projected onto the question of knowledge, and both were over-simplified. More specifically, the problem arises when masculinity is taken as the universal and the norm, as is so often the case.¹⁷ When rationality becomes valued as the default mode of thought, and masculinity as the default mode of being, then its pseudo-opposite, intuition, is projected onto masculinity's counterpart.

Other scholars argue that this history is even longer. Historian of science Paul N. Edwards suggests rationality, which he defines as "a dispassionate, context-independent, logic-oriented discourse fundamentally separated from its object" has, as both a concept and as a practice, "a very long history of association with masculinity, from Aristotle to Descartes to Locke." The cultural association of computers with rationality and maleness, he argues, is thus historical.¹⁸ Philosopher

¹⁶ Michèle Le Dœuff, *The Sex of Knowing*, trans. Kathryn Hamer and Lorraine Code (New York: Routledge, 2003), 4.

¹⁷ Le Dœuff, 7–8. Descartes, according to philosopher Genevieve Lloyd, theorized intuitions as perceptions that are systematized by reason. It was Spinoza that distinguished intuition as a different form of thought from reason (Lloyd, "The Man of Reason." *Metaphilosophy* 10, no. 1 (1979): 18–37).

¹⁸ Paul N. Edwards, "The Army and the Microworld: Computers and the Politics of Gender Identity," *Signs* 16, no. 1 (1990): 108.

and ecofeminist Val Plumwood also suggests that the polarizing treatment of gender characteristics—women as intuitive, men as intellectual—is as old as Western culture itself. The relationship between femininity and masculinity, she argues, is not merely binarism—“a division of the world into two orders”—or a simple dichotomy, because binaries and dichotomies would imply an equal relation between opposites. Dualistic pairs “present a false dichotomy,” for they are based on a *hierarchy* in which half is inherently inferior to the other.¹⁹ As Simone de Beauvoir famously pointed out, in western thought the feminine exists only in relation to the masculine, and in an inferior position.²⁰ Dualism, Plumwood argues, does not create difference from scratch, but rather capitalizes on patterns of difference that already exist, and re-presents them in a hierarchical way. Dualism reinforces a rigid binary and denies the possibility of continuity between opposites. How do we move beyond binarism when it is so ingrained in western intellectual history? Plumwood’s call-to-action echoes Nochlin’s: we must first unmask “the identity of the master hidden behind the neutral guise of the human and of the ideals of rationality.”²¹

While Molnar’s practice has never been self-consciously feminist, her approach to intuition calls into question the “neutrality” and “rationality” of cold abstraction, which are in turn rooted in these gendered dualisms. While her (almost exclusively male) contemporaries sought to *eliminate* intuitive reasoning through systematic processes, Molnar used systematicity to *investigate* intuition. In other words, Molnar went beyond the binary to ask more nuanced questions: Can intuition be quantified? Can it be simulated using randomness? Before attending to these questions, it is important to

¹⁹ Val Plumwood, *Feminism and the Mastery of Nature* (Routledge, 1993), 51. I thank Femke Reniers for their generosity in suggesting this book.

²⁰ Simone de Beauvoir, *The Second Sex*, ed. and trans. H.M. Parshley (New York: Vintage, 1952). Beauvoir also wrote, “... one is not born a genius: one becomes a genius; and the feminine situation has up to the present rendered this becoming practically impossible” (133).

²¹ Plumwood, *Feminism and the Mastery of Nature*, 68.

understand how intuition has been—and continues to be—gendered in both abstraction and computing.

Gender-Neutral Abstraction

The concept of gender in abstraction is complex, and addressing it exhaustively lies outside the scope of this chapter and dissertation. Recently, the subject of women artists in abstraction has been given long overdue attention in European museums with embarrassingly belated exhibitions such as *Elles font l'abstraction* at the Centre Pompidou and *Zwischen System & Intuition: konkrete Künstlerinnen* at the Kunstmuseum Stuttgart, both in 2021. Most art historical accounts of gender and abstraction revolve around the shifting relationship between painting and decorative art (or “fine” and applied art) in the early twentieth century western Europe, with decorative art viewed as the “natural” domain of women beginning around 1914, as art historian Bibiana Obler remarks.²²

Feminist art historians have long noticed the binary codes underpinning biases against women artists. In her work on Sonia Delaunay—who became a role model to Vera Molnar in her early years in Paris—art historian Whitney Chadwick writes:

The identification of a woman artist’s creativity with the innate and powerful generative forces of nature places women’s productions outside the mediated sphere of male cultural activity. Men study and think; women feel and generate instinctively. In the Western polarizing of mind and body, men are rewarded for being intellectual and theoretical, women for being intuitive and procreational.²³

²² Bibiana K. Obler, *Intimate Collaborations: Kandinsky & Münter, Arp & Tauber* (New Haven: Yale University Press, 2014), 1.

²³ Whitney Chadwick, “Living Simultaneously: Sonia & Robert Delaunay,” in *Significant Others: Creativity & Intimate Partnership*, ed. Whitney Chadwick and Isabelle De Courtivron (New York: Thames and Hudson, 1993), 38–39.

These binaries operate at the level of art history and criticism as well. In 1994, Amelia Jones wrote, “art history pretends that artistic and interpretive authority are gender neutral” but at the end of the day, “the female is still body.”²⁴

While artists like Molnar embraced geometric forms for their neutrality in terms of both gender and politics, the role of women artists in geometric abstraction has been largely overlooked by feminist art historians, who have dismissed their work as an “homage to a typically male visual language.”²⁵ Still, for better or for worse, geometric abstraction has been free of the gendered, bodily readings that plagued more organic abstraction. Eva-Maria Froitzheim’s recent exhibition *Konkrete Künstlerinnen* gave women in geometric abstraction, including Vera Molnar, overdue attention, but introduces them with this peculiar curatorial statement:

The women artists whose works are exhibited here did not allow themselves to be reduced to measurements and figures, but progressed to some extent intuitively. Intuition refers to a moment of insight which is not rational or intellectual, but which comprehends things and phenomena directly, with mind and spirit. In each case, the reality of life in question helps to provide inspiration.²⁶

This well-intentioned introduction unfortunately only reinforces the reductive gender binary that we have seen with the pitting of the machinic against the handmade, hard against soft, rational against intuitive. Such a reading does not account for the complexity of gender dynamics in postwar European geometric abstraction, especially geometric abstraction rendered with computers.

²⁴ Amelia Jones, “Dis/Playing the Phallus: Male Artists Perform Their Masculinities,” *Art History* 17, no. 4 (1994): 547, 564. This bias is explored beautifully in Anne M. Wagner’s chapter on Georgia O’Keeffe in *Three Artists (Three Women): Modernism and the Art of Hesse, Krasner, and O’Keeffe* (Berkeley: University of California Press, 1996).

²⁵ Beat Wismer, “Einführende Bemerkungen zu einem Gebiet komplexer Beziehungen,” in *Karo - Dame: konstruktive, konkrete und radikale Kunst von Frauen von 1914 bis heute: Aarau, Aargauer Kunsthaus, 28. Mai bis 30. Juli 1995*, ed. Beat Wismer (Aarau; Baden: Aargauer Kunsthaus ; L. Müller, 1995), 13.

²⁶ Eva-Marina Froitzheim, “Introductory thoughts,” in *Zwischen System & Intuition: konkrete Künstlerinnen*, ed. Ulrike Groos and Eva-Marina Froitzheim, 2021.

Molnar positions her practice in between concrete/constructivist, conceptual, and computer art, associating these three traditions with rationality.²⁷ Indeed, a geometric abstract vocabulary and ‘scientific’ approach to art as research can be traced back to Russian Constructivism. We might also locate in Constructivism this idea that rational, cold abstraction is somehow genderless. Art historian Christina Kiaer notes that although the Marxist program of Constructivism rejected both conventional notions of artistic genius and the gendered hierarchy between fine and utilitarian arts, it did not quite live up to its “potential to be sexually indifferent.”²⁸ Briony Fer suggests that Constructivism’s promise of sexual indifference was “actually the masculine disguised as the indifferent.” Fer argues that Lyubov Popova’s use of rulers and protractors “invoked the notation of engineers and technical drawing,” a domain that was gendered male in the 1920s. These tools inflected Popova’s lines with “the gendered associations of a dominant form of knowledge” as well as “a neutral, ‘indifferent’ language of rationality.”²⁹ In other words, what was deemed gender-equal or gender-neutral, in practice, leaned masculine. In a similar way, Molnar’s use of computational tools, techniques, and vocabularies imbued her work with a sense of rationality and a subtle masculine authority. At the same time, her lines, like Popova’s, dislodge these tools and vocabularies from their ‘proper’ or intended use, which serves to undermine these very hierarchies.

Molnar’s participation in the postwar revival of *l’art concret* and her co-founding of CRAV in 1960 suggests that she was interested in the suppression of authorship, which by extension implies a

²⁷ « Je me situe entre les trois « con »: les conceptuels, les constructivistes et les computers. » Jean-Pierre Arnaud, “Une Hongroise à Paris: Entretien avec Vera Molnar,” in *Artistes hongrois en France, 1920-2000: autour de la collection Szöüllösi-Nagy-Nemes: [exposition, Angers, Hôtel Bessonneau, 13 avril-15 juin 2002]* (Angers: Présence de l’art contemporain, 2002), 9. She repeats this in Amely Deiss and Vincent Baby, “Entretien avec Véra Molnar,” in *Véra Molnar: Une Rétrospective, 1942-2012*, ed. Sylvain Amic, Couleurs contemporaines (Paris: Chauveau, 2012), 16. Note that « con » is also slang for idiot, as well as a pejorative for a vagina; this word play is lost in the English translation.

²⁸ Christina Kiaer, “His and Her Constructivism,” in *Rodchenko & Popova: Defining Constructivism*, 2009, 145.

²⁹ Briony Fer, “What’s in a Line? Gender and Modernity,” *Oxford Art Journal* 13, no. 1 (1990): 77–88.

suppression of gender identity, though that was never a stated aim of the founders. *L'art concret* was, in large part, a rejection of Piet Mondrian's highly *intuitive* approach to geometric abstract painting. Mondrian has been called an "apologist" for intuitive painting practices, for he continued to value intuition as other geometric abstractionists began to suppress it.³⁰ Concrete and 'cold' abstractionists applied the tools, methods, and discourse of science, mathematics, and technology—typically gendered male—to art to apply rationality to the creative process, in order to demystify it and make it universally legible. Their systematic, programmatic thinking was indebted to constructivist practices as well as mathematical systems of thought.³¹ But in the process of debunking the myth of creative genius, they effectively reinforced its masculinity. Erasing subjectivity also erased difference.

Molnar's approach to intuition resonates most strongly with those of other women geometric abstractionists, including the Russian Constructivist Varvara Stepanova and the English Constructionist artist Gillian Wise. Like Molnar, Stepanova was most fascinated by aspects of the creative process that were intangible or irrational.³² For Stepanova, art was not the *result* of research, but rather the *object* of research, the result of which could not be calculated from the outset. Similarly, Gillian Wise—a friend of Molnar's through Wise's one-time partner Anthony Hill—reclaimed the rational as part of an intuitive practice. In a 1968 issue of *Leonardo*, Wise wrote, "Working with a concrete form with discipline... leaves one more conscious of the irrational or non-rational element in taking decisions."³³ Like Molnar, these artists were interested in exploring the

³⁰ Wismer, "Einführende Bemerkungen zu einem Gebiet komplexer Beziehungen," 16.

³¹ See Richard Wright, "From System to Software: Computer Programming and the Death of Constructivist Art," in *White Heat Cold Logic: British Computer Art 1960-1980*, ed. Paul Brown et al., Leonardo (Cambridge, Mass.: MIT Press, 2008), 119–39.

³² Hella Nocke-Schrepper, "«Von der schöpferischen Form zur Konstruktion» - Frauen als Künstlerinnen und Kunsttheoretikerinnen in der russischen Avantgarde," in *Karo - Dame: konstruktive, konkrete und radikale Kunst von Frauen von 1914 bis heute: Aarau, Aargauer Kunsthaus, 28. Mai bis 30. Juli 1995*, ed. Beat Wismer (Aarau; Baden: Aargauer Kunsthaus ; L. Müller, 1995), 28.

³³ Wright, "From System to Software: Computer Programming and the Death of Constructivist Art," 134.

tensions between subjectivity and objectivity, the push and pull between rationality and intuition.³⁴

Rather than suppressing intuitive decision-making, they used rational tools and languages—both visual and verbal—to investigate it with scientific rigor.

“Why should it matter if a square was drawn by a man or a woman?” Molnar has asked me in our conversations about gender. It shouldn’t matter, and I by no means want to formulate a gender-essentialist argument about women’s mark-making or some essential difference between ‘his and her’ geometric abstraction. Rather, I want to look at the gender biases embedded into technologies, into materials, and even into shapes and formal languages. For even in its lack of Pollock-style machismo, geometric abstraction manages to read as a masculine visual language. And in many ways, Molnar’s fluency in this language earned her a seat at the table—she participated at conferences on perceptual psychology, was the only female member of the Sorbonne-based *Art et Informatique* group, and was convinced that her gender was inconsequential, irrelevant, and uninteresting to the study of her work.

By looking closely at women abstractionists who used the gendered tools and discourses of the hard sciences to investigate intuition and irrationality, which had been gendered feminine and implicitly devalued on those grounds, we may thus begin to see geometric abstraction as a more heterogeneous domain than previously understood. While these artists’ practices were by no means self-consciously feminist—in fact, Molnar would wholeheartedly reject this term—I suggest that there is a proto-feminist bent to interrogating the role of intuition within a domain that worked so hard to suppress it.

³⁴ The question of subjectivity is foregrounded in my previous dissertation chapter, “Love Story: Conversations with the Computer Screen.”

Hard And Soft Computing

It was not only in the domain of painting that the role of intuition was being gendered, and implicitly devalued. This emphasis on rational, systematic art practices, which reached its peak in what Sean Keller dubs the “scientific sixties,” coincided with major shifts in the gender dynamics of the computing industry as well as the rise of what cultural historian Kristin Ross calls “technocratic masculinity” in postwar France.³⁵ Technocracy in this context refers to the intersection of technology and bureaucracy controlled by an educated elite. Produced with the tools of the military-industrial-educational complex and plotted on the same paper as census reports and early studies in artificial intelligence, early computer art had a distinctly technocratic aesthetic that recalled the “aesthetics of administration” that art historian Benjamin Buchloh observes in early conceptual art.³⁶

While those with the most control and power over the tools and discourse of computing insisted on its neutrality in terms of both gender and politics—emphasizing the egalitarianism of science—this neutrality was merely a new masculinity in disguise. The powerful industry of postwar computing, growing at an exponential rate, was in fact gendered overwhelmingly masculine. The gendered history of computing looks a bit different in France than in the United States or the United Kingdom, where “computers” first referred to women who operated early mainframes in the 1940s (**Figure 03.04**). France only began manufacturing large computers in 1954, when the Société d’Électronique et d’Automatisme (SEA) secured a military contract.³⁷ After the French government

³⁵ Sean Keller, *Automatic Architecture: Motivating Form After Modernism* (Chicago: The University of Chicago Press, 2017), 52; Kristin Ross, *Fast Cars, Clean Bodies: Decolonization and the Reordering of French Culture* (Cambridge, Mass.: MIT Press, 1995).

³⁶ Benjamin H. D. Buchloh, “Conceptual Art 1962-1969: From the Aesthetic of Administration to the Critique of Institutions,” *October* 55 (1990): 105–43.

³⁷ Chantal Morley and Martina McDowell, “The Gendering of the Computing Field in Finland, France and the United Kingdom Between 1960 and 1990,” in *Connecting Women: Women, Gender and ICT in Europe in the Nineteenth and Twentieth Century*, ed. Valérie Schafer and Benjamin G. Thierry, 1st ed. 2015, *History of Computing* (Cham: Springer International Publishing: Imprint: Springer, 2015), 124, 132.

launched the Plan Calcul to develop a national computer manufacturing industry in 1966, computing was strongly backed by public policy, seen as the “branch of the future.” It was during the 1960s and 70s that the figure of the professional “computer scientist” emerged.³⁸ The archetypal French computer scientist was a “technicist” who believed computers would improve working conditions and communications. He [sic] valued experimentation and self-motivated learning. An engineering degree was not a prerequisite; like today, one could become a computer scientist by simply knowing the right people and having the aptitude to learn on the job.³⁹ Like the geometric abstract painter, the postwar technocrat did not exude testosterone or machismo, but embodied a more straight-laced, rational masculinity that often paraded as a sort of gender-neutrality.

On a superficial level, women were encouraged to join the computing industry; as early as the 1950s, “advertisers used images of women to convey the simplicity of using computers” (**Figure 03.05**).⁴⁰ However, women in France were systematically excluded from both formal and informal education and networks in the computer programming profession, and as a result were excluded from positions of power and treated like outsiders even if they had spent decades in computing.⁴¹ In French society at large, women and technical activities were considered fundamentally incompatible. As computer science was the product of four typically masculine domains—the military, engineering, industry, and universities—it implicitly maintained the historical sexual division of labor

³⁸ Hélène Stevens, “The Professional Fate of Woman Engineers in the Computer Sciences: Unexpected Reversals,” *Sociologie Du Travail* 51S (2009): e18.

³⁹ Stevens, e19.

⁴⁰ Morley and McDowell, “The Gendering of the Computing Field in Finland, France and the United Kingdom Between 1960 and 1990,” 132. Conversely, “Such advertising campaigns may have given rise to the idea that women working in the field of computer science were less skilled.”

⁴¹ Morley and McDowell, “The Gendering of the Computing Field in Finland, France and the United Kingdom Between 1960 and 1990.” A telling example is that of Alice Recoque, who with Françoise Becquet designed the CAB500 computer at SEA around 1957. This was a very early conversational machine, a forerunner of micro- and personal computers. While Recoque went on to design other successful microcomputers, she was never promoted to a position of responsibility because “small computers”—though they would become the machines of the future—were not technically part of the national Plan Calcul.

despite its newness.⁴² This was the environment Vera Molnar entered when she asked the computer lab director to allow her to experiment on their machines and was received with laughter.⁴³ On the one hand, the unexplored territory of emerging technologies offered great potential for artistic experimentation. On the other hand, artists like Molnar remained doubly marginalized in the mainstream art world, first as women artists and then as media artists.

As the computer lab remained an overwhelmingly masculine space, the advent of personal computing in the 1980s, which brought computers into the domestic space, had the potential to level these gender hierarchies. But PCs were not yet user-friendly in the twenty-first-century sense; they still required users to learn programming languages, which women and girls had less time for given their disproportionate housework responsibilities.⁴⁴ Even as it became more widely accessible, computing remained what sociologist Judy Wajcman called “an alien culture for girls,” a boys’ club that valorized traditionally masculine approaches to technology.

In her seminal book *The Second Self: Computers and the Human Spirit* (1984), Sherry Turkle distinguishes two different styles of computer programming. In her ethnographic study of schoolchildren learning to computer program in the language LOGO, Turkle categorizes her subjects as “hard masters” or “soft masters.” Paul Edwards paraphrases Turkle’s distinction: “‘Hard masters’ employ a

⁴² Catherine Marry, *Les femmes ingénieurs: une révolution respectueuse* (Paris: Belin, 2004); Sherry Turkle, *The Second Self: Computers and the Human Spirit*, 20th anniversary ed., 1st MIT Press ed. (MIT Press, 2005); Edwards, “The Army and the Microworld”; Stevens, “The Professional Fate of Woman Engineers in the Computer Sciences: Unexpected Reversals,” e19.

⁴³ There is a notable parallel between gender dynamics in Cold War era computing and new media art practices. In 1983, a French government study of working women reported that many felt the computer science field was less marked by gender stereotypes than other areas of engineering that had a longer history (Morley and McDowell, “The Gendering of the Computing Field in Finland, France and the United Kingdom Between 1960 and 1990,” 126). This echoes some women artists’ views that the new media arts were easier to break into because they lacked the gendered baggage of “old master” artists (Vanalyne Green, “Vertical Hold: A History of Women’s Video Art,” in *Feedback: The Video Data Bank Catalog of Video Art and Artist Interviews*, ed. Kate Horsfield and Lucas Hilderbrand (Philadelphia: Temple University Press, 2006), 24).

⁴⁴ Judy Wajcman, *Feminism Confronts Technology* (University Park, Pa.: Pennsylvania State University Press, 1991), 95.

linear style that depends on planning, advance conceptualization, and precise technical skills, while ‘soft masters’ rely on a less structured system of gradual evolution, interaction, and intuition.”⁴⁵

Turkle maps these two types of mastery onto the “two cultures” divide between the arts and sciences: “Hard mastery is the mastery of the planner, the engineer, soft mastery is the mastery of the artist: try this, wait for a response, try something else, let the overall shape emerge from an interaction with the medium. It is more like a conversation than a monologue.”⁴⁶ Though mastery style is, in principle, based on “personality,” Turkle admits that, in her study, “girls tend to be soft masters, while the hard masters are overwhelmingly male,” a result she contributes to cultural conditioning: girls are taught negotiation and compromise, while boys are taught decisiveness and control as pillars of “male behavior.”⁴⁷ While she does not establish a hierarchy between these two approaches, Turkle’s invocation of the hard/soft dialectic implicitly suggests that, as Wajcman writes, “Soft mastery is culturally constructed as inferior.”⁴⁸

Programming Intuition

Turkle’s “soft mastery,” in its emphasis on the interactive back-and-forth between user and machine, might be used to describe Molnar’s mode of working with the computer. In the previous chapter, I introduced what Molnar dubbed her “conversational” method in the mid-1970s, a term I suggest she borrows from the French word for interactive computing. The conversational method employs a mainframe computer, a CRT vector graphics display (an early computer screen), and a plotter to create iterative series of ‘drawings.’ We saw how this was not merely a systematic painting process, but also a design for a controlled aesthetic experiment. With one isolated variable, little external

⁴⁵ Edwards, “The Army and the Microworld,” 103.

⁴⁶ Turkle, *The Second Self*, 101.

⁴⁷ Turkle, 105.

⁴⁸ Wajcman, *Feminism Confronts Technology*, 156.

stimuli, and her attention focused on the screen in front of her, Molnar could concentrate on the parameter change that occurred before her, as well as her response to it. The aim, I argue, was to investigate subjective, artistic choice.

At a moment when artists and researchers were invested in removing artistic subjectivity from the creative process, in an effort to challenge the traditional notion of artistic ‘genius,’ Molnar showed the futility of aiming for a rational, ‘objective’ approach to art-making. She was well aware that even a computer program had to be authored. Instead of resisting her subjectivity, she focused her attention on better understanding it. In the previous chapter, I discussed Molnar’s quest to pinpoint a “threshold” of qualitative change in the image before her. This phenomenon went by different names over the course of her career, from *un état esthétique satisfaisant, le fait d’art*, or *un événement plastique*. Whatever she called it, it was thanks to the CRT display that Molnar could systematically study it, by isolating the window in which this moment happens.

That moment of aesthetic decision-making, Molnar suggests, is essentially “intuitive.”⁴⁹ While computer artists and conceptual artists alike, from Manfred Mohr to Sol Le Witt, warned against the interference of artistic intuition during the execution of a program, Molnar permitted her own intuition to intervene so long as it was “controlled” by using a “strict methodology.”⁵⁰ That is, her intuition could only inform decision-making on one variable at a time.

What was an intuitive decision for Molnar? Like Klee, she does not explicitly define this in her writing, and her position on the matter seems to shift around over the course of her career. This is

⁴⁹ Vera Molnar, “Regards Sur Mes Images,” *Revue d’Esthétique*, no. 7 (1984): 117, <http://www.veramolnar.com/?p=998>; Vera Molnar, “Fax to Vincent Baby: Description Du Programme ‘Molnar’ 1974-1976,” 2002.

⁵⁰ Vera Molnar, *Transformations – Vera Molnar (The Concourse Gallery, London, 10 June – 2 July, 1976)*, 1976.

perhaps because intuition is, at its core, elusive, and it is precisely this elusiveness that Molnar is chasing after. In her series *Transformations* (Figure 6), for example, for each iteration the x- and y-coordinates of the concentric squares' corners were determined not by Molnar herself, but by an algorithm called a pseudorandom number generator (PRNG).⁵¹ Prior to working with computers, Molnar had used dice, as well as a telephone book, to introduce random numbers into her *machine imaginaire* programs.⁵² Random numbers introduced a degree of mechanical objectivity, meaning Molnar only had to focus on making one subjective decision at a time.⁵³ In other words, not having to decide where to place the squares allowed her to focus on the *effect* of displacing the squares from one composition to the other. This is where her intuition came into play. As she moved from one image to the next, sometimes toggling back and forth between two versions, she made an intuitive decision about which one to keep. This was a choice that the computer was not (and arguably *could not be*) programmed to make on its own. Here, intuition enters the work not through the gesture of the warm hand, but in a methodical intervention, one that only the artist is privy to.

A quarter century after making *Transformations*, Molnar stated in an interview, “I insist on the more rational side [of art], because intuition and genius are really elusive. I am aware that some things escape me completely.”⁵⁴ Like her 1975 text that railed against “blind intuition,” this statement suggests that for Molnar, intuition does not come from a divine source, nor is it unique to a chosen

⁵¹ It is called pseudo-random because it generates a sequence of numbers whose properties approximate the sequences of random numbers, such as those obtained from rolling dice.

⁵² Vera Molnar, “MOLNDRIAN (1959-1974) - *Hommage à Mondrian*” (1974). Like Molnar, François Morellet also used a telephone book to source random numbers in the 1950s (Yve-Alain Bois, “François Morellet/Sol LeWitt: A Case Study Revisited.” *October*, no. 157 (2016): 161–80).

⁵³ In their seminal work on objectivity, Lorraine Daston and Peter Galison trace scientific image-makers' belief in “mechanical objectivity,” which they employed to “[combat] the subjectivity of scientific and aesthetic judgment.” “Objective” tools like photography were embedded with an ideology of “neutral” truthness. (“The Image of Objectivity.” *Representations*, no. 40 (1992): 82, 111).

⁵⁴ Arnaud, “Une Hongroise à Paris: Entretien avec Vera Molnar,” 9. Original French : « *sur le côté plutôt rationnel, car l'intuition et le génie, c'est vraiment insaisissable. Je suis consciente que certaines choses m'échappent complètement.* ».

few “genius” artists. But as we saw above, Molnar does not try to eliminate intuition from her practice altogether. She recognizes its unavoidability as well as its elusiveness to definition, but that does not stop her from trying to locate and describe it.

Intuition is linked to instinct, the ability to know or understand something without conscious reasoning. As a mode of reasoning, it is the opposite of rationality, which arrives at knowledge through reason or logic. *Randomness* also happens without method or conscious decision. But while intuition became undesirable in the scientific sixties, randomness became the ultimate buzzword—and remains one to this day in the field of creative computing. I suggest that gender plays no small part here.

Ultimately, Molnar’s conversational method is designed to elicit an aesthetic response that is not influenced by cultural factors but is instead rooted in visual perception. When series are executed by hand, Molnar argues, the artist’s choices are subject to be influenced by their “personal whim, cultural and educational background and ease of execution.”⁵⁵ But when the machine comes into play, especially the computer screen, the artist/viewer is prompted to respond to a picture that she had no part in executing herself. The swiftness of Molnar’s method emphasizes the importance of making a split-second decision from the gut. By isolating this moment of decision-making, this threshold of (her) aesthetic satisfaction, Molnar comes close to scientifically describing this elusive moment in the creative process.

⁵⁵ Vera Molnar, Untitled text [“*Pour Los Angeles et Canada*”] (January 1975), Carton 05: Textes: Anglais. Original text is in English.

This offers a subtle but significant difference from the approach of her close friend, the painter François Morellet, who also used chance procedures to neutralize subjectivity in his own “programmed experimental painting.” In his studies of Morellet’s and Kelly’s systematic painting practices of the 1950s, Yve-Alain Bois notes that both artists recognized the impossibility of eliminating subjectivity so long as they were the ones choosing the system that generated the art. Their “extraordinary insight,” Bois writes, was to incorporate chance processes into the design of the system, which would bring an element of arbitrariness that could “eliminate all subjective determination.”⁵⁶

By offering a close look at Molnar’s process and situating it in relation to other computational art practices at the time, I suggest that Kelly’s and Morellet’s use of randomness was not so extraordinary. In fact, the German computer artists of the “Stuttgart school,” influenced by the philosopher Max Bense, also employed PRNGs in their programs to similar effect.⁵⁷ To these artist-engineers, randomness connoted total objectivity. I am suggesting that their “randomness” was chance cloaked in technocratic clothing, shed of any of its mystical connotations.⁵⁸ Technocratic randomness became a masculine foil to feminine intuition.

One of the few computer artists besides Molnar who self-consciously invoked intuition was Frieder Nake, who belonged to the aforementioned Stuttgart school. In his article “On the inversion of

⁵⁶ Yve-Alain Bois, “Ellsworth Kelly in France: Anti-Composition in Its Many Guises,” in *Ellsworth Kelly: The Years in France, 1948-1954*, ed. Mary Yakush, trans. Gregory Sims (Washington, D.C.: National Gallery of Art, 1992), 26; Yve-Alain Bois, “François Morellet/Sol LeWitt: A Case Study,” in *Artistic Exchange: Acts of the 28th International Congress of Art History, Berlin, July 15–20* (Berlin: Akademie Verlag, 1992); Yve-Alain Bois, “François Morellet/Sol LeWitt: A Case Study Revisited,” *October*, no. 157 (2016): 161–80.

⁵⁷ Christoph Klütsch, “Information Aesthetics and the Stuttgart School,” in *Mainframe Experimentalism: Early Computing and the Foundations of the Digital Arts*, ed. Hannah Higgins and Douglas Kahn (Berkeley: University of California Press, 2012), 72.

⁵⁸ On the connection between intuition and mysticism, Molnar distances herself from the geometric abstract painter Aurélie Nemours, though their work is often exhibited together in France and in Germany.

information aesthetics,” published in an issue of the Zagreb-based publication *bit international* titled “dialogue with the machine,” Nake raises many similar points to Molnar. However, I quote Nake at length to emphasize how drastically different his style was:

Each painter is a restricted picture generator. So is each picture generating program. At all times, artists have applied the same method most computer programs employ: they tried to vary a theme as often as possible in order to attain a ‘best’ (in their judgment) object. [...] In practice, we have of course a combination of these: we pre-select, generate, and select, U’ = (PS, U, S).

[...] Everything we know in advance about the pictures that are to be produced, we can advantageously put into the pre-selector PS; everything we are not able to predict about the pictures, we must leave in the selector S. In [12] I described one way of defining pre-selectors by choosing an ‘aesthetic program’ (R, M, I); here R denotes a ‘repertoire of signs’, M ‘set of syntactic rules’ to combine these signs, and I an ‘intuition’ that chooses, during the process of production, the signs out of R and the rules out of M.⁵⁹

For Nake, intuition is reduced to a variable *I* that can be programmed. He can control *I*, dialing it up or down. By attempting to quantify intuition, Nake seems to push it further away from subjectivity. While Molnar expresses similar ideas about intuition to Nake, she stops short of describing intuition with a mathematical formula.⁶⁰ Instead, she emphasizes its elusiveness, and attempts to locate it using a scientific method, her “conversational” method.

Une dance à deux

Molnar was not the only computer art pioneer to adhere to a (pseudo-)scientific method. German art historian Christoph Klütsch argues that working with computers signaled a major methodological shift for artists. Instead of working in a traditional mode of trial and error, “computer artists set up an experimental situation, scientifically describable and repeatable.”⁶¹ But this methodology, I want

⁵⁹ Frieder Nake, “On the Inversion of Information Aesthetics,” *Bit*, no. 7 (1971): 61.

⁶⁰ A note in Molnar’s *Journaux intimes* about Nake’s “simulation” of intuition, from June 1, 1984, indicates that she was reading or revisiting his text then.

⁶¹ Klütsch, “Information Aesthetics and the Stuttgart School,” 72.

to add, was not limited to computer art. It also resonates with what French philosopher of art Sarah Troche calls *le hasard méthodique* (methodical chance), a particular strain of twentieth-century art that she contrasts to *l'esthétique de l'accident* (the aesthetics of the accidental). *Le hasard méthodique*, exemplified by the practices of Marcel Duchamp, François Morellet, and John Cage involves the systematic use of chance procedures, working with rules that could be executed by anyone, which thereby destabilized the traditional concept of the artist-genius. Like a scientific experiment, the results of these processes are describable and repeatable. Morellet epitomizes Troche's first category by his avoidance of *la main chaude*, which he associates with the valorization of genius in traditional painting, instead opting for *la main froide*, the symbol of methodical rigor.

L'esthétique de l'accident, on the other hand, is irreducible to a precise description of technique. This category encompasses artists who work with chance procedures that *cannot* be repeated, such as the *informel* painters (Dubuffet, Fautrier, Wols) and the poster-boy abstract expressionist Jackson Pollock. Troche cites Dubuffet, who famously quipped that starting a painting is akin to embarking on an adventure where one does not know the destination. Painting, for Dubuffet, is a “*dance à deux*” with chance. The more visible the artist's hand—*la main chaude*—is in the work, the more expressive it is. For these painters, Troche seems to suggest, chance is inextricable from genius, neither being describable nor repeatable.⁶²

Molnar's approach to chance, as we have come to understand it, disrupts the neatness of Troche's otherwise useful categories. Like Morellet and Cage, Molnar works with a meticulous set of rules and instructions. She employs the PRNG to introduce objectivity into her process and insists on employing a “rigorous method” to debunk myths of artistic genius, decisions led by “blind

⁶² Sarah Troche, *Le hasard comme méthode: figures de l'aléa dans l'art du XXe siècle*, 2015, 24, 29, 32–34.

intuition.” She ‘draws’ with a literal *main froide*—the mechanical arm of the computer plotter—and identifies as an *abstraction froide* painter.

At the same time, Molnar’s approach to painting most closely echoes Dubuffet’s. She embarks on each series like an adventure, with an openness to where it might lead her. The drawings she makes using the “conversational method” cannot be repeated, for they entail a *dance à deux*, an interaction, between Molnar and the CRT screen that only she, with her particular aesthetic responses, can produce. While Molnar claims to not make art “solely for personal satisfaction,” the pictures she shows us are only those that she has already vetted.⁶³ Molnar uses systematic processes to question artistic genius without attempting to completely automate the artistic process. She brings *la main froide* in conversation with *la main chaude* in order to disrupt these dichotomies. Molnar shows us how the two can work together to help us better understand creativity and perception, to demystify it without necessarily quantifying it. Her practice suggests that chance processes and intuitive reasoning can, in fact, be employed in tandem.

In an undated, unpublished text likely written in the early 2000s, Molnar suggests that she simulates “the human” in her computer drawings by “injecting a certain percentage of awkwardness and irregularities” into her programs.⁶⁴ In recent years, however, Molnar has seemed to suggest that intuition, that mode of reasoning which distinguishes humans from computers, might be programmable after all. As early as 1989, she writes, “Thanks to the possibilities offered by randomness generators, one can imitate, simulate (in computational terms) artistic intuition.”⁶⁵ More

⁶³ Vera Molnar, “Toward Aesthetic Guidelines for Paintings with the Aid of a Computer,” *Leonardo* 8, no. 3 (1975): 189.

⁶⁴ “*J’injecte un certain pourcentage de maladroitness et d’irrégularités dans le dessin en faisant de ‘l’humain’ artificiellement.*” Molnar, Vera. “Description Du Programme ‘Molnar (1974-1976)’” manuscript faxed to Vincent Baby on October 25, 2002. Also in Molnar archives: Carton 05: Textes: Français.

⁶⁵ Vera Molnar, « Léonard de Vinci s’il eût eu un ordinateur », in + - 0, n° 52, février 1989 (4, 6).

recently, when asked by curator Hans Ulrich Obrist to reflect on the role of randomness in her work, Molnar replied:

[...] if you replace the word ‘random’ with ‘intuition’, there you have it. With intuition, suddenly you say – now what if I used a curve instead of a straight line and what sort of a curve? And then you try it – that’s intuition. Randomness does the same thing.⁶⁶

Nowadays, Molnar refers to randomness as *l’intuition artificielle*, artificial intuition.⁶⁷ This elision of intuition and randomness belies the discrete role that these concepts have played in her practice, especially in the early days of interactive computing. At the same time, Molnar’s remarks draw attention to what intuition and randomness have in common: they both operate without conscious reasoning, and they both carry a sense of immediacy. Intuition and randomness both entail a split-second decision, implemented without rumination. Perhaps, she suggests, they are not so different. However, proposing that randomness and intuition “do the same thing,” smooths over what I believe is a productive friction between the two. Molnar’s experiments suggest that while randomness can be programmed, intuition cannot. I want to suggest that while randomness and intuition do *not* “do the same thing,” in Molnar’s practice, they must be used—like zeroes and ones—to complementary effect.

I am not suggesting that Molnar was consciously working against this gendered dimension of intuition. By embracing rationality in the sense of logical reasoning, it seems she may have even internalized some of these biases against ‘feminine’ modes of reasoning. At the same time, she was one of the only systematic artists of her generation to tackle the question of intuition, to work *with* it rather than against it. Molnar’s practice demonstrates that objectivity and subjectivity are not

⁶⁶ Hans Ulrich Obrist, “Vera Molnar in Conversation with Hans Ulrich Obrist,” in *Bookmarks: Revisiting Hungarian Art of the 1960s and 1970s*, ed. Hans Ulrich Obrist and András Szántó (Koenig Books, 2018), 87.

⁶⁷ Conversation with Vera Molnar, August 17, 2022.

necessarily mutually exclusive. Rationality can, in fact, coexist with intuition. As Plumwood suggests, rigid dualism denies continuity. Rather than further entrenching these binary codes—zeroes and ones, feminine and masculine, intuition and intellect, human and machine—Molnar’s work diffuses these binaries and explores the spaces in between. She demonstrates that working in these in-between spaces—between painting and programming, between programmed and intuitive mark-making, between objective systems and subjective input, and between masculine and feminine modes of thinking. These were the spaces where innovations in postwar abstraction could really happen.

Coda

Over four decades after taking a pen to *Carrés concentriques*, Molnar, now in her late nineties, is exasperated by journalists asking her whether she prefers the computer-drawn line or the hand-drawn line. She has not personally touched a computer since the early 1990s, preferring to sketch by hand in her Paris retirement home and dictate instructions over the phone to a more computer-savvy assistant in Germany, who “cleans up” her drawings on the computer, redrawing them using computer-aided design (CAD) software. Even still, she maintains that this is the wrong question. “It’s like asking a little kid, who do you like better, your mom or your dad? Or, better yet, what do you like better, inhaling or exhaling?”⁶⁸ You can’t have one without the other. ■

⁶⁸ Vera Molnar in conversation with the author, May 8, 2021.

Epilogue

By tracing the continuous lines in Molnar's work and words, we find many threads that weave in and out, looping back onto themselves. Together, these threads make up a *szővet*, a textile, a life's work, one that is recursive and ongoing, even now, as the artist approaches her hundredth year on earth. The plotter drawings, the screenshots, the *Journaux Intimes*—these objects show us only glimpses into Molnar's complex process, a process characterized by iteration. What I have shown is not a comprehensive account of Molnar's work, but rather an investigation into the way she works. Ultimately, the works I have chosen to focus on from her vast oeuvre and sprawling archives are a result of my own subjective decision-making, my own aesthetic preferences. Like Molnar's drawings and photographs, the words on these pages are only a fragment of my own creative process over the last few years.

While Molnar's work has received much celebration recently, I have sought to bring a critical perspective into the mix, taking her art and her writing seriously while also taking her words with a grain of salt. It is a rare privilege to develop a long-form project like this with access to and support from the artist. There were many roadblocks along the way, including the Big Bad—the COVID-19 pandemic—which Molnar, despite the vulnerability of her advanced age, survived relatively unscathed. After a series of hospitalizations in the spring of 2020, she moved permanently into an assisted living home, an *Établissement d'hébergement pour personnes âgées dépendantes* (residential facility for dependent elderly people, known as an EHPAD), in Paris. No longer having to worry about taking care of herself, Molnar has embraced the EHPAD like an artist residency, churning out project after

project and welcoming visitors on a daily basis to discuss new exhibitions, publications, and commissions.

For me, what was supposed to be a romantic research year in Paris in 2020-2021 ended up looking very different than I had imagined. Jumping over hurdle upon hurdle of bureaucratic obstacles, I finally made it to France in the fall of 2020, just before the second *confinement* sent the city into another lockdown. Without its cafés and museums, Paris was unrecognizable. My daily activities were suddenly limited to the grocery store, walking the dog, one hour of government-sanctioned outdoor exercise, and, remarkably, visits to loved ones in the EHPAD. In this deeply isolating time, Vera Molnar was one of the few people I had regular contact with, as she had generously added me to her list of *proches*—her close friends and family. Our conversations maintained a semblance of normalcy in a wild and turbulent time. We developed not only a strong working relationship, but also a beautiful intergenerational friendship. Speaking our shared mother tongue, Hungarian, quickly brought a sense of intimacy to the relationship, and access to certain memories that she had not previously shared.

As I have written about elsewhere, perhaps the biggest challenge of this dissertation was maintaining respect toward the artist while also finding my own voice, saying what I felt was important to say.¹ I have lost count of how many times a colleague has told me they are lucky to be working on a dead artist. The challenges I have faced, however, relating to the ethics of oral history and the artist interview, are what led me to grow not only as a scholar but also as a person, and if I were to go back to the outset of this project, I would not change a thing.

¹ See my forthcoming essay “Herstory or Mine? Writing Feminist Histories of Art with Self-Mythologies in Mind,” in *Theorising the Artist Interview*, ed. Lucia Farinati and Jennifer Thatcher (London: Routledge).

In the spring of 2021, sitting in the garden of her EHPAD, Molnar showed me a series of drawings she titled *EHPAD-Géométries*, which she had made in one of her notebooks with alternating blank and ruled pages (**Figure 4.01**). On the blank pages, she had drawn a set of interlacing circles, experimenting with different densities of shapes. The circles looked standardized, identically sized, and symmetrical. I asked her if she had used a compass to draw them, and she laughed, saying, “*nyuszikám*, this is a jam jar.”² Without access to the tools and materials that she had collected over decades in her home studio, Molnar has been resourceful, finding ways to keep drawing, experimenting, and researching, with an unrelenting commitment to geometric forms. Drawing seems to be a practice that grounds her, that she reaches for when there is nothing else left. Even before the pandemic, I received a photo of Molnar at the hospital, drawing on the backs of her daily lunch menus as she recovered from a broken wrist (**Figure 4.02**). While the humbleness of these materials is a far cry from the high-technology of her plotter drawings, there is a remarkable consistency to her lines—both the forms she traces and the lines of inquiry she follows.

While I was captivated by the *EHPAD-Géométries*, Molnar reminded me they were rough sketches, ugly things that needed to be “cleaned up” by her assistant, Axel Rohlf, in Germany (**Figure 4.03**). As Molnar doesn’t use email, she relies on snail mail or a friend with a smartphone to send her drawings to Rohlf, an architect by training, who uses CAD programs to redraw Molnar’s forms and transpose them to vinyl on canvas. While Molnar is far removed from the computer these days, her process with Rohlf still involves a back-and-forth, a comparison of different iterations until she

² Vera Molnar in conversation with the author, May 30, 2021. *Nyuszikám*, my little rabbit, is a term of endearment in Hungarian. See Zsöfi Valyi-Nagy, “L’atelier EHPAD: Conversations with Vera Molnar in her retirement home/studio” in *Vera Molnar: Variations* (Beall Center for Art + Technology, April 2 – August 27, 2022), ed. David Familian (Forthcoming).

settles on the ‘right one.’³ We can see the hand-drawn and computer-generated image side-by-side in Molnar’s artist’s book *Main/Machine* (2020, **Figure 4.04**). Despite their back-and-forth, the images Molnar and her assistant make together seem to be missing something. It’s as if the lines are too clean.

In his introduction to Vera Molnar’s first solo exhibition in the United States, curator David Familian wrote, “What distinguishes Molnár from her mostly male contemporaries is how her programs elicited a ‘hand-drawn’ quality in her work that is unexpected given its technological processes.”⁴ It is true that Molnar’s plotter drawings are not coldly machinic, but retain a certain handmade quality even when the artist’s hand is not present. Since the plotter pen moves back and forth, left and right, up and down, it traces back over itself. Moments where the lines overlap or intersect are visible, marked by a darkening where there is a buildup of ink. As the plotter pen navigates around a corner or draws a diagonal line, there is an ever so slight tremor to the line, a small wobble that mimics the imprecision of a hand. These were qualities that Molnar seemed to embrace in the computer-aided image, even thinking up ways to program a tremor to make a machine-made line appear more handmade.

This imprecision, the ambiguity between handmade and machine-made lines, is what draws the viewer closer, to speculate as to how the picture might have been made. When the circles, lines, or squares are programmed in CAD today, they lose these elements of imprecision. There are no tremors, no mistakes, no ambiguities. There is a word Molnar uses to describe the act of making and

³ Axel Rohlf in conversation with the author, February 11, 2022, Bremen, Germany; while Rohlf is unpaid for his work, Molnar chooses two final compositions every time, and lets Rohlf keep one, thus amounting to a sizable collection of works that may one day accrue value.

⁴ David Familian, wall text for *Vera Molnar: Variations*, Beall Center for Art + Technology, University of California, Irvine, 2022.

remaking a mark—*repentir*. While it literally refers to remorse or regret, *repentir*, to Molnar, is an opportunity, a chance to revisit something, to do it differently the second or fifth or hundredth time.

The *EHPAD-Géométries* raise many questions about how we treat the work and the words of aging artists. In the conservation of artworks, for example, there has been a tendency to distrust what an elderly artist has to say about their early work, for it is not ‘authentic’ to who they were when they made it forty, fifty, seventy years ago. The temporal gap between making and reflecting might be too wide; it might cloud our understanding of the work as it was ‘intended’ to exist in the world. Art history has shown a similar bias, teaching art historians to avoid the ‘interference’ of the living artist’s word in their interpretation of a work.

But what if interference is precisely where meaning is made? To return to Jennifer Roberts’s idea of “mis-expertise,” it is in those moments when the artist’s word contradicts the artist’s work, or the artist’s word rubs up against the art historian’s word, that productive frictions arise. These frictions can create sparks that, in turn, create new meaning.

In physics, interference is visualized using geometric forms—two sets of concentric circles, their centers a slight distance apart, so that their superimposition and slight misalignment gives rise to a sense of visual vibration. In art we call this a moiré pattern, a term from the languages of textiles—specifically a type of silk with a rippled finish. While in printmaking, moiré patterns are considered a mistake, a sort of analog glitch to be avoided, for example, a result of the misalignment of silkscreens, their optical effects became interesting to artists and perceptual psychologists in the mid-twentieth century.

Moirés is the title of a series of ten plotter drawings Vera and François made together in 1972, the only works in this medium that they co-signed (**Figure 4.05**). Alternately titled *Cercles, carrés et un triangle gris* (*Gray circles, squares and a triangle*), each drawing explores the interference pattern arising from the misalignment of various concentric geometric shapes, including squares, circles, triangles, and octagons. These works were, to my knowledge, never exhibited or reproduced. They constitute visual research: neither squarely artwork nor scientific experiment or illustration. It is one of the best examples of *la science d'art* that the Molnars spent their careers in pursuit of.

For Roberts, moirés are “irrational effects from the combination of rational elements.” They are “chiropoetic”—not made by the human hand. Their whimsical waves emerge only in the irregular combination of two regular, rational, linear structures. For Roberts, the moiré is both stochastic and rational.⁵ While neither Molnar ever landed on pure objectivity—I would suggest that Vera Molnar never even bothered looking for it—the convergence of their individual, systematic practices gave rise to a moiré, a rationally irrational interference pattern, that caused a ripple effect in both of their respective fields.

Vera Molnar and I will never completely agree on how, exactly, to interpret her work or the relevance of her life to her work. While I often see parts of myself in her, and likely vice versa, we are two individuals, generations and cultures apart. We are like another set of concentric circles, shapes that overlap and overlay, but never in perfect alignment. Our voices create interference, giving rise to a third shape, a ripple, one that is much harder to pin down, which invites us both to see our work—and perhaps even ourselves—in ways neither of us had before. ■

⁵ Jennifer Roberts, “Contact: Art and the Pull of Print. Part Five: Interference,” the 70th A. W. Mellon Lectures in the Fine Arts, 2021.

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Introduction

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Introduction

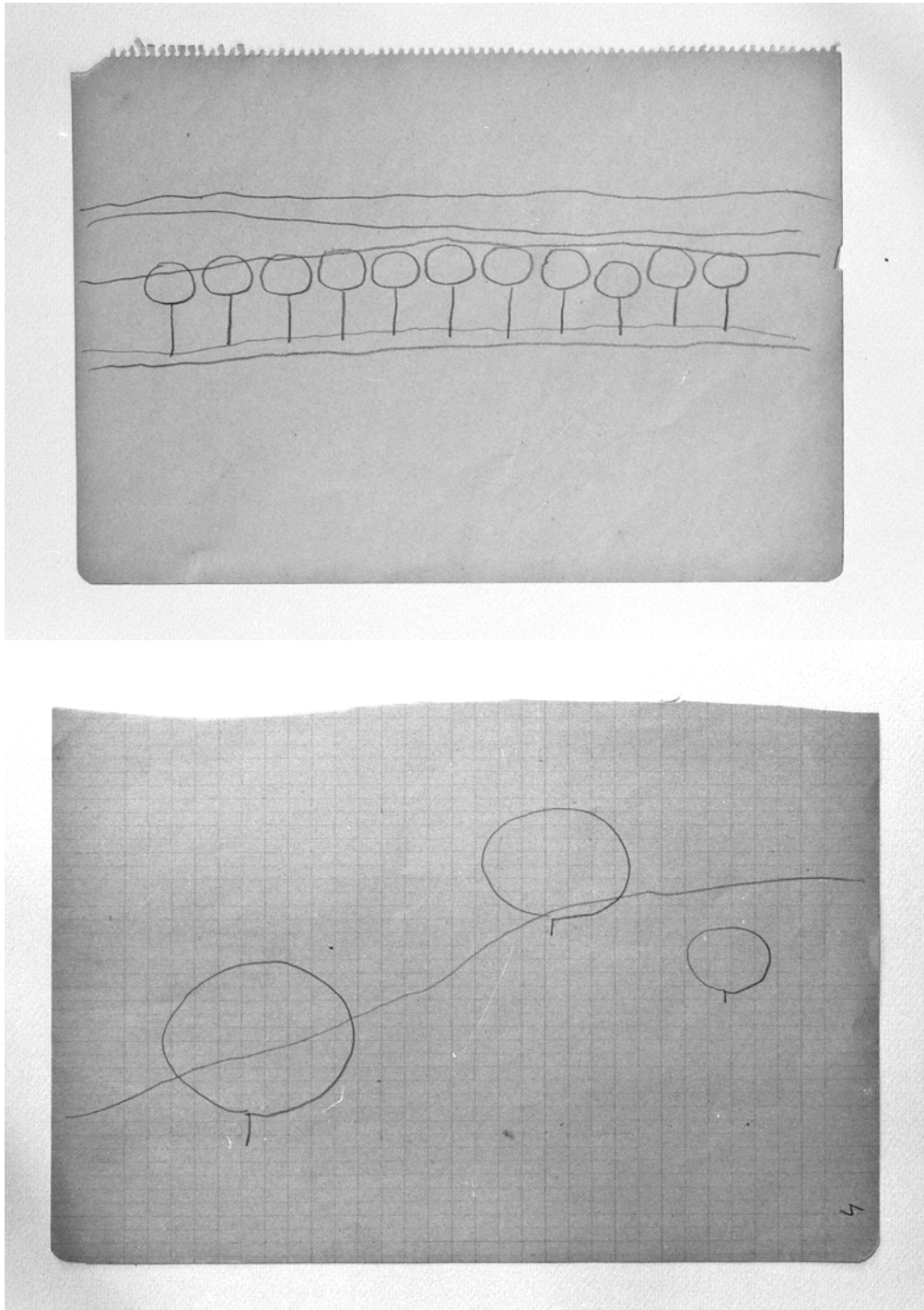


Figure 0.01 Vera Gács (Molnar), *Arbres et collines géométriques*, 1946. Scanned 35mm slides, photos by Vera Molnar, works in collection of Centre national d'art et de culture Georges-Pompidou (Centre Pompidou)

ART CONCRET

GROUPE ET REVUE FONDÉS EN 1930 A PARIS

PREMIÈRE ANNÉE-NUMÉRO D'INTRODUCTION-AVRIL MIL NEUF CENT TRENTE

BASE DE LA PEINTURE CONCRÈTE

Nous disons :

- 1° L'art est universel.
- 2° L'œuvre d'art doit être entièrement conçue et formée par l'esprit avant son exécution. Elle ne doit rien recevoir des données formelles de la nature, ni de la sensualité, ni de la sentimentalité.
Nous voulons exclure le lyrisme, le dramatisme, le symbolisme, etc.
- 3° Le tableau doit être entièrement construit avec des éléments purement plastiques, c'est-à-dire plans et couleurs. Un élément pictural n'a pas d'autre signification que « lui-même » en conséquence le tableau n'a pas d'autre signification que « lui-même ».
- 4° La construction du tableau, aussi bien que ses éléments, doit être simple et contrôlable visuellement.
- 5° La technique doit être mécanique c'est-à-dire exacte, anti-impressionniste.
- 6° Effort pour la clarté absolue.

Carlsund, Doesbourg, Hélion, Tutundjian, Wantz.

1

Figure 0.02 The founding principles of *l'art concret*, published in Jean Hélion, ed. "Art Concret (Revue)" N. d'introduction (1930). Bibliothèque Kandinsky, Centre Pompidou, Paris.

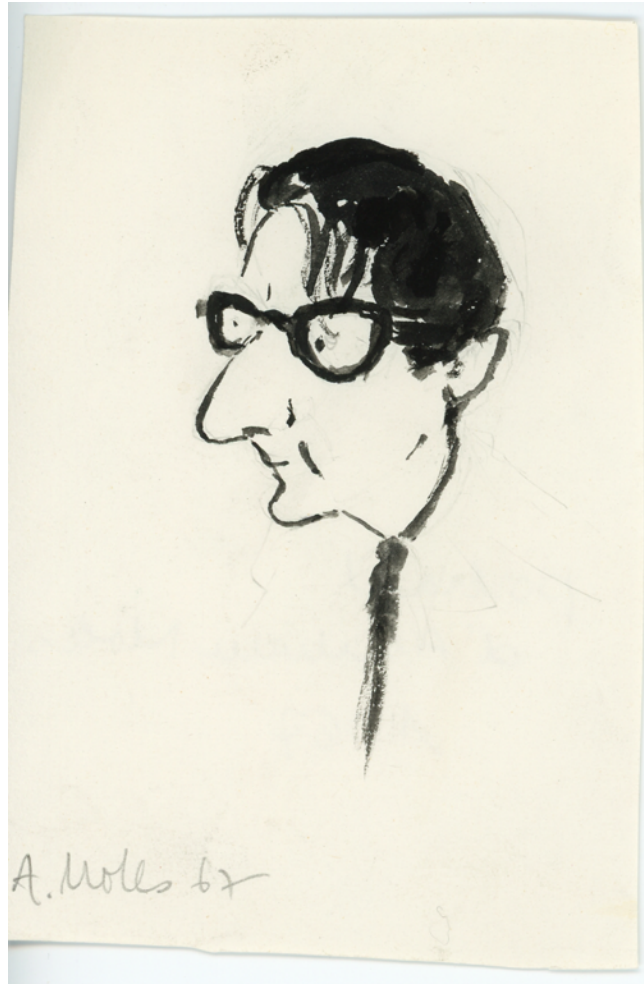


Figure 0.03 François Molnar, Portrait of Abraham Moles, 1967 (Archives Vera Molnar, Paris)

TOWARD AESTHETIC GUIDELINES FOR PAINTINGS WITH THE AID OF A COMPUTER

Vera Molnar*

Abstract—The author makes nonfigurative drawings and paintings that are the results of a procedure in which simple geometrical shapes and their combination were successively altered in specific ways. In 1968 she began to use a computer to assist her. The computer displays (on a CRT screen) images in which shapes and/or their arrangement are altered successively. When she sees a pleasing example that she may wish to execute as a drawing or a painting, she instructs the computer to record it on a plotter. She has studied a number of such series in which alterations occur successively in small steps to determine which alteration is responsible for the appearance of a picture that she judges to be aesthetically superior to those that preceded it. She includes an example of her judgment of the aesthetic quality of pictures chosen from a particular series.

I.

I am a painter, an image-maker, in particular, of images of a nonfigurative kind. I 'create' visual forms in the sense that they consist of combinations of shapes that cannot be found in nature.

I decided that I would become a painter when I was 12 years of age under the influence of an uncle of mine who, in his leisure time, painted a number of scenes of woodland nymphs in twilight. I began by making pictures of nymphs and trees but soon I replaced figurative subject matter by simple geometrical shapes. Later I began to make non-figurative pictures that were the result of a procedure in which initial simple geometrical elements and their combination were successively altered in specific ways, a procedure that I continue to follow. In 1968, I was able to gain access to a digital computer to facilitate the execution of this time-consuming procedure.

I am forcefully impressed by the fact that viewers tend to agree on what they consider as 'beautiful', 'indifferent' and 'ugly' compositional arrangements, in particular arrangements of squares, triangles and dots, which can be produced readily on a computer display. Osgood made psychological tests on artistic taste and found that there is less divergence of taste than is generally believed [1]. Personally, I doubt that 'beauty' is amenable to definition but I shall not explore the question here.

II.

What I should especially like to know is what changes have occurred in a picture on which I am working when it begins to please me. What are the specific elements of a composition that cause it to give to me aesthetic satisfaction and then later to a viewer? I seek a concrete answer, one that entails experimentation rather than philosophical speculations. I am not interested in my subconscious or unconscious states. I should like to avoid even the notion of consciousness and to follow the objective approach of behaviorist psychology.

Of course, to make good pictures one should know not only about composition but also about the psychology of perception and about experimental aesthetics [2]. It would be most helpful to an artist to be able to apply principles of aesthetics but, despite the efforts of painters and others interested in art during past centuries, such principles continue to elude discovery. There are those who believe that such principles do not exist, that art is solely intuitive. Nevertheless, some of these same sceptics have formulated arbitrary rules that, because there were arbitrary, did not have general utility. The principles that I believe exist are in the form of laws that are determined by human physiology and psychology and recent achievements in the human sciences encourage my belief. But I am certain that in order to find them experimental methods of science rather than philosophical speculation will be required [3, 4]. In effect, art can profitably use experimental methods of the physical sciences. But I do not mean to imply that art will become science.

* Artist living at 54 rue Hallé, 75014 Paris, France. Based on a text in French (Received 22 May 1974.)

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III.

I do not agree with those who believe that developments in art simply happen. I am convinced that initiative must be applied to obtain an understanding of these developments and I wish to do my part. Whenever I begin a picture, I have an initial idea of it in mind. The procedure that I use to arrive at the final work, to be described below, is tedious, if carried through by hand. Furthermore, the final picture rarely corresponds to my initial idea of it.

I develop a picture by means of a series of small probing steps and each step is followed by evaluation. In my opinion, painters should employ such a procedure, especially if they consciously wish to learn what of aesthetic importance is occurring on the canvas as the painting develops and what effect the work may have on viewers. Making a series of pictures that are alike except for the variation of one parameter is not uncommon. Many painters from those of Mount Athos to those of today have done this. Claude Monet, a good example, painted both a haystack and the Rouen cathedral repeatedly in different lighting.

When I have an idea for a new picture, I make the first version of it rather quickly. Usually I am more or less dissatisfied with it and I modify it. I alter in a stepwise manner the dimensions, proportions and arrangement of the shapes. When simple geometrical shapes are used, such modifications are relatively easy to make. By comparing the successive pictures resulting from a series of modifications, I can decide whether the trend is toward the result that I desire. What is so thrilling to experience is not only the stepwise approach toward the envisioned goal but also sometimes the transformation of an indifferent version into one that I find aesthetically appealing.

This stepwise procedure has, however, two important disadvantages if carried out by hand. Above all, it is tedious and slow. In order to make the necessary comparisons in a developing series of pictures, I must make many similar ones of the same size and with the same technique and precision. Another disadvantage is that, since time is limited, I can consider only a few of many possible modifications. Furthermore, these choices are influenced by disparate factors such as personal whim, cultural and educational background and ease of execution.

IV.

Using an IBM 370 computer, I have been able to minimize the effort required during the preparatory phase of making a picture. This computer can produce a series of images (the shapes and their arrangement may be simple or complicated) on an IBM 2250 CRT screen and/or of

Fig. 1. Computer drawings, 25 × 25 cm. Top: 'Carrel', 050072/06', 1972 (Collection of Brys-Schraen, Brussels, Belgium); center: 'Carrel', 250173/1', 1973; bottom: 'Carrel', 071273/21', 1973.

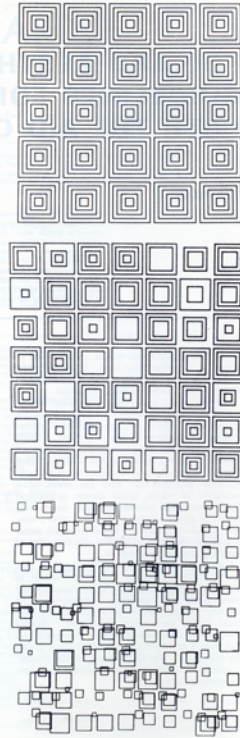


Figure 0.04 Vera Molnar, "Toward Aesthetic Guidelines for Paintings with the Aid of a Computer." *Leonardo* 8, no. 3 (1975), ed. Frank Malina: 185–89 (Archives Vera Molnar)



Figure 0.05 Benson flatbed plotter used for cartography, France, c.1970 (L'Institut national de l'information géographique et forestière)



Figure 0.06 IBM system/370 mainframe computer, 1970s (Jan-Arendt Klingel)

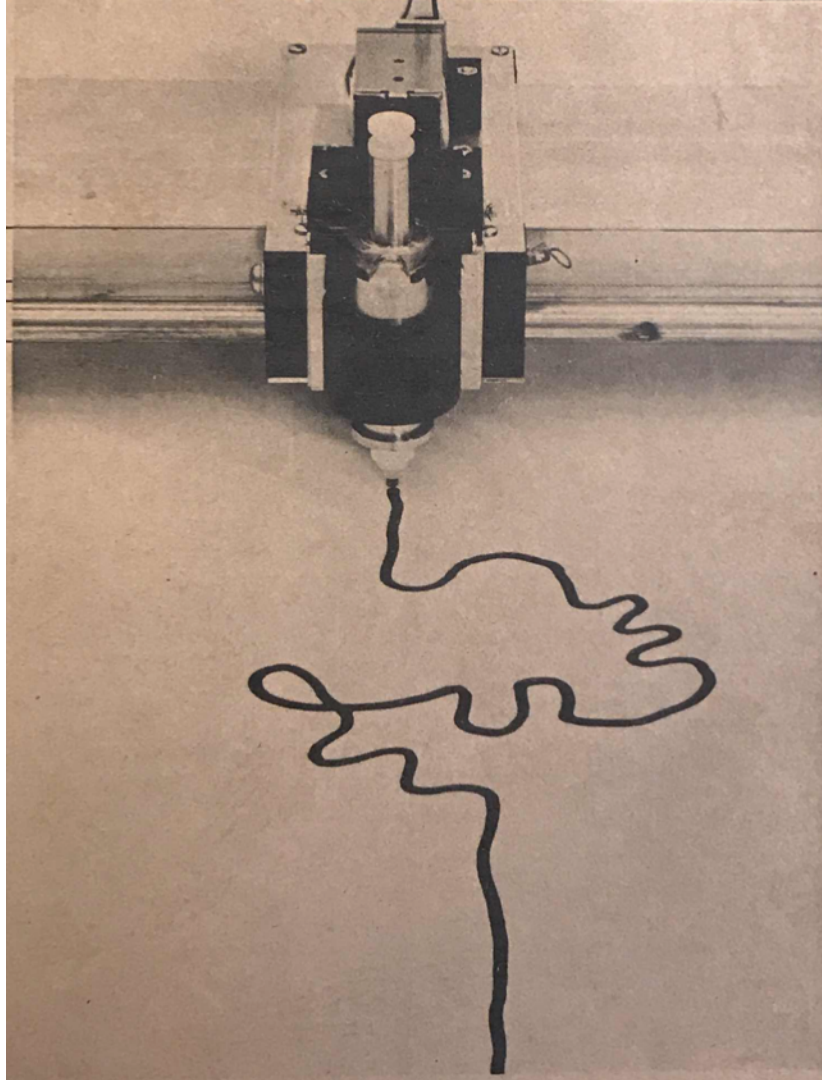


Figure 0.07 Plotter pen from the cover of Coqart, Roger, ed. *Aspeten: De Computer in de Visuele Kunst*
Brussels: Internationaal Centrum voor Structuuranalyse en Constructivisme (ICSAC), 1981



Figure 0.08 Vera Molnar with her BFM personal computer in her studio, Paris, 1993. The large painting on the wall is *Horizontales/5*, 1973, Vinyl paint on canvas, now in collection of FRAC Bretagne (Archives Vera Molnar; scanned 35mm negative)



Figure 0.09 Front and back cover of Centre de recherche de l'art visuel, *Acte de fondation*, July 1960 (Frank Popper Papers, Archives de la critique d'art, Rennes, France. While the name Molnar is only listed once, both Vera and François were founding members.

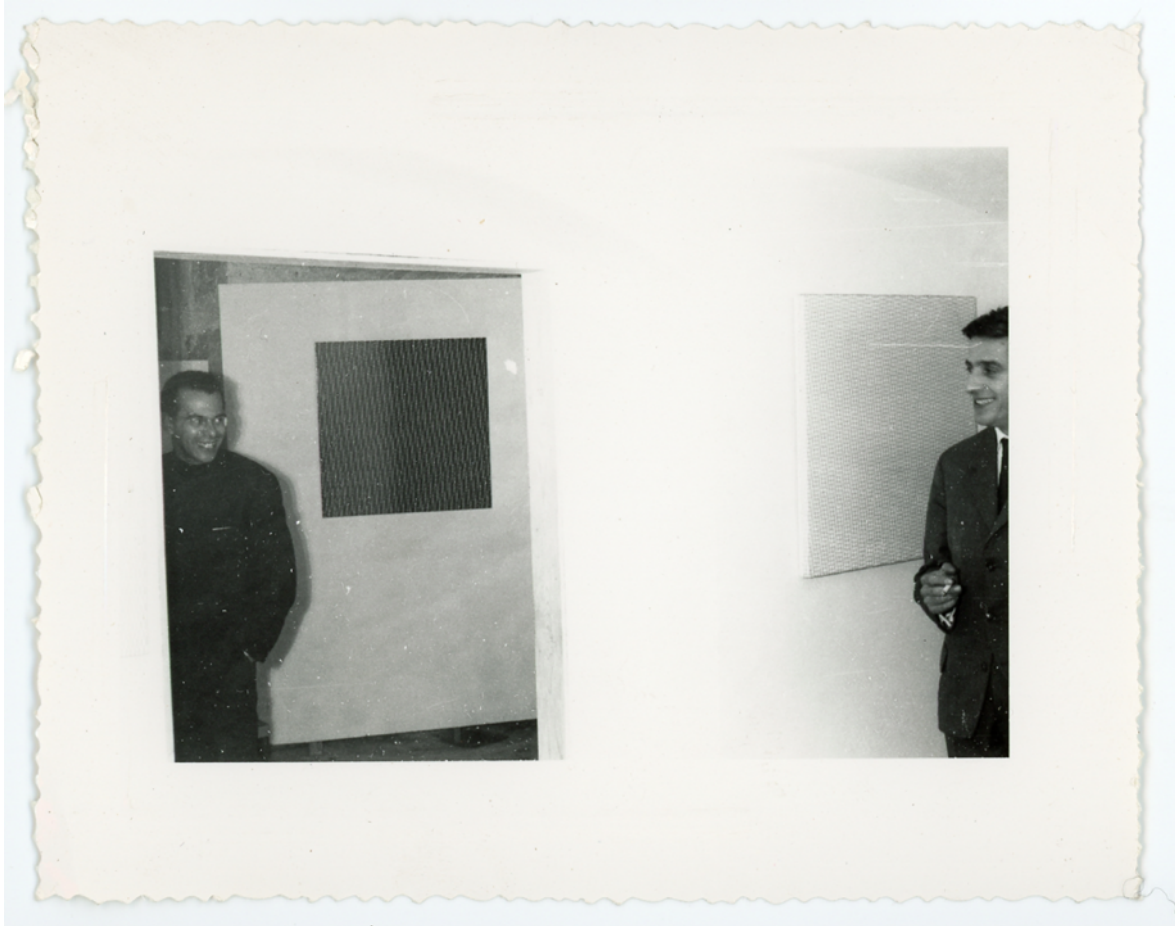


Figure 0.10 Almir Malvignier (left) and François Molnar (right), c. 1962, possibly at a *New Tendencies* exhibition in Zagreb (Photographer unknown, Archives Vera Molnar)



Figure 0.11 François Molnar at home on rue de Gergovie, Paris, 1954. Photo by Vera Molnar.
(Archives Vera Molnar)



Figure 0.12 Vera Molnar at home on rue de Gergovie, Paris, 1954. Photo by François Molnar.
Scanned medium format negative. (Archives Vera Molnar)

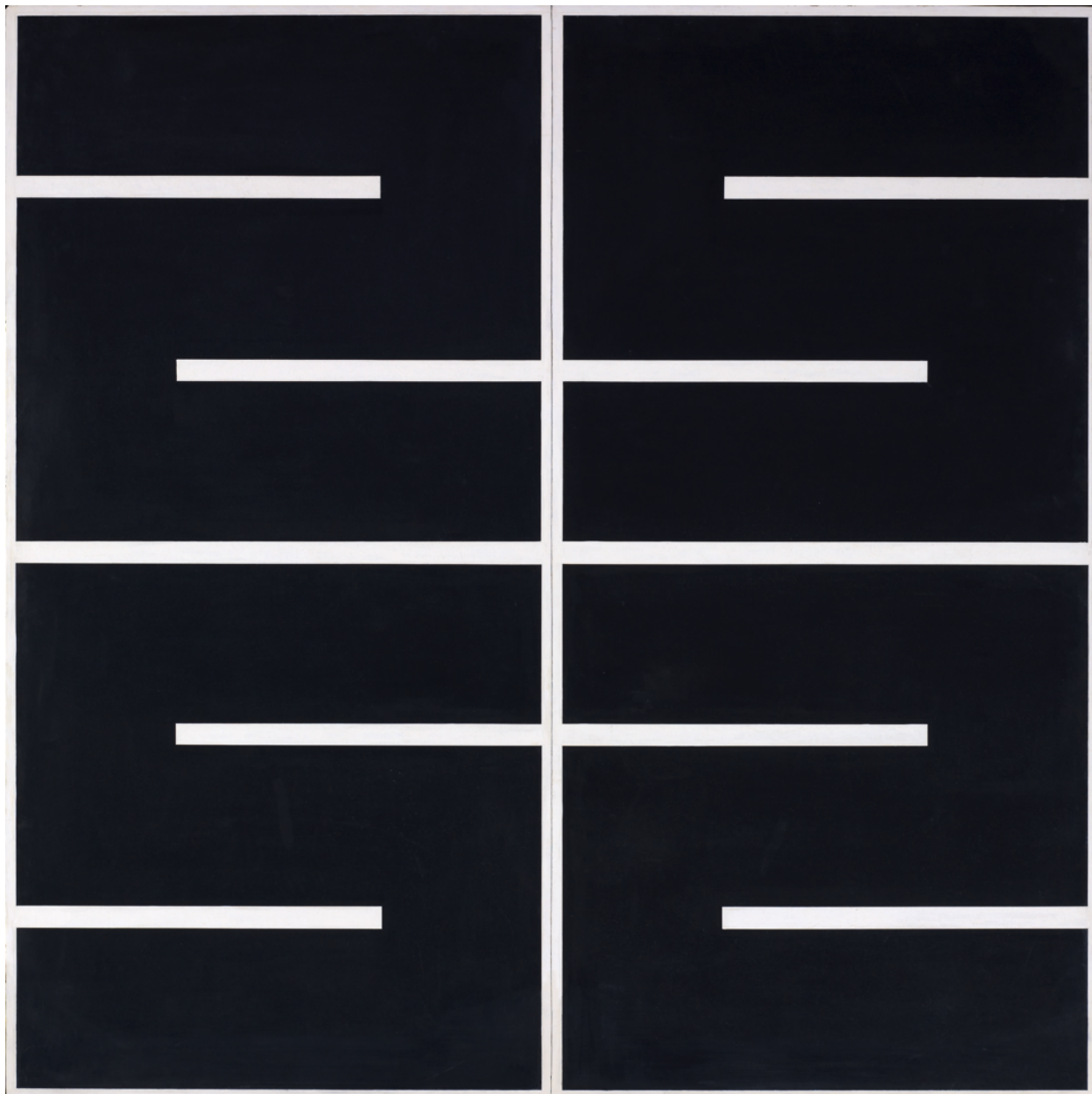


Figure 0.13 Vera and François Molnar, *Effet esthétique de l'inversion des fonctions, par la fluctuation de l'attention*, 1960, Oil or gouache on chipboard, 150 x 150 cm (Ville de Grenoble, France / Musée de Grenoble-J.L. LaCroix © ADAGP, Paris)

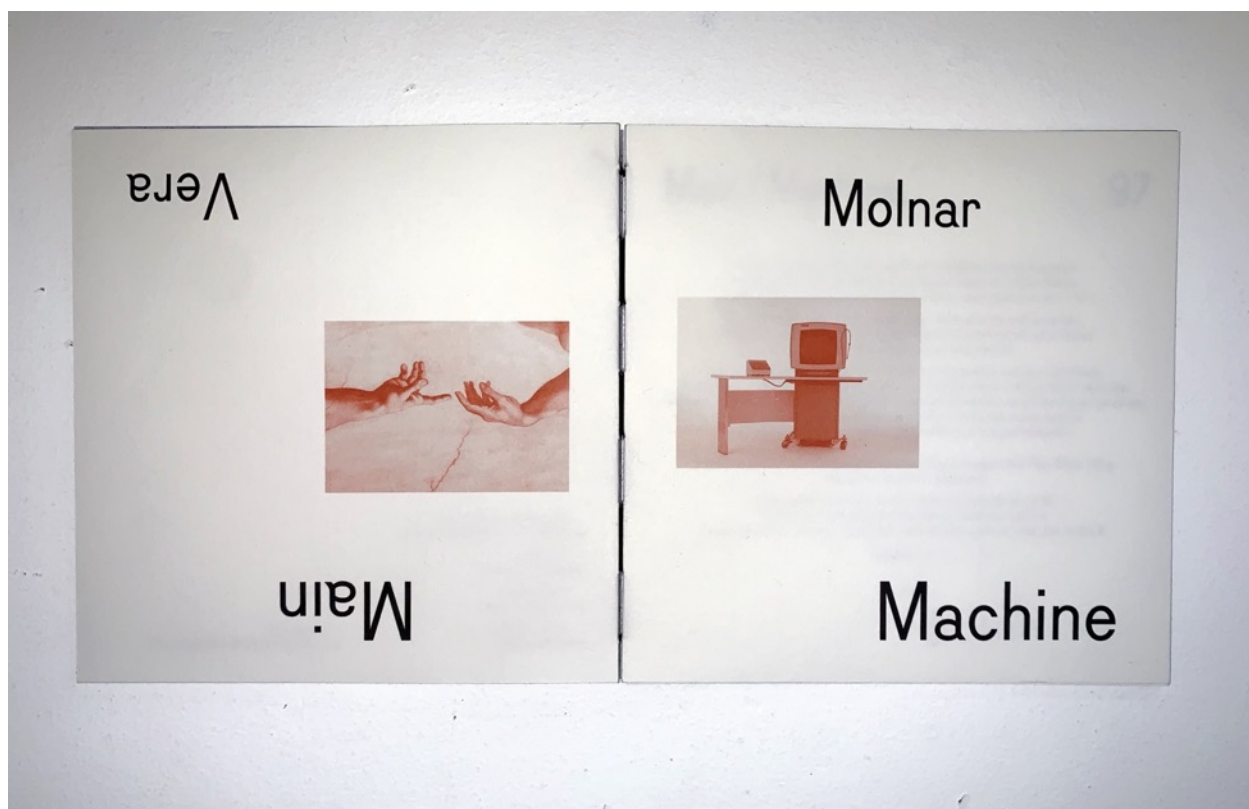


Figure 0.14 Vera Molnar, *Main/Machine*, 2020, Hand-bound artist's book, 16,5 x 16,5 cm, printed on Sennelier, Awagami, and Cromático papers, 80 pages, edition of 45 (Bernard Chauveau Édition, | Galerie 8+4, Paris, France. Photo by the author)



Figure 0.15 Portrait, 1939,, with inscription by Vera Gács (Molnar) (Photographer unknown, Archives Vera Molnar)

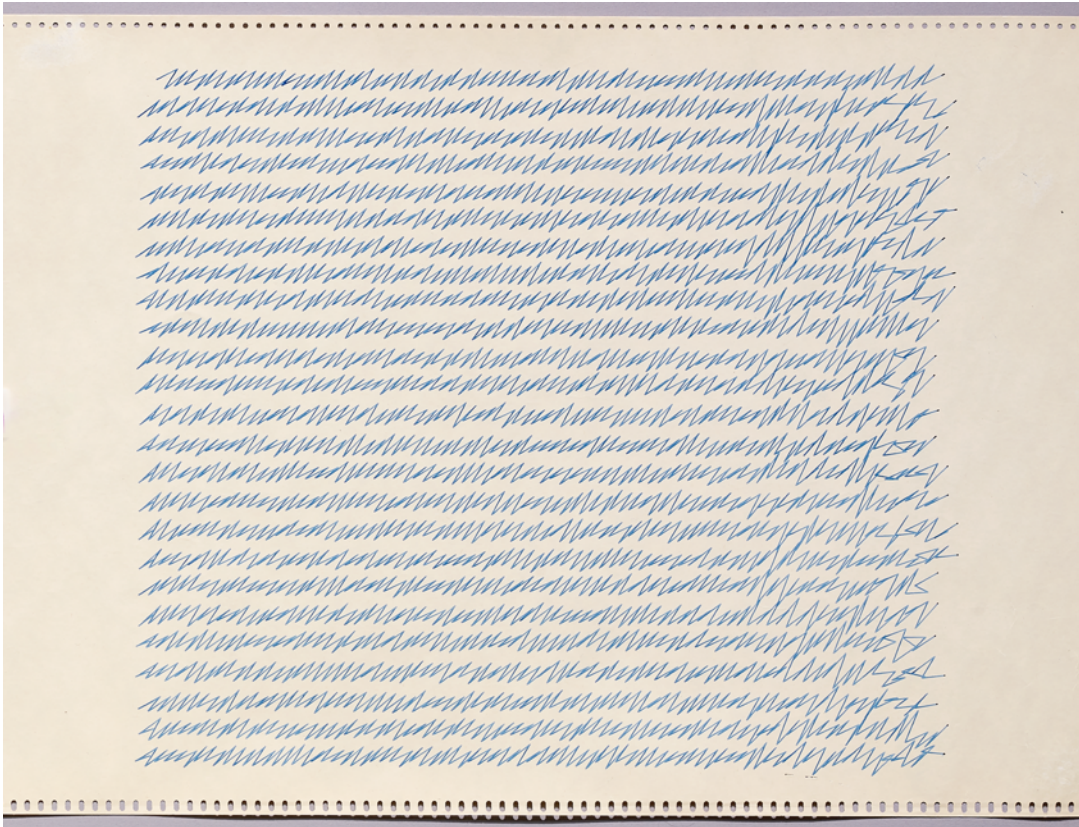


Figure 1.01.01 Vera Molnar, *Lettres de ma mère* (2 of 11 plotter drawings in blue Indian ink on Calcomp roll paper), 1988, total size 30 x. 450 cm (Musée de Grenoble, France © ADAGP, Paris)

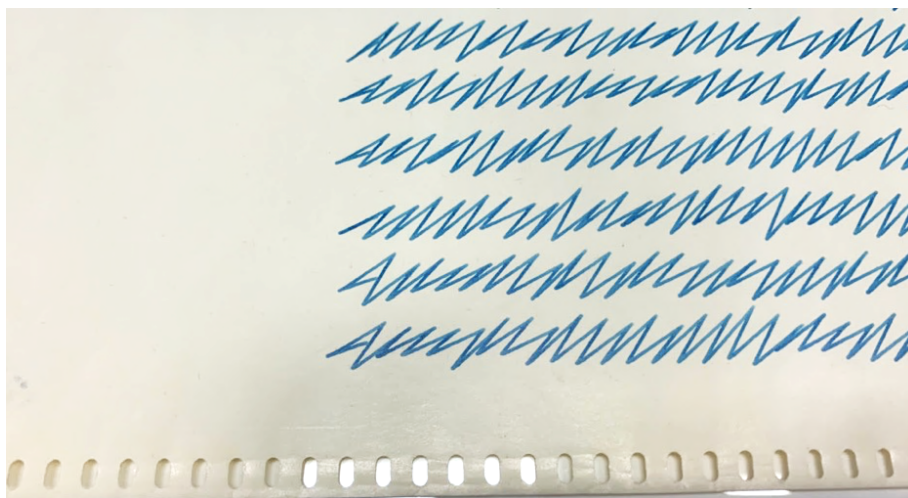


Figure 1.01.02 Detail, Vera Molnar, *Lettres de ma mère*, 1988 (Musée de Grenoble, France ; photo by the author)



Figure 1.02.01 Tektronix 4052 *microcomputer* programmed with an emulation of Vera Molnar's *Lettres de ma mère*, 2022, at the Signallabor at Humboldt University, Berlin, *Germany* (Photos by Julia Sandor, Artykfilm)

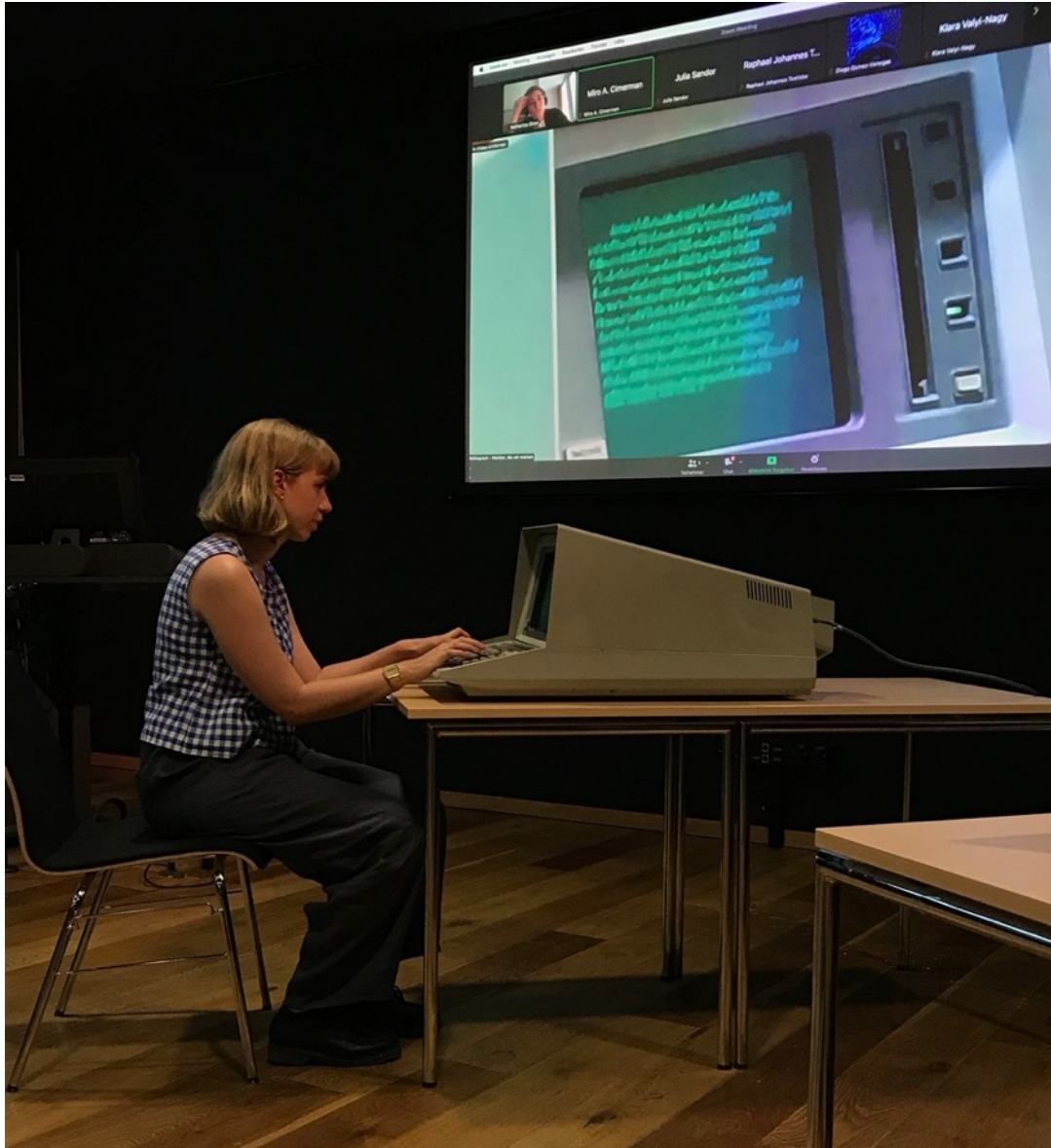


Figure 1.02.02 The author programming a Tektronix 4052 microcomputer programmed with an emulation of Vera Molnar's *Lettres de ma mère*, 2022, at the Institut für Medienwissenschaft, Humboldt University, Berlin, Germany (Photo by Max Boersma)



Figure 1.03 Vera Molnar, *À la recherche de Paul Klee*, 1970, flatbed plotter drawing (ink on paper), FRAC Bretagne

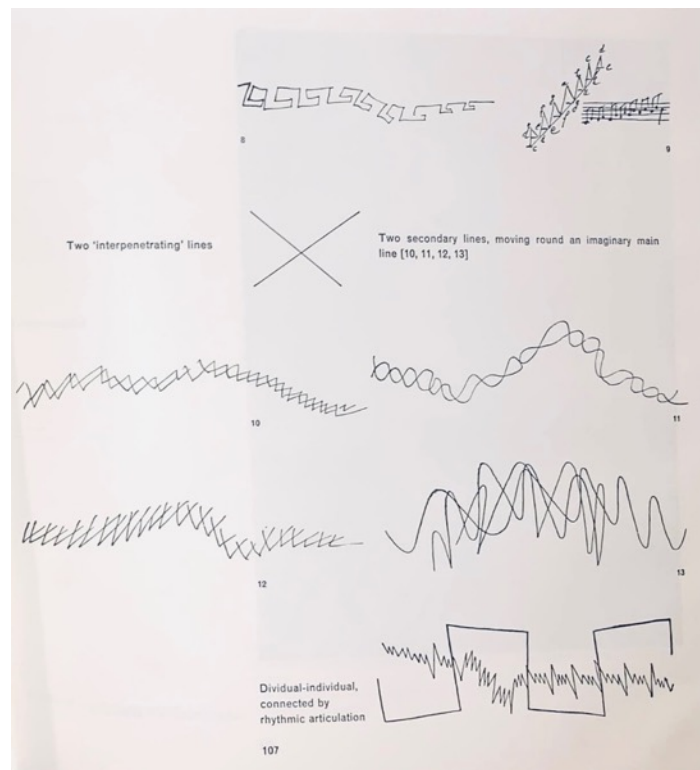


Figure 1.04 Paul Klee's *Notebooks: Volume I: The Thinking Eye* (from the English edition, published 1964, London: Lund Humphries)

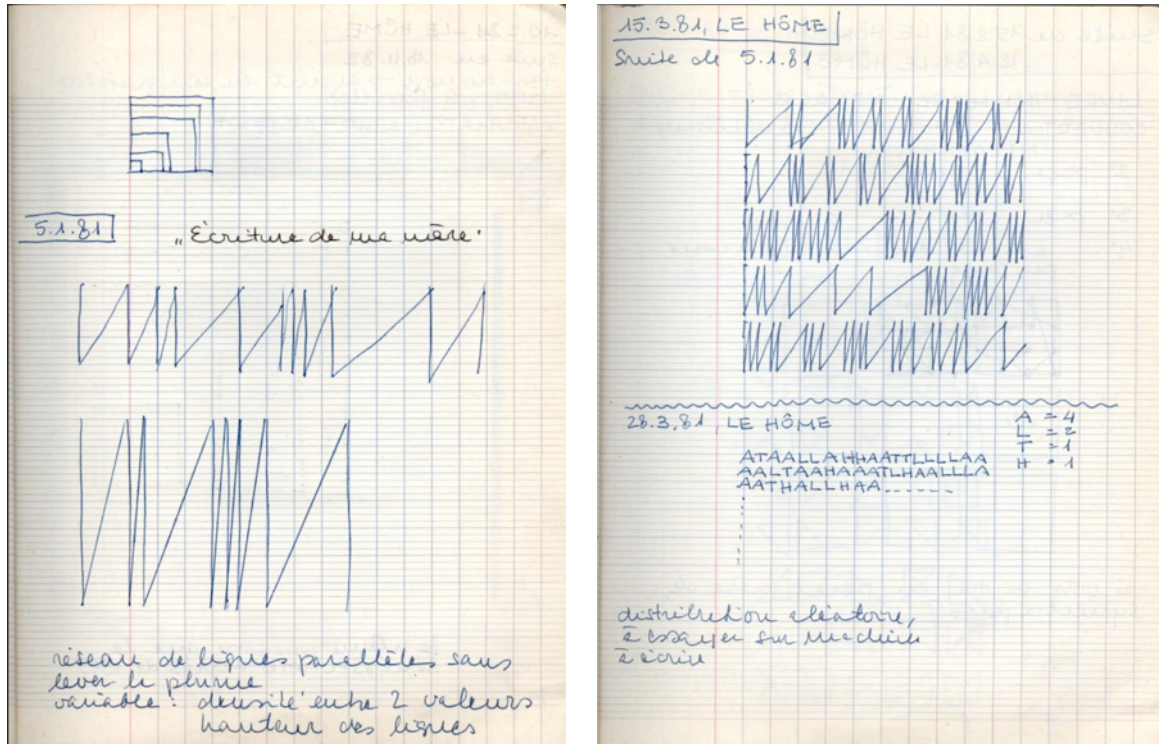


Figure 1.05 Vera Molnar, sketchbook entries from January 5 and March 15, 1981 (Photos by Vincent Baby. *Véra Molnar: Journaux intimes 1976-2003* (interactive CD-ROM), edited by Pierre Braun, Vincent Baby, and Boris Volant. Présent composé. Rennes, Haute Bretagne, France: Université Rennes 2, 2009)

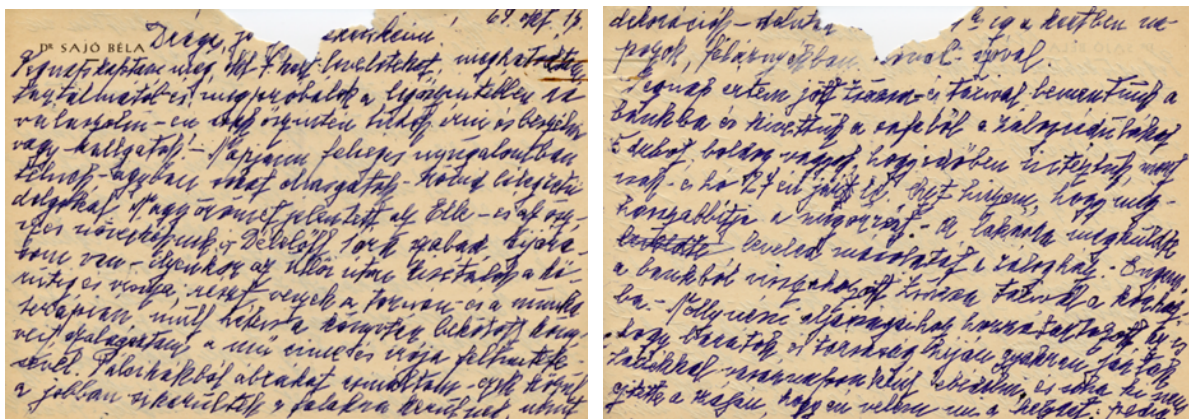


Figure 1.06 Original letters from Vera Molnar's mother, written in October 1969, measuring about 20 x 14.5 cm each (Photo by the author, Archives Vera Molnar)



Figure 1.07.01 The second of nine letters in Vera Molnar's *Lettres de ma mère*, 1988 (FRAC Picardie, Amiens, France)

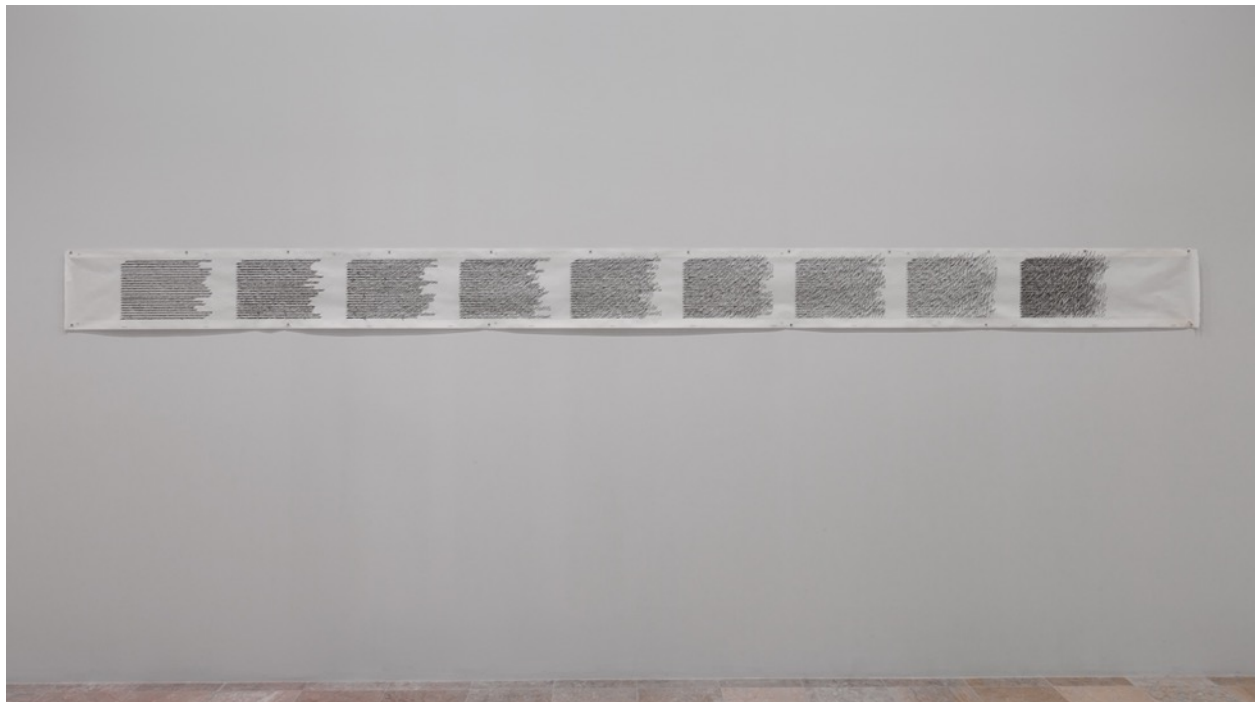


Figure 1.07.02 Vera Molnar, *Lettres de ma mère*, 1988 (FRAC Picardie, Amiens, France)

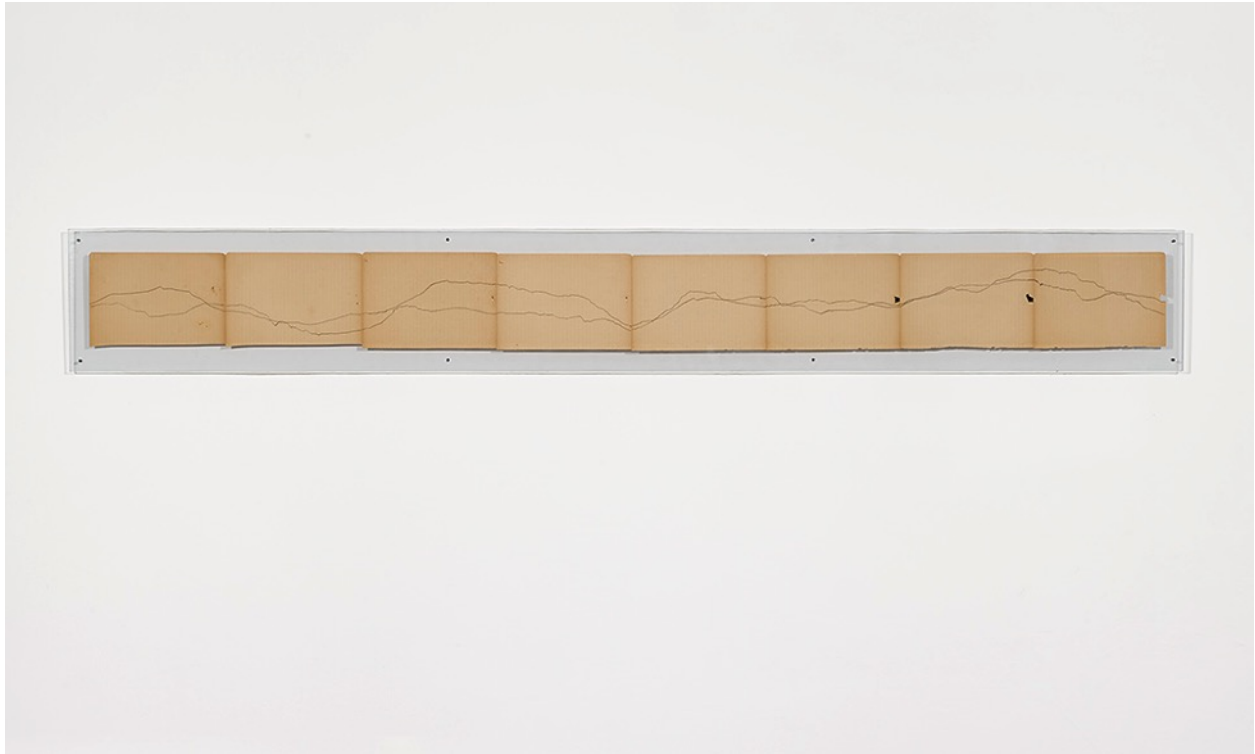


Figure 1.08 Vera Molnar, *Collines géométriques* [*Geometric hills*], 1946, Graphite on eight sheets of A4 paper, 17.5 x 197 cm (Centre Pompidou, Paris, France)

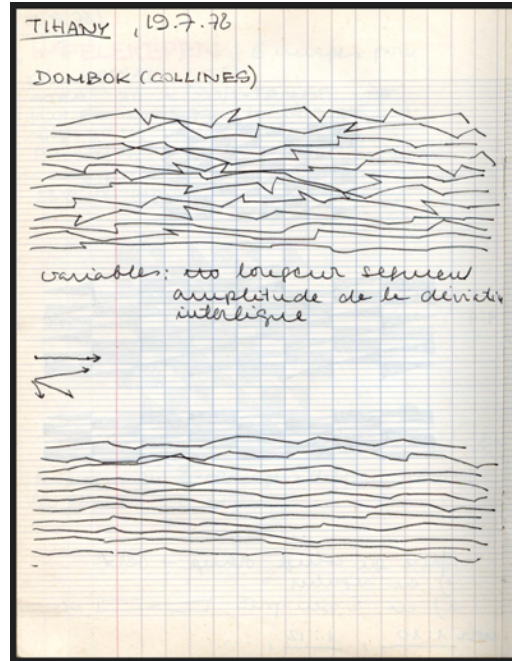


Figure 1.09 Vera Molnar, sketchbook entry from July 19, 1978 in Tihany, Hungary (Photo by Vincent Baby. *Véra Molnar: Journaux intimes 1976-2003* (interactive CD-ROM), edited by Pierre Braun, Vincent Baby, and Boris Volant. Présent composé. Rennes, Haute Bretagne, France: Université Rennes 2, 2009)

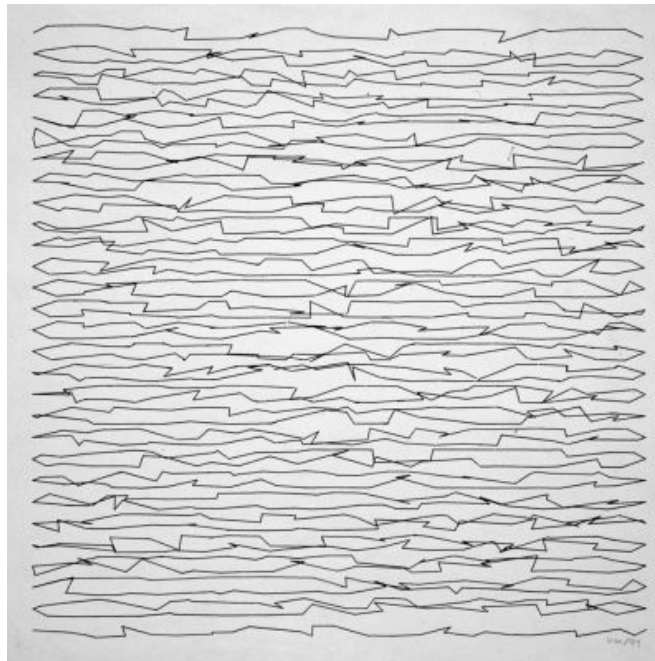


Figure 1.10 Vera Molnar, *Horizontales*, 1971, Plotter drawing (FRAC Bretagne)

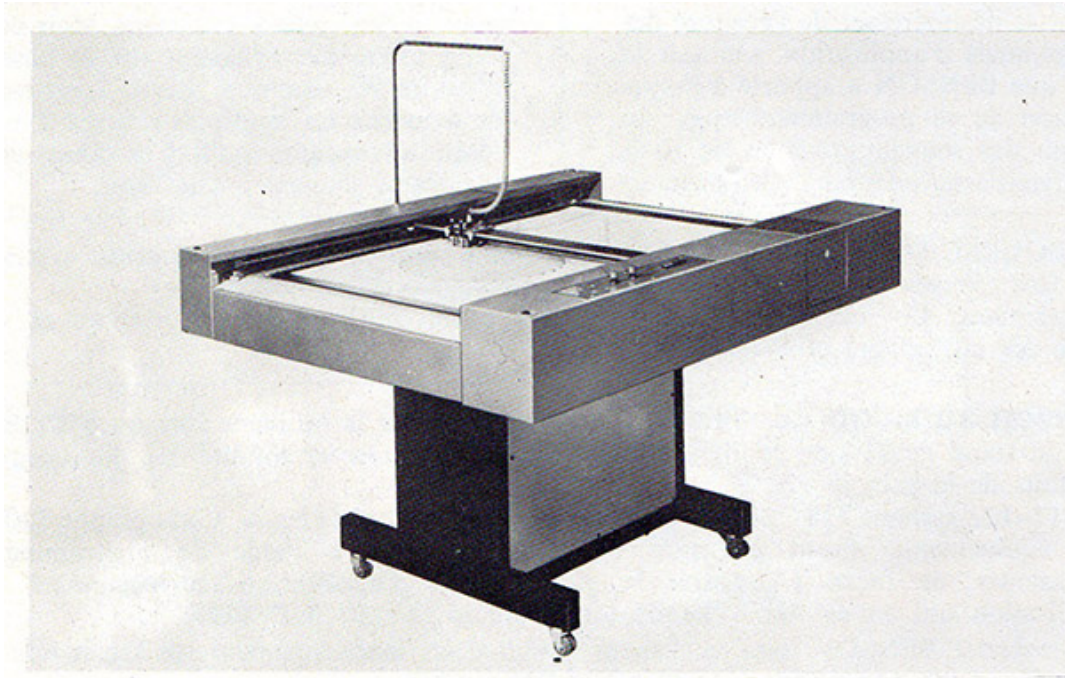


Figure 1.11.01 Benson flatbed plotter, c. 1972 (Manfred Mohr)

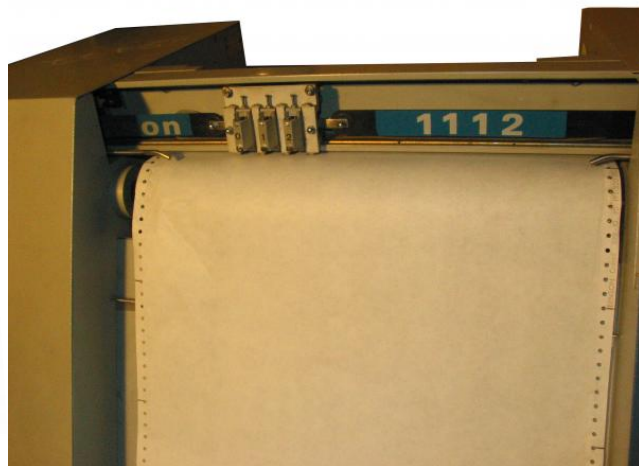


Figure 1.11.02 Benson 1112 drum plotter, c.1980, with 30 cm wide roll paper (Association pour un conservatoire de l'informatique et de la télématique (ACONIT), Grenoble, France)

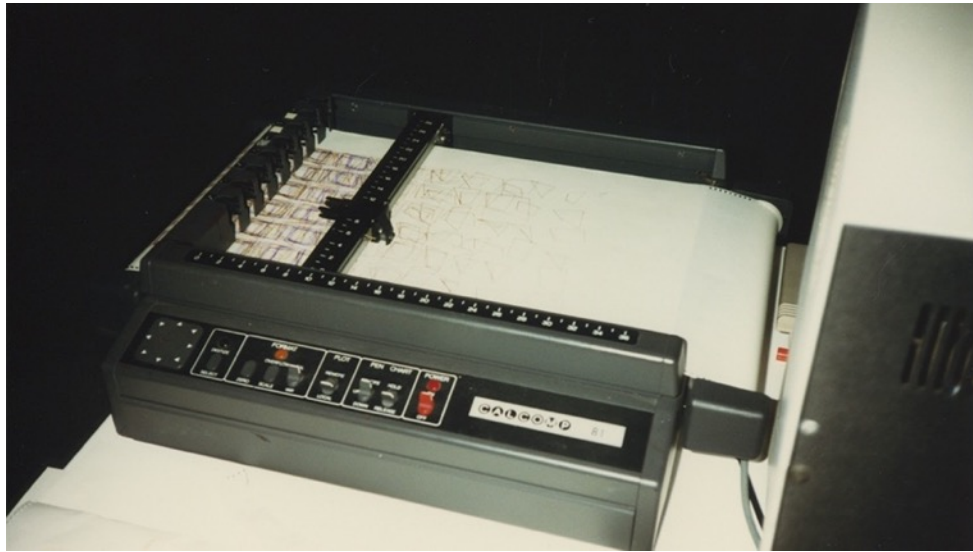


Figure 1.12 Vera Molnar's Calcomp 81 plotter, 1988 (scanned 35mm negative, photo by Vera or François Molnar, Archives Vera Molnar)



Figure 1.13 Vera Molnar with a version of *Lettres de ma mère*, 1988, Le-Hôme-sur-Mer, Normandy (scanned 35mm negative, photo by François Molnar, Archives Vera Molnar)



Figure 1.14.01 Handwriting manual for Hungarian schoolchildren featuring Luttor-style *zsinorírás*, c. 1936 (Photo by Tibor Szikora, Cinketype)

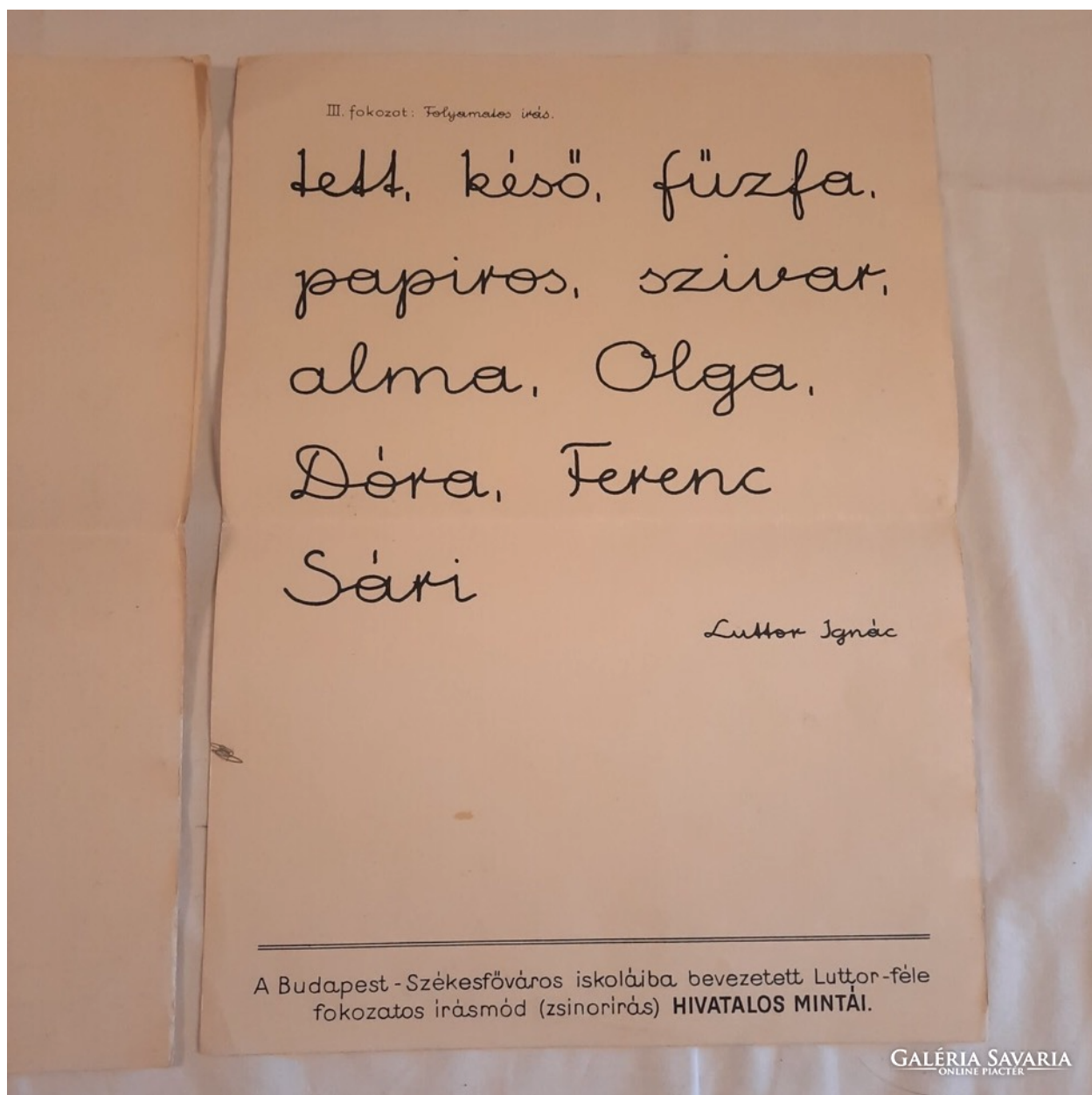


Figure 1.14.02 Official samples from a Lutter-style handwriting teaching aide, c.1939, 34.5 x 25.5 cm (Galéria Savaria)



Figure 1.15 Tracing Molnar's lines at the Signallabor at Humboldt University, Berlin, May 2022
(Photo by Julia Sándor, Artykfilm)

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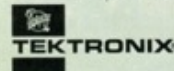
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Figure 1.16 Ad for the Tektronix 4051 microcomputer, the forerunner to the Tektronix 4052. From the April 15, 1976 issue of *Electronics* magazine, page 120 (Public domain)



Figure 1.17 Detail of the Tektronix 4052 keyboard in the archives of ARTA, Centre Pompidou (Photo by the author)

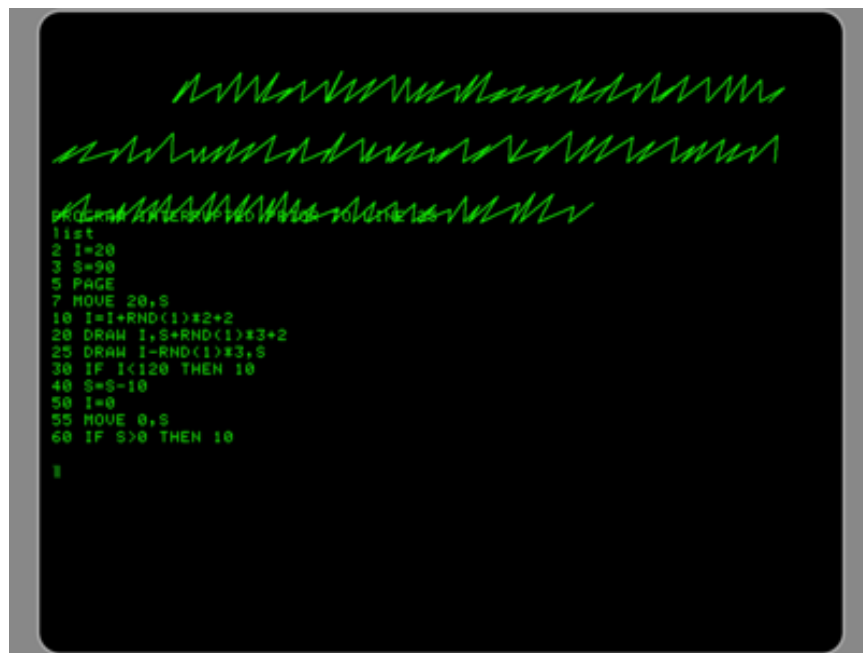


Figure 1.18 Screenshot from an online Tektrokix 4052 emulator, demonstrating the coexistence of graphics and text on screen, 2022 (image by the author)

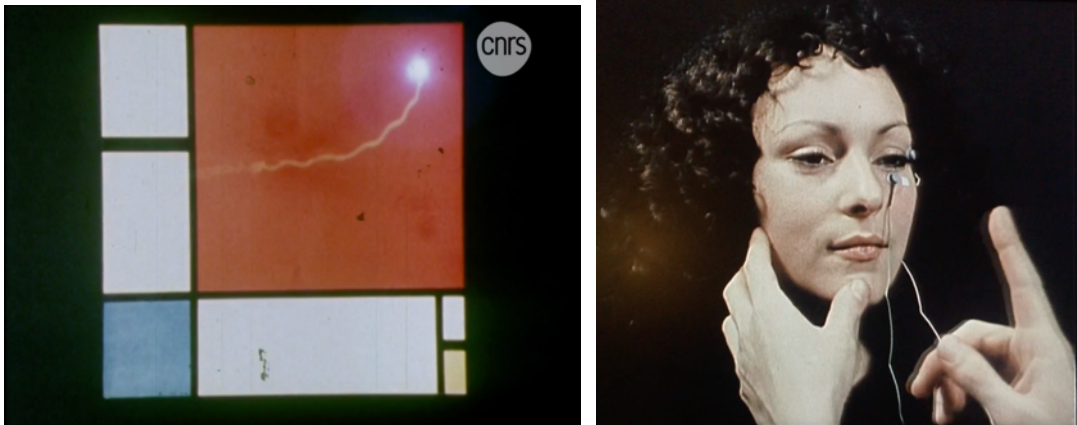
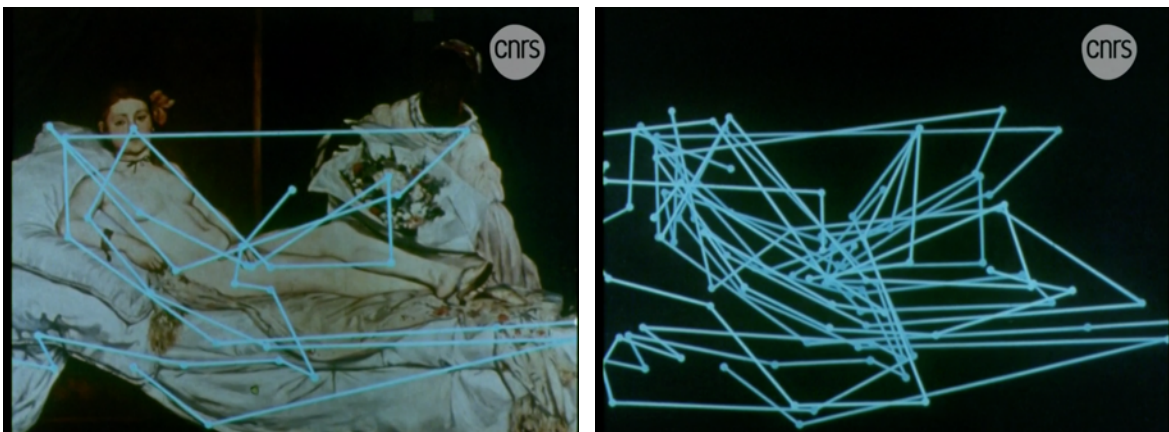


Figure 1.19 Stills from *La syntaxe du regard: étude de la stratégie oculomotrice appliquée à l'esthétique expérimentale*, 1978, a film featuring François Molnar's experimental psychology research. CNRS Audiovisuel (prod., distrib.)



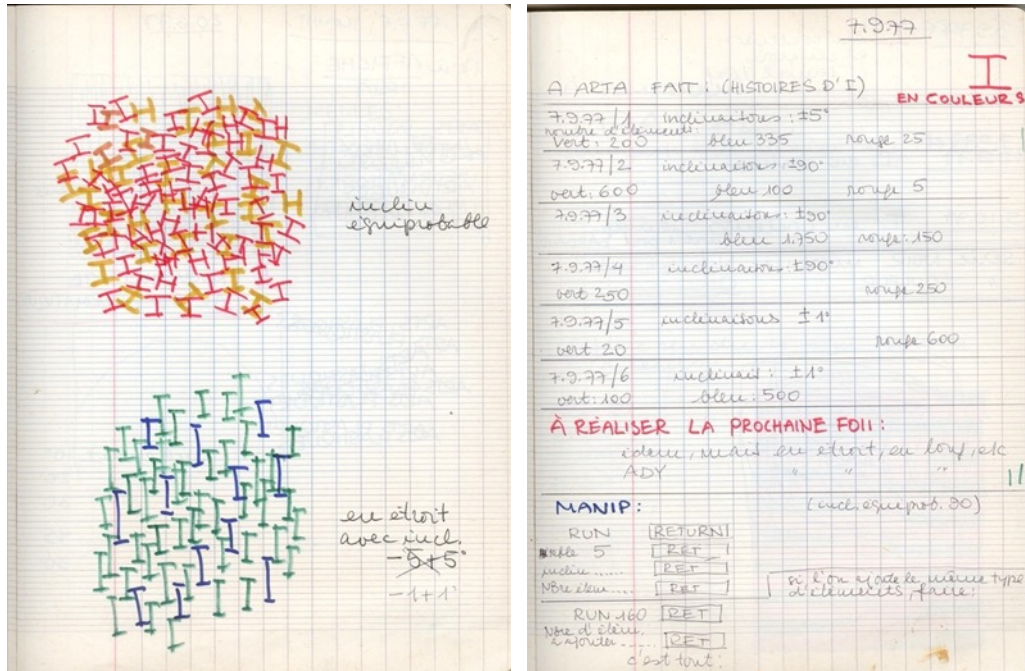


Figure 1.20.01 Vera Molnar, sketchbook entries from June 8, 1977 (left) and September 7, 1977 (right) (Photo by Vincent Baby. *Véra Molnar: Journaux intimes 1976-2003* (interactive CD-ROM), edited by Pierre Braun, Vincent Baby, and Boris Volant. Présent composé. Rennes, Haute Bretagne, France: Université Rennes 2, 2009)

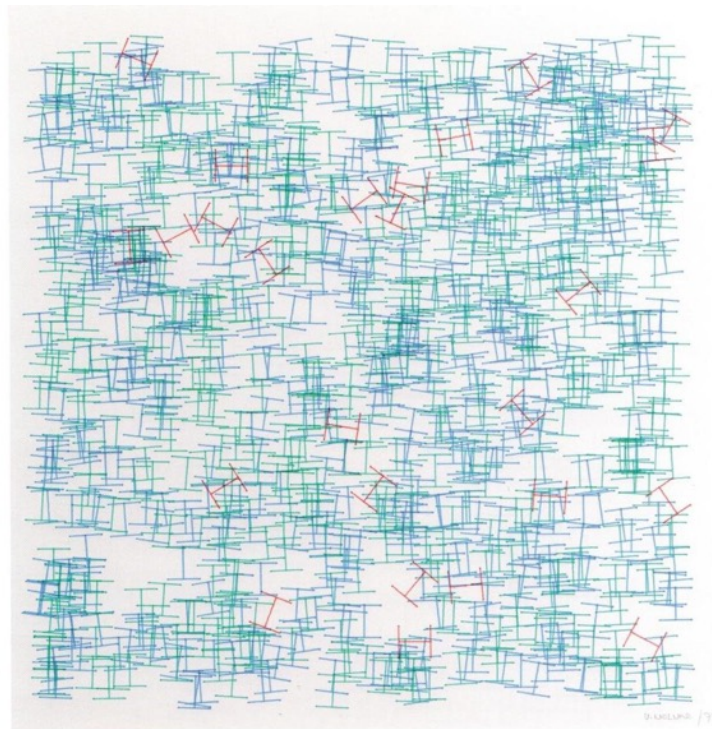


Figure 1.20.02 Vera Molnar, *Histoire d'I* (réf. G), 1977, Plotter drawing on paper, 10 x 10.5 in (Anne & Michael Spalter Digital Art Collection)



Figure 1.21.01 Tektronix flatbed tabletop plotter (ARTA archives, Centre Pompidou; photo by the author)



Figure 1.21.02 Tektronix interchangeable plotter pens (ARTA archives, Centre Pompidou; photo by the author)

My Mother's Letters: Simulation by Computer

Vera Molnar



Mother had a wonderful handwriting—somewhat Gothic, somewhat hysterical. She began each line regularly and strictly with Gothic letters, which toward the end of the line became more and more restless, nervous, almost hysterical. As she aged, the letters became quite troubled, perturbed. Slowly the Gothic disappeared, leaving only the hysterical. Each week I received a letter, which meant a real experience for my visual world. The letters were more and more difficult to decipher but they looked very pleasant.

After her death there were no more letters . . .

I started "simulating" on computer her gothical-hysterical missives to myself (see Color Plate B No. 1).

POST-SCRIPTUM

Among the many unknown factors, the one that causes art to *be* art is composition: the force holding the work together. Perhaps the force and the quality of the composition

differentiate a *chef d'oeuvre* from a plane surface covered with all sorts of colors and forms. "A composition is such a pictorial performance whereby the different parts of a painting are united, linked together" wrote Leon-Battista Alberti [1]. Composition that creates and ensures unity is likely to be a physiological or biological necessity. We know little about this, although for some decades now more and more interesting experiments are being attempted in scientific-aesthetic laboratories (to register, for example, someone's eye movements while viewing a painting) to try to reach some understanding of this unknown phenomenon that would be very important to the visual arts. From ancient times to our present days, philosophers, aestheticians and a long line of artists have tried to understand and to describe composition. The visual artist who is interested today in the problem of composition naturally, almost instinctively, returns to the principles handed down from the history of art, which constitute the foundations of the artist's learning. But are these classical laws of classical composition still usable and valid today? The first reassuring answer would be that these principles, like art itself, are universal and permanent, constituting the solid basis of every artistic endeavor.

While creating and reflecting, a visual artist might ponder whether these traditions and "recipes" are still valid for today's visual world. And what if they have become obsolete? Are they still satisfactory from today's psychological and physiological points of view? Actually it seems that they are really out of date. First of all, they are obsolete because the principles and proportions were arrived at by artists and thinkers through the observation of nature's forms and proportions and from the study of the human body. According to Paul Valéry [2] the antique architect Eupalino's temple perpetuates the bodily proportions of his love—that of a Greek virgin. Secondly, and perhaps more importantly, these principles of composition that were not immediately

ABSTRACT

My Mother's Letters is an attempt at simulation, an artificial re-creation of the handwriting of the artist's mother. This work presents two different approaches: (1) to get as near as possible to the formal aspects of the handwriting and (2) to reconcile the ill-balanced aspect of the letters (almost regular on the left-hand side, close to chaotic on the right-hand side) and a classical method of picture composition, working with principles such as symmetry, rebalanced asymmetry or countercomposition. The drawings were done with the help of a computer and a plotter, except for one series, where the artist used a printer instead of a plotter. The last pieces show the overlapping of plotter-tracing and actual handwriting: a kind of dialogue between human and machine.

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Although it was not possible for Vera Molnar to attend the Creativity and Cognition symposium (13–15 April 1993, Loughborough University, Leicestershire, England), she has been invited to be a guest contributor to this section due to her work in the spirit of the symposium.

Figure 1.22 The first page of Vera Molnar's article "My Mother's Letters: Simulation by Computer," featuring her plotter drawing *Portrait de ma mère* (1988) in *Leonardo* 28, no. 3 (1995): 167–70.



Figure 1.23 Dr. Dr. Stefan Höltgen (foreground) and Zsofi Valyi-Nagy (background) collaborating on a BASIC program for the Tektronix 4052, 2022, Signallabor, Humboldt-Universität, Berlin
(Photo by Julia Sandor, Artykfilm)

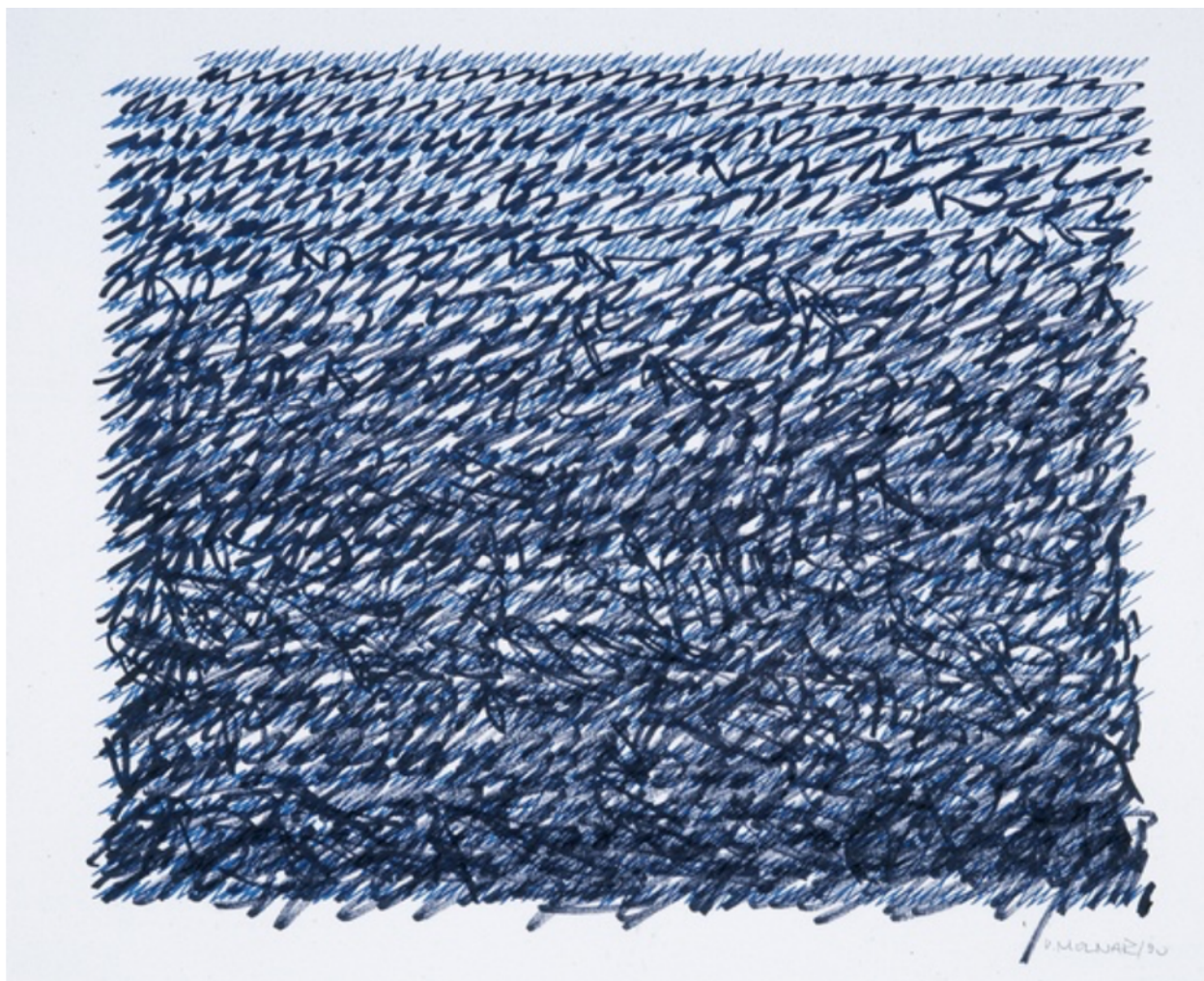


Figure 1.24 Vera Molnar, *Lettres de ma mère (Etude main + machine)*, 1990, computer plotter ink and felt-tip pen on paper, 30 x 40 cm (Musée de Grenoble, France © ADAGP, Paris)

Chapter 2



Figure 2.01 Vera Molnar, *A la machine non-imaginaire* or *Un des premières images d'après listing - BULL - 1968*, 1968, Colored marker on paper, mounted to cardstock, image size approx. 40 x 40 cm (DAM Projects, Berlin, Germany)

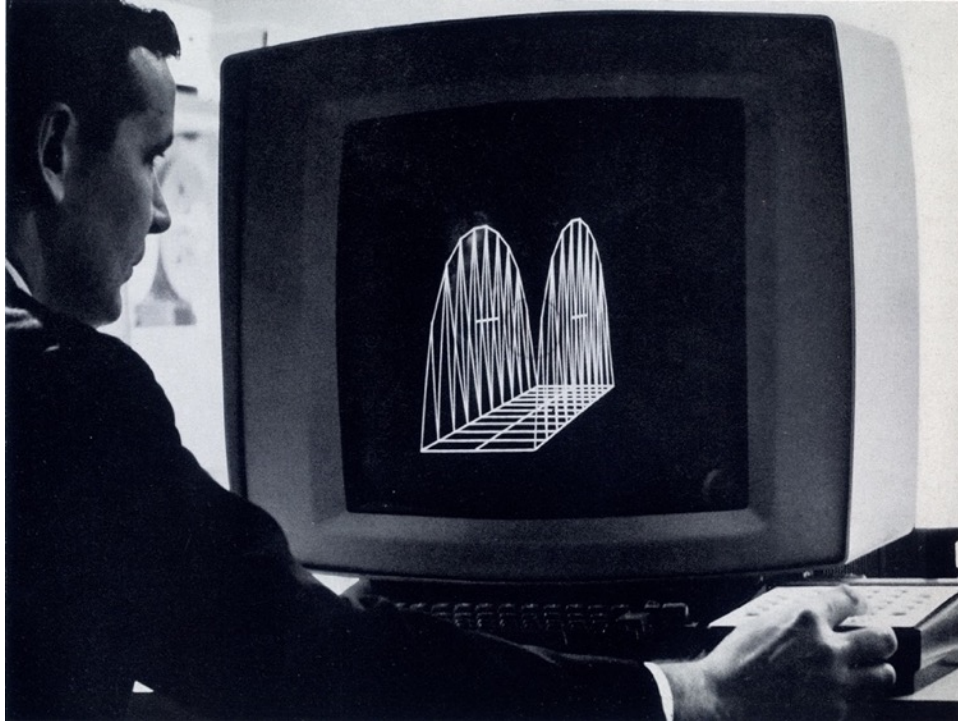


Figure 2.02.01 An engineer using an IBM 2250 CRT screen to model the construction of a bridge, from Herbert W. Franke's book *Computergraphik, Computerkunst* (Munich: Bruckmann, 1971, 23).



Figure 2.02.02 An IBM 2250 display unit connected to an IBM 360/195 Console, March 1972, Chilton, UK (Chilton Annual Report 1972)



Figure 2.03 Vera Molnar, Computer plotter drawing from series *Love Story*, 1974 [Hour of calculation: September 19, 1974, 16:55:21], Ink on paper, Programmed in Fortran on an IBM system/370 mainframe computer with a and IBM 2250 CRT display, output using Benson roll plotter. Approximately 55 x 36 cm unframed (Galerie ONIRIS, Rennes, France)

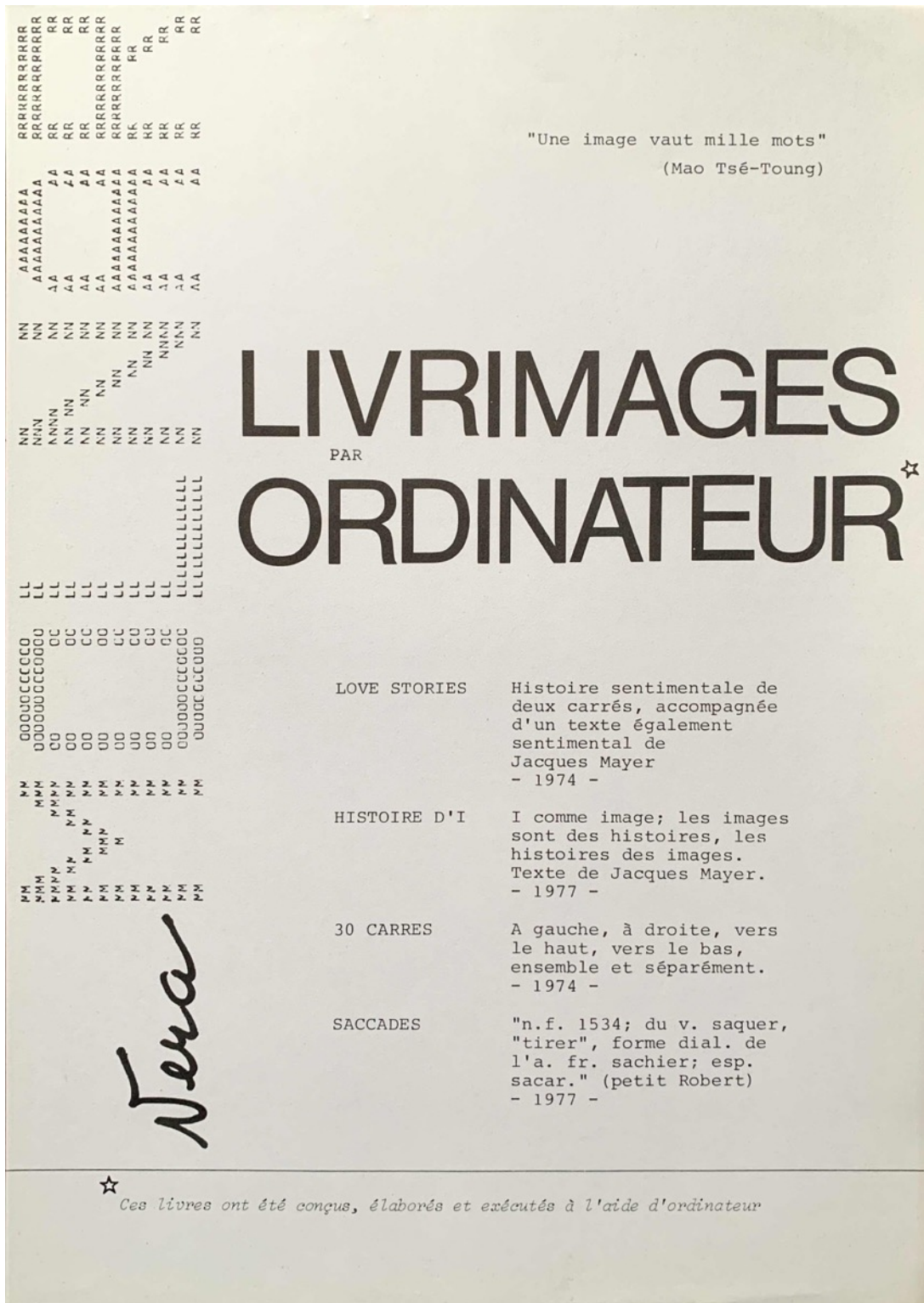


Figure 2.04.01 Vera Molnar, *Livrimages par ordinateur*, c. 1977. Bottom text reads “Ces livres ont été conçus, élaborés et exécutés à l’aide d’ordinateur” (These books were conceived, developed, and executed with the help of a computer)” (Archives Vera Molnar, Carton 01: 1970-80: Love-Stories/74, Paris)



Figure 2.04.02 Vera Molnar, Maquette for *Love-Story à l'ordinateur*, 1974, Artist's book, photographs mounted to cardboard, accordion fold with eight leaves, 14.5 x 17 cm each (Szöllősi-Nagy--Nemes Collection, Hungary; Photo by Péter Herendi)



Figure 2.04.03 Vera Molnar, *Love-Story à l'ordinateur*, Accordion fold artist's book, 1974 (Location unknown, image courtesy Galerie Linde Hollinger, Ladenburg, Germany)



Figure 2.05 Vera (left) and François (right) Molnar dressed as “Malevich” for a masked ball, at their home in Paris, 1989 (photographer unknown; Archives Vera Molnar)

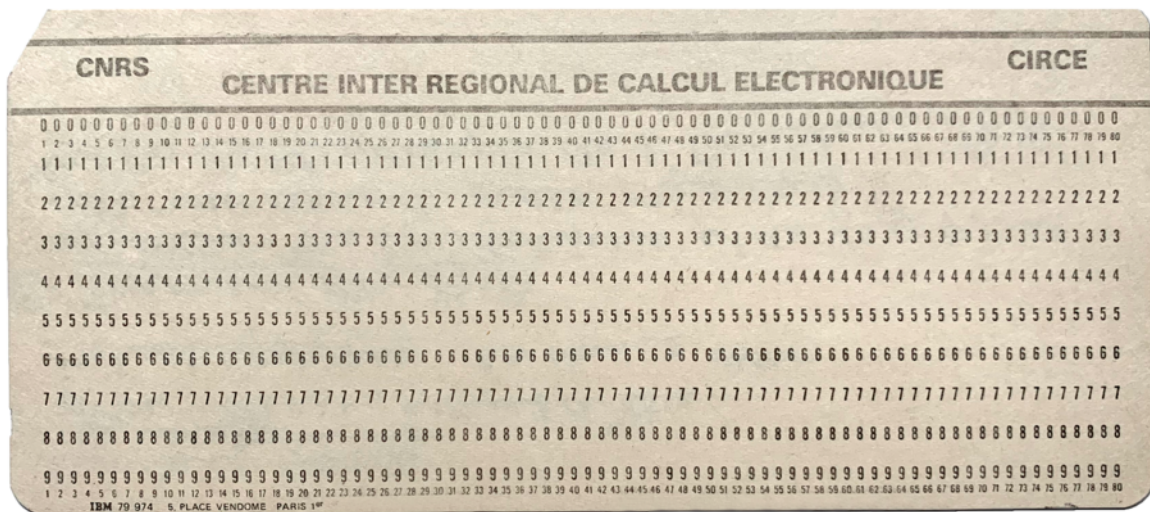


Figure 2.06 Unused punch card from the Centre de calcul interregional de calcul électronique (CIRCE) in Orsay, c. 1970, 18.6 x 8.5 cm (Archives Vera Molnar: Carton 05: Textes; Photo by the author)

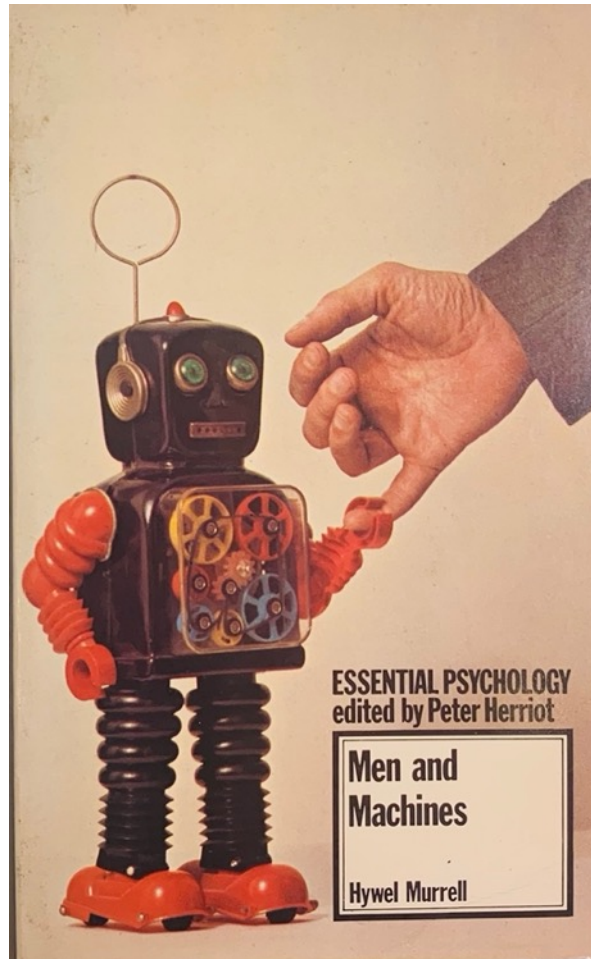


Figure 2.07 Hywel Murrell's *Men and Machines*, edited by Peter Herriot (London: Methuen & Co), 1976 (from François Molnar's bookshelf, Paris, France)

TRANSFORMATIONS VERA MOLNAR

pcl

The Concourse Gallery
35 Marylebone Road London NW1
10th June - 2nd July

Figure 2.08.01 Vera Molnar, cover for *Transformations*, exhibition catalogue for the Concourse Gallery at PCL, 1976, 21.5 x 23 cm (Archives Vera Molnar)

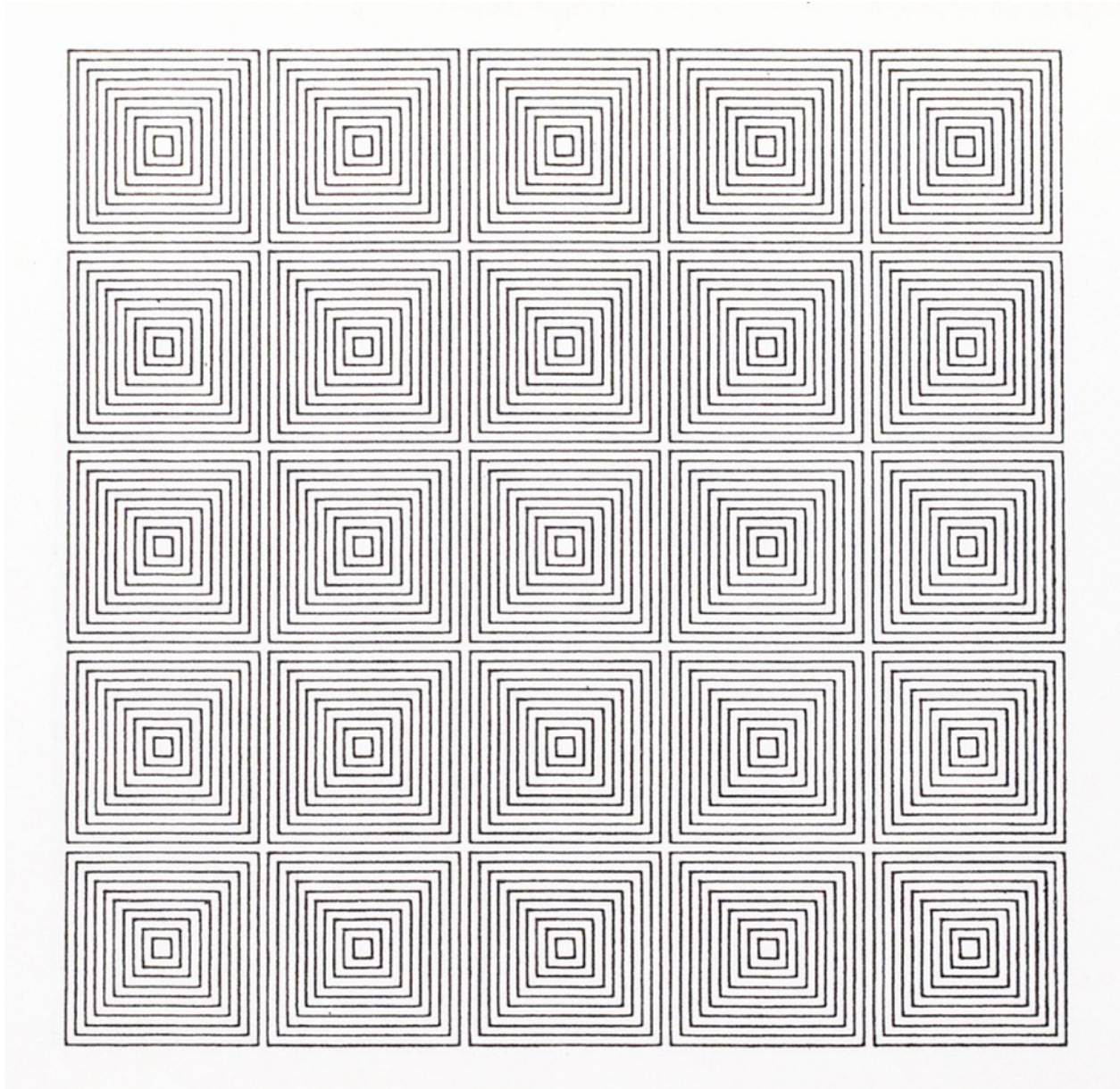


Figure 2.08.02 *Transformations* catalogue, page 1

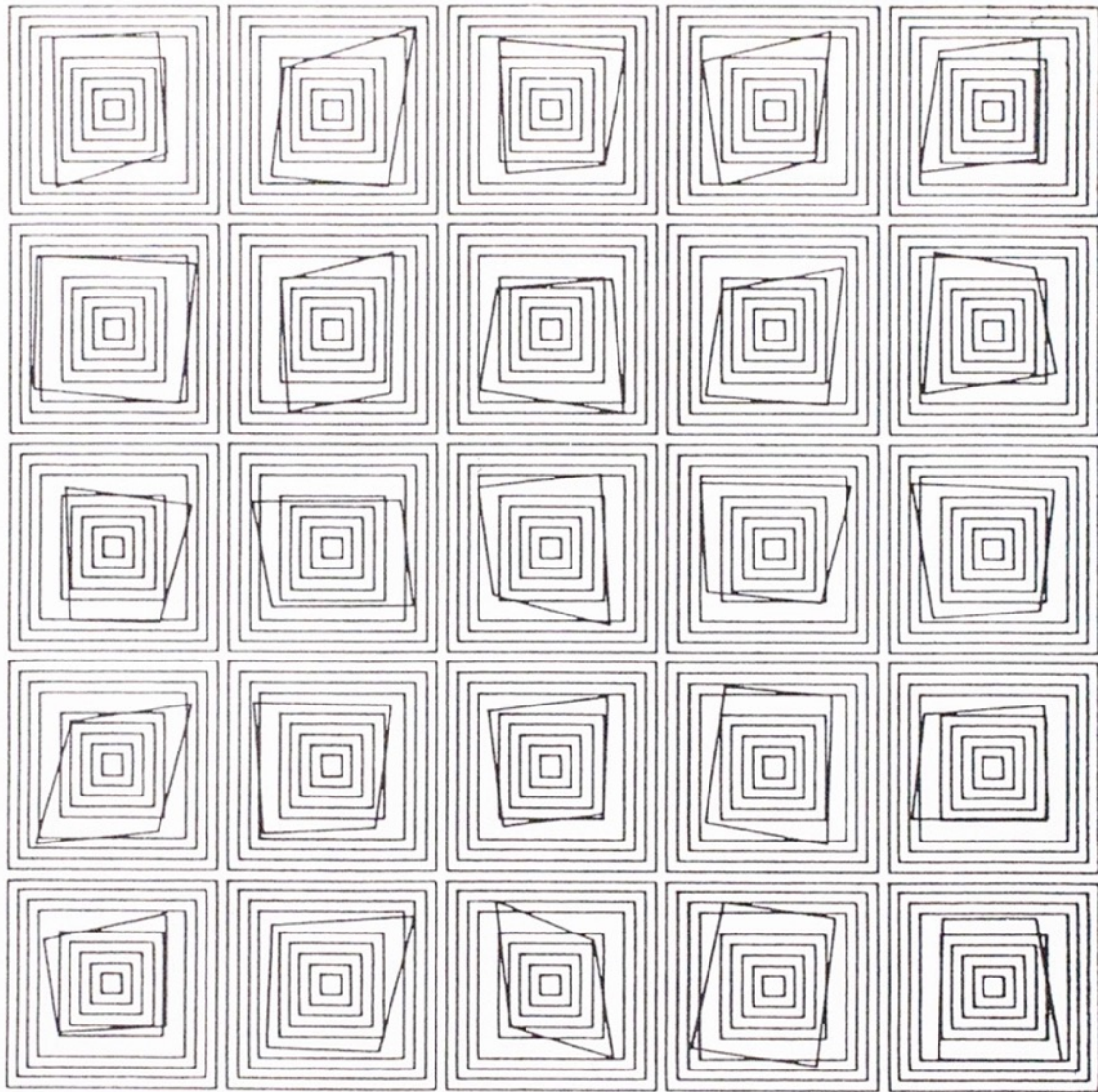


Figure 2.08.03 *Transformations* catalogue, page 2

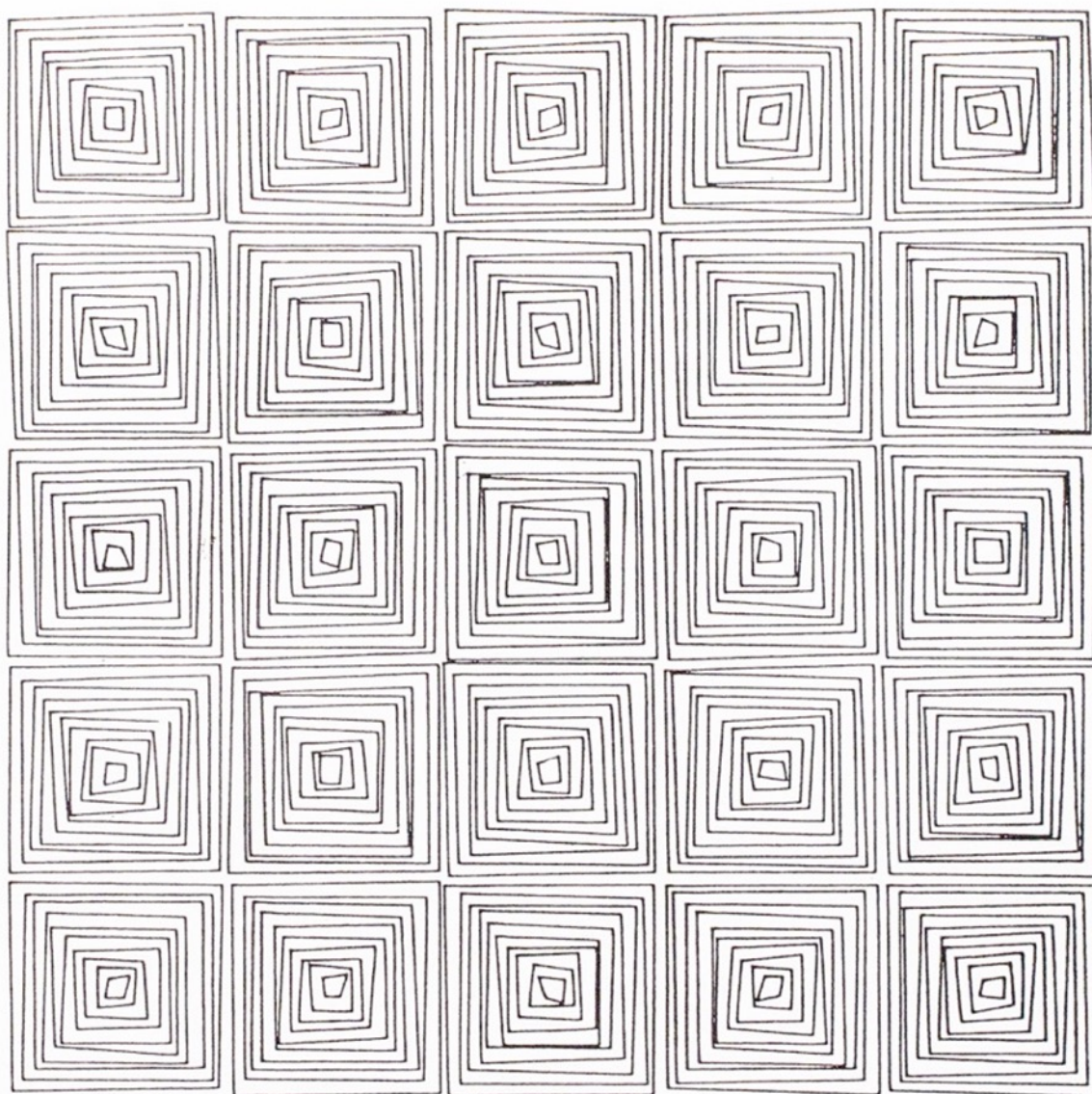


Figure 2.08.04 *Transformations* catalogue, page 3

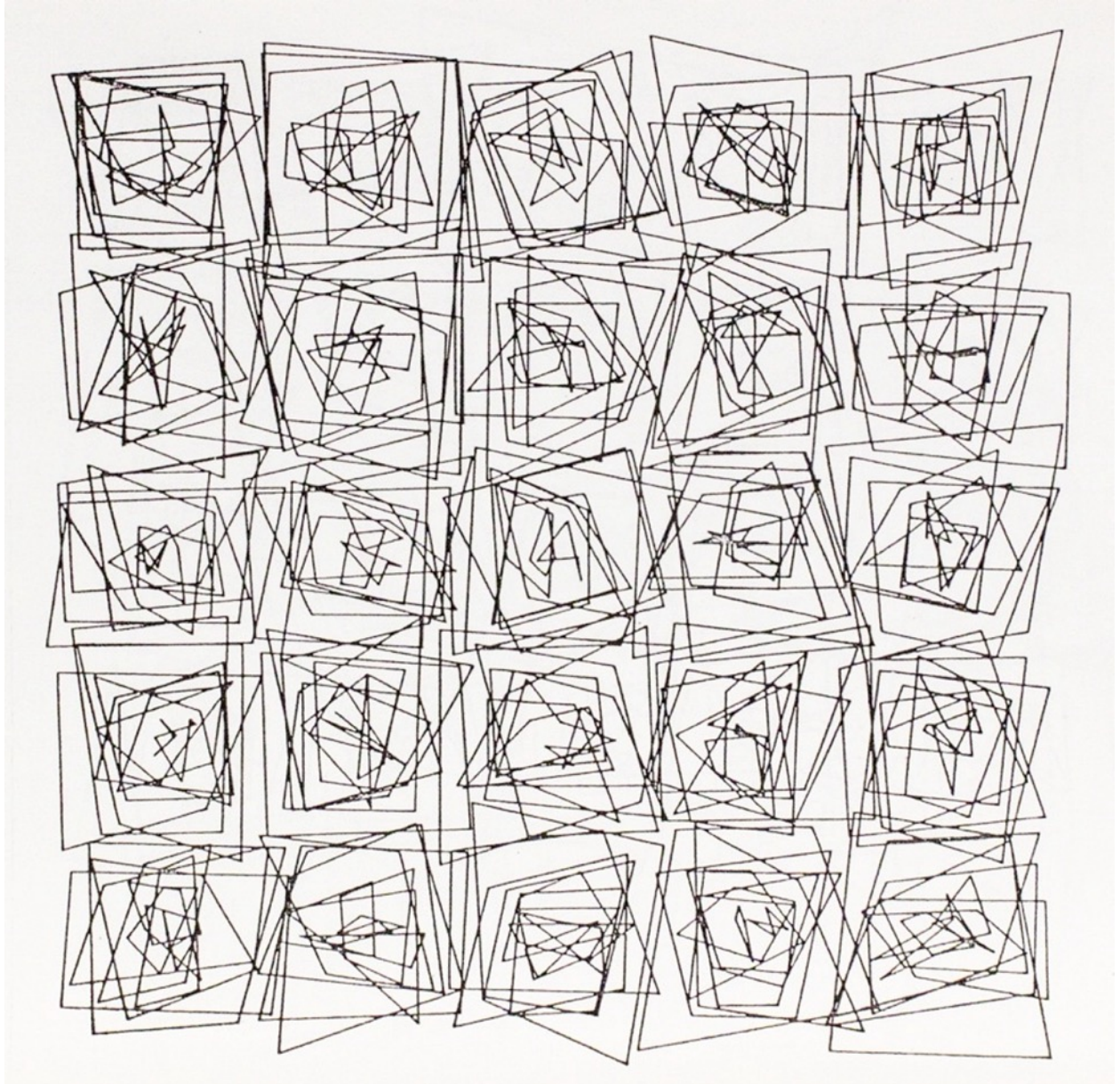


Figure 2.08.05 *Transformations* catalogue, page 14

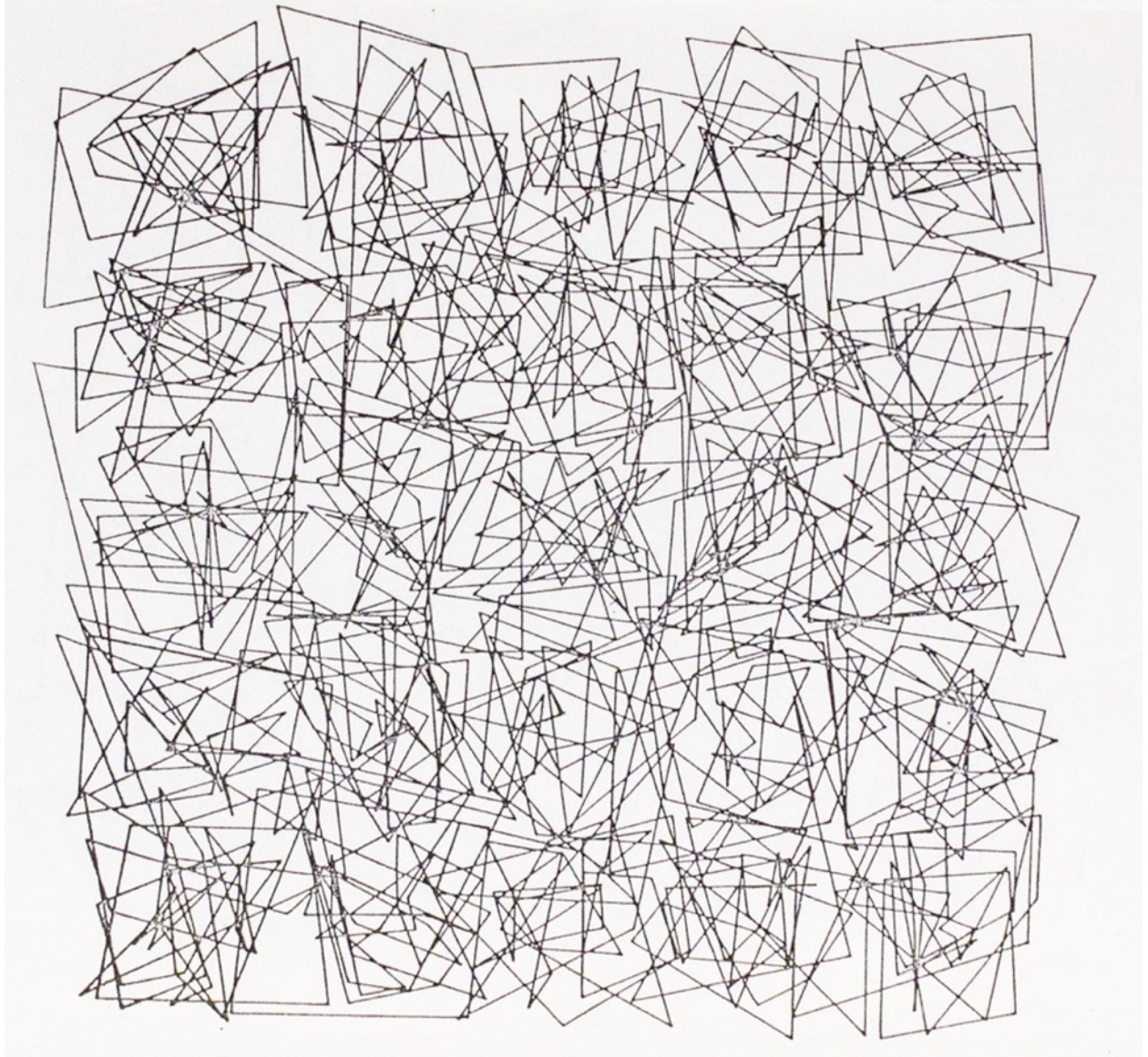


Figure 2.08.06 *Transformations* catalogue, page 17

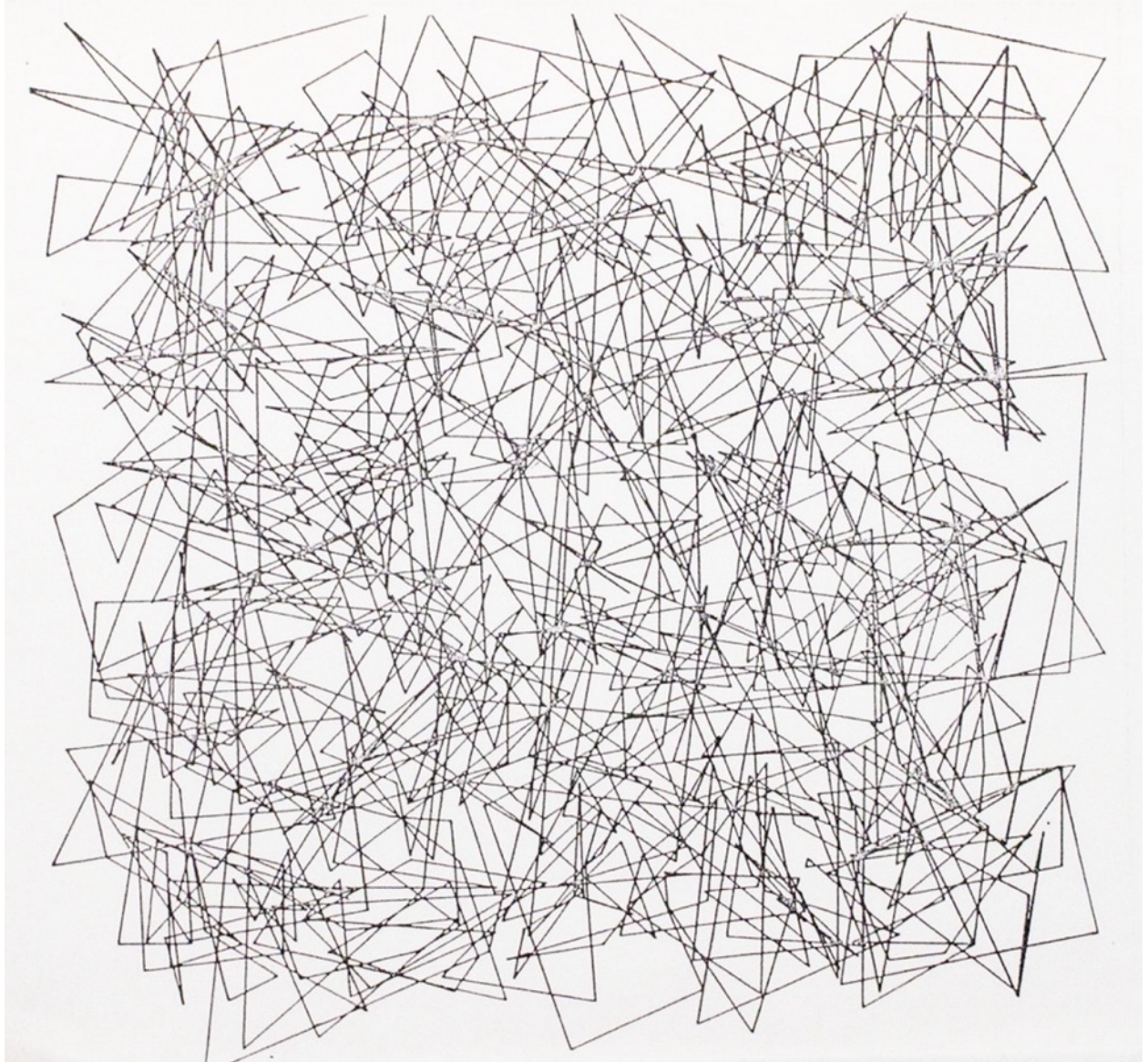


Figure 2.08.07 *Transformations* catalogue, page 18

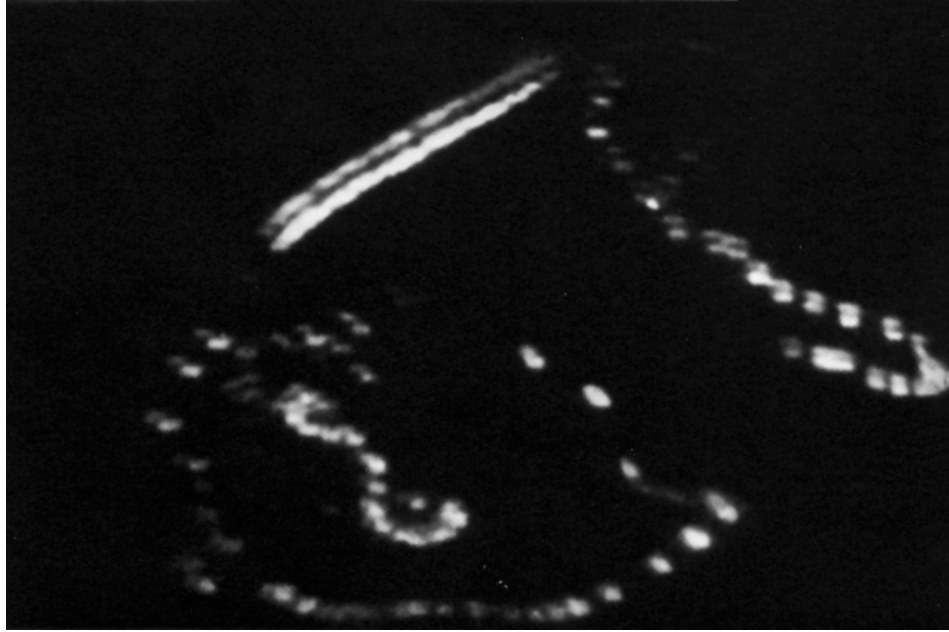


Figure 2.09 Lucio Fontana, *Immagini luminose in movimento*, 1952. Archive Fondazione Lucio Fontana, Milan, reprinted in Stephen Petersen, *Space-Age Aesthetics* (University Park: Pennsylvania State University Press, 2009, 90).

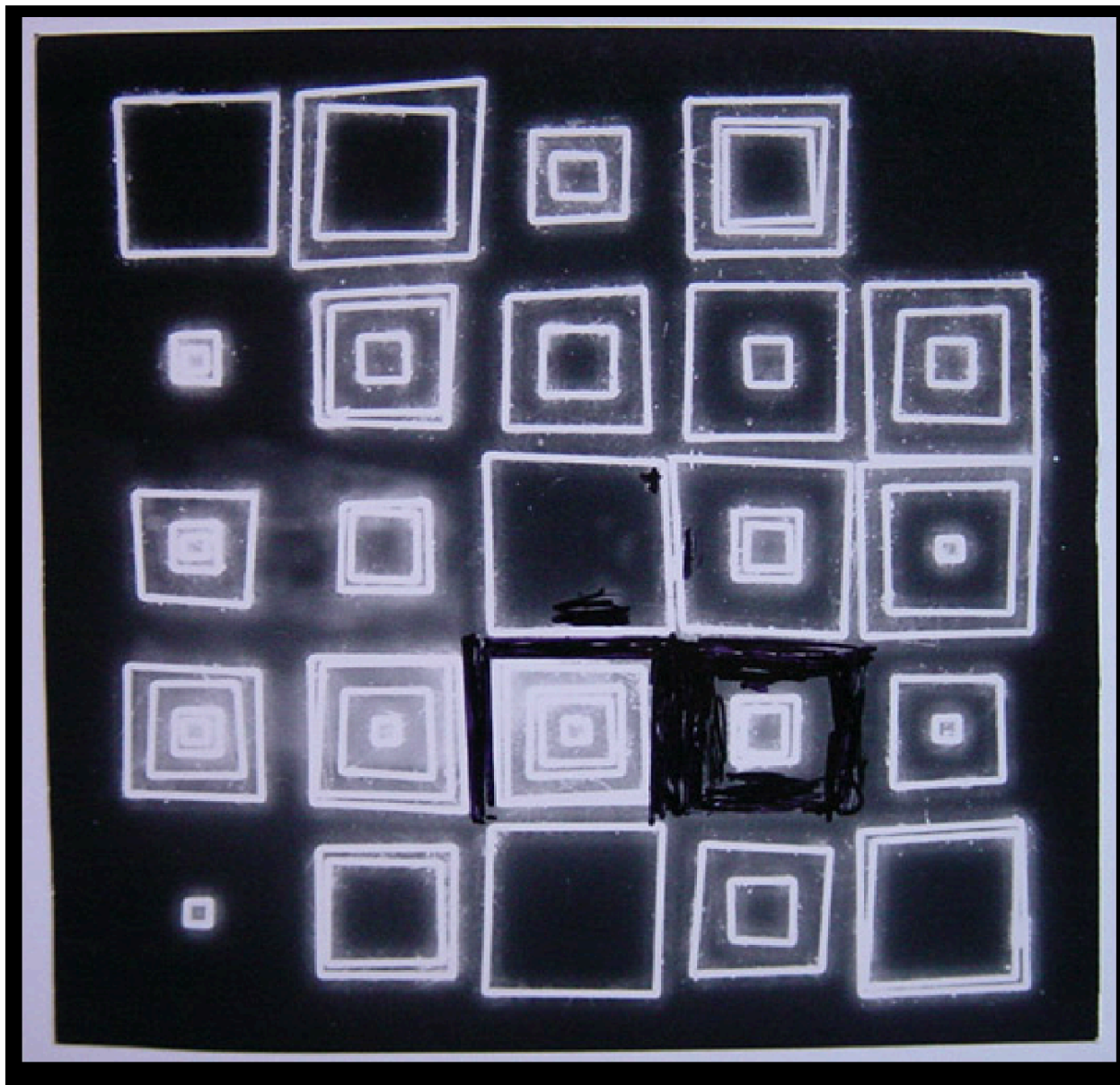


Figure 2.10 Vera Molnar, *(Dés-)ordres*, 1973, Photograph of CRT display with marker (Collection of the artist, location unknown; Vera Molnar online catalogue raisonnée compiled by Vincent Baby)

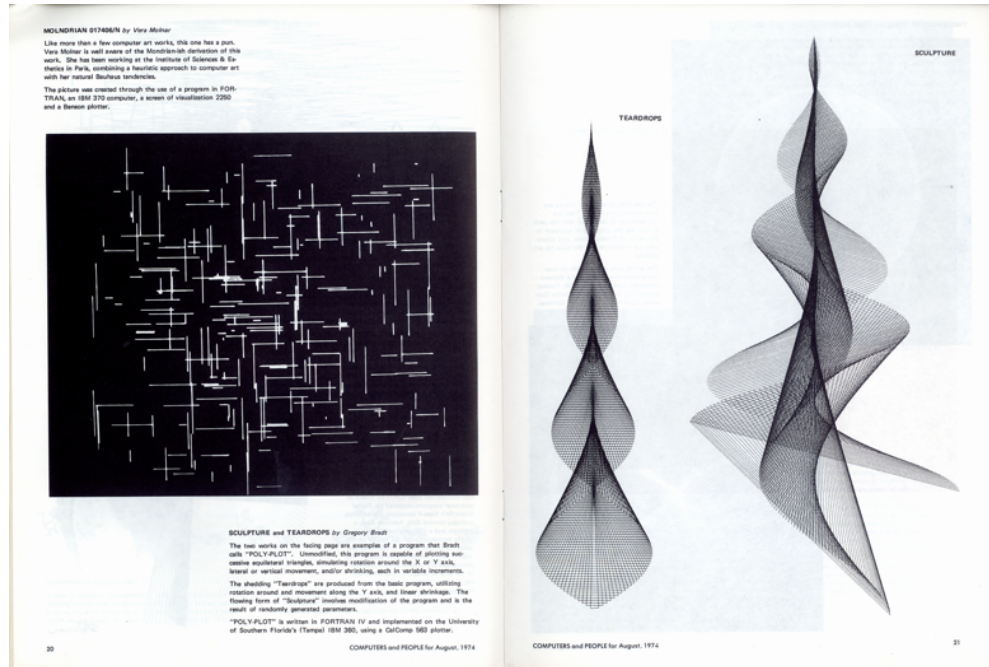


Figure 2.11.01 Vera Molnar's *MOLNDRIAN 017406/N* in *Computers and People*, Vol. 23, No. 8 (August 1974). The caption reads “*Like more than a few computer art works, this one has a pun. Vera Molnar is well aware of the Mondrian-ish derivation of this work. She has been working at the Institute of Sciences & Esthetics in Paris, combining a heuristic approach to computer art with her natural Bauhaus tendencies. The picture was created through the use of a program in FORTRAN, an IBM 370 computer, a screen of visualization 2250 and a Benson Plotter*” (20). The facing page features two plotter drawings by Gregory Bradt.

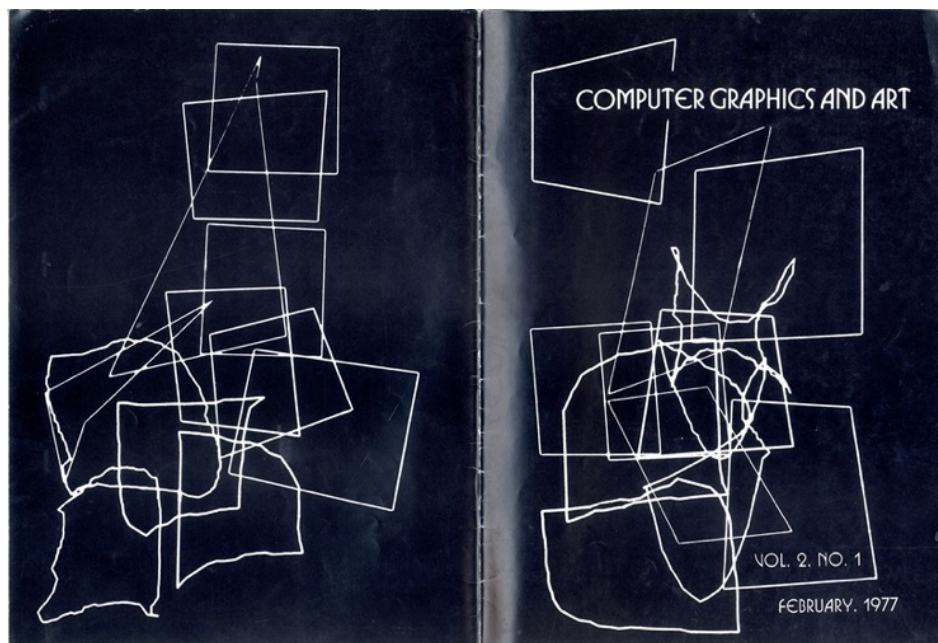


Figure 2.11.02 Vera Molnar, Front and back cover of *Computer Graphics and Art*, Vol. 2, No. 1, February 1977

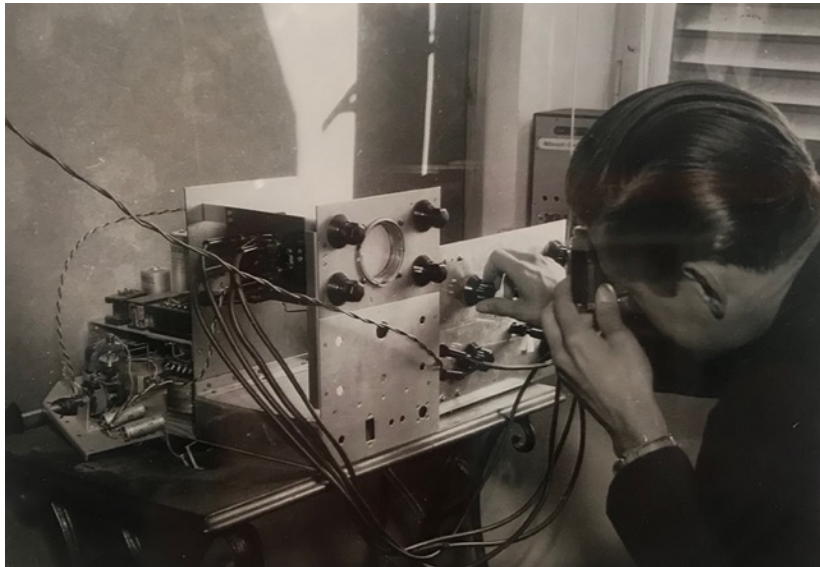


Figure 2.12.01 Herbert W. Franke photographing the oscilloscope screen, 1954 (ZKM archives. Karlsruhe, Germany)



Figure 2.12.02 Herbert W. Franke, *Elektronische Grafik, Werkgruppe Pendeloszillogramme* (*Electronic Graphics, pendulum oscillograms series*), created 1955/56, printed 1970, 35 x 26.5 in, (Anne & Michael Spalter Digital Art Collection)

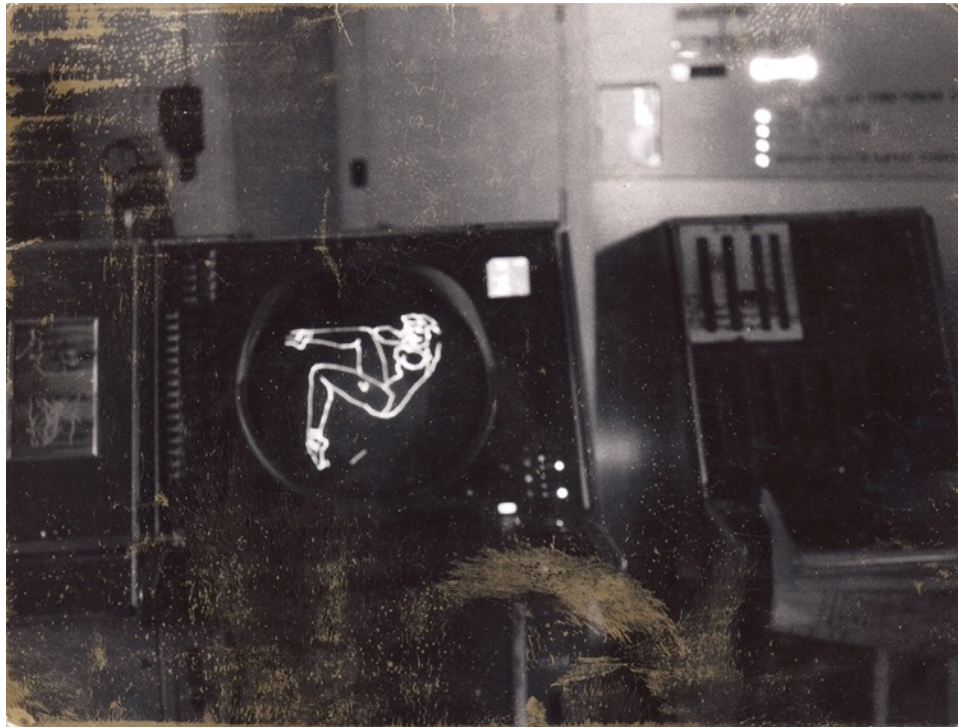


Figure 2.13 Lawrence A. Tipton (US Air Force), 1959, Polaroid photograph of a pin-up diagnostic program running on a IBM AN/FSQ-7 computer, part of US SAGE defense system; vector line-art on an OA-1008/FSQ situation display console, Fort Lee Air Force Station, Virginia, USA (Benj Edwards)

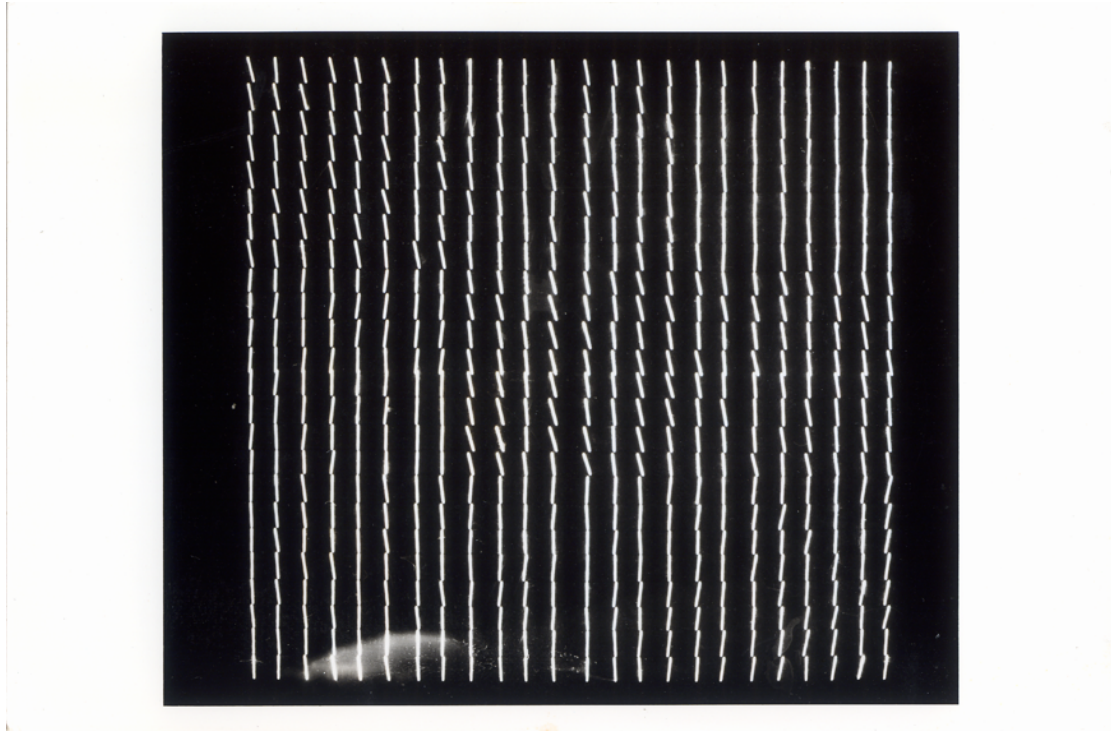


Figure 2.14.01 Vera Molnar, Photograph of CRT display showing series *Inclinaisons*, c.1974
(Archives Vera Molnar)

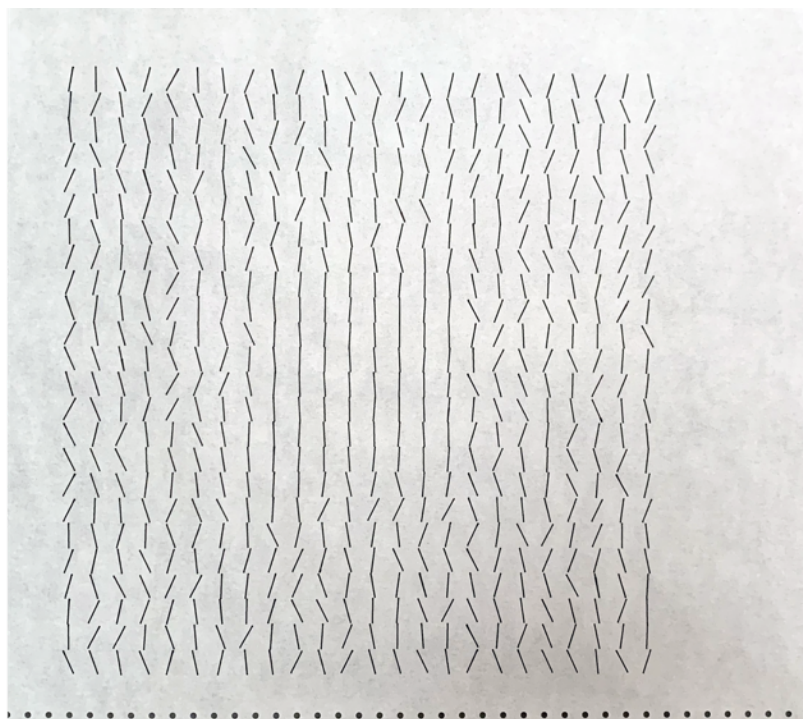


Figure 2.14.02 Detail, Vera Molnar, Plotter drawing from series *Inclinaisons*, March 7, 1974
(Collection of the artist, photograph by the author)

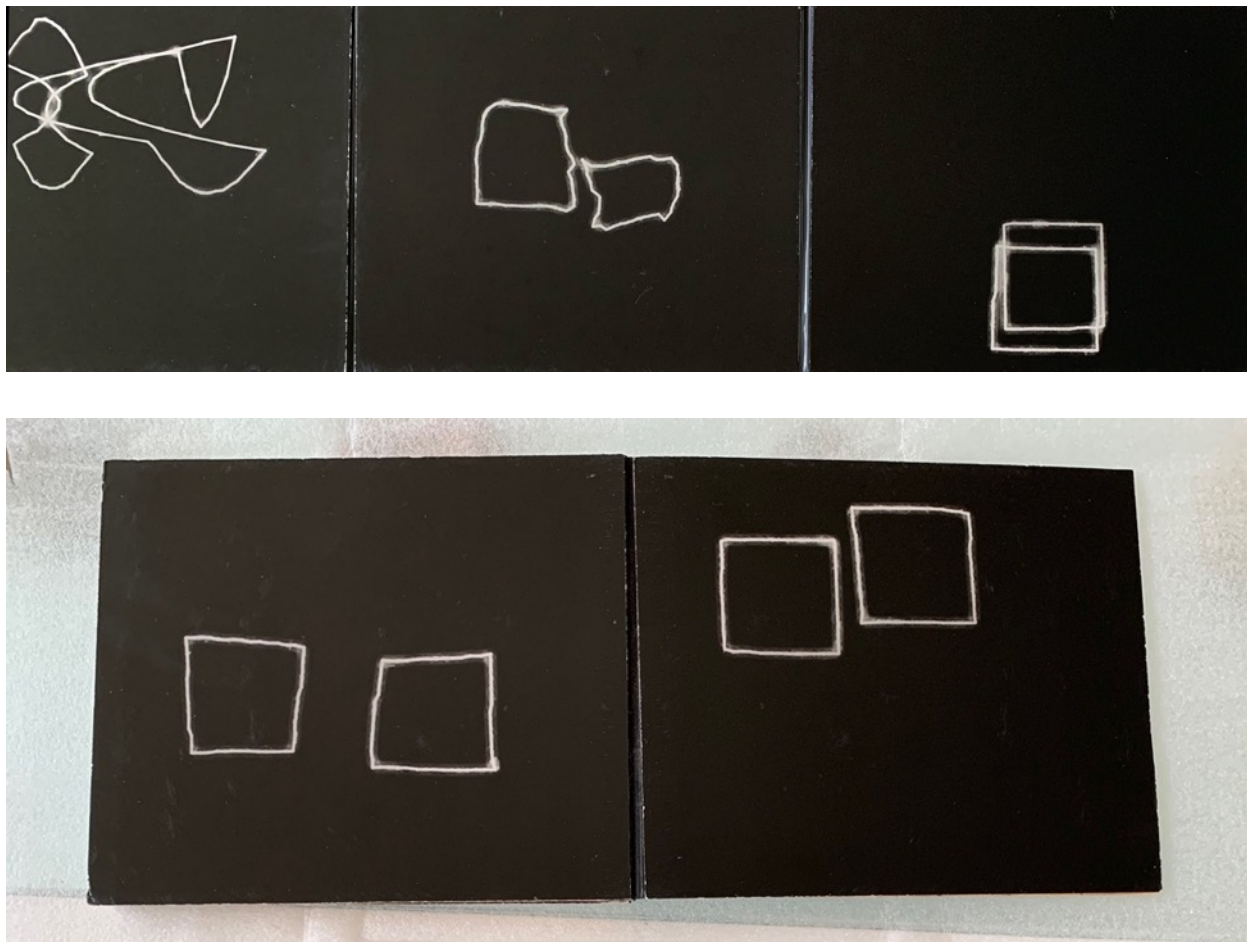


Figure 2.15 Details, Vera Molnar, Maquette for *Love-Story: à l'ordinateur*, 1974 (Szöllősi-Nagy--Nemes Collection, Hungary; Photos by the author)

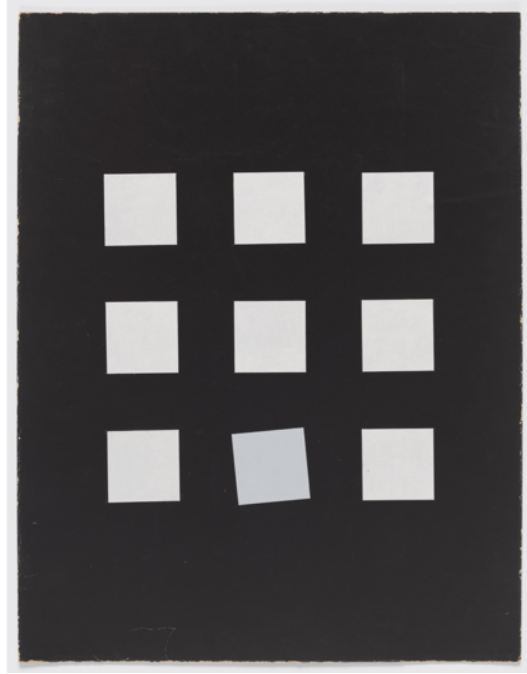


Figure 2.16.01 Vera Molnar, Untitled, 1952, Gouache and collage on paper, 25 x 19 3/8 inches (63.5 x 49.2 cm), signed on reverse (Museum of Modern Art, New York)

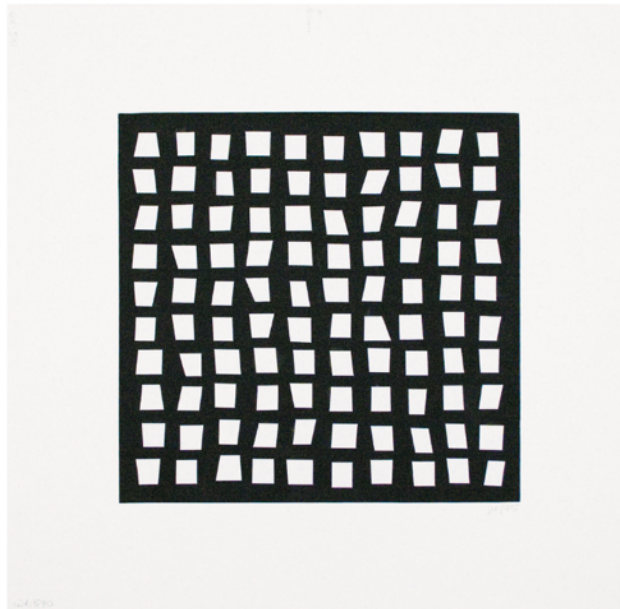


Figure 2.16.02 Vera Molnar, *Computer-icône 12*, 1975, cut-paper collage, 15 7/8 x 15 7/8 inches (40.3 x 40.3 cm) (Shopmaker Modern)

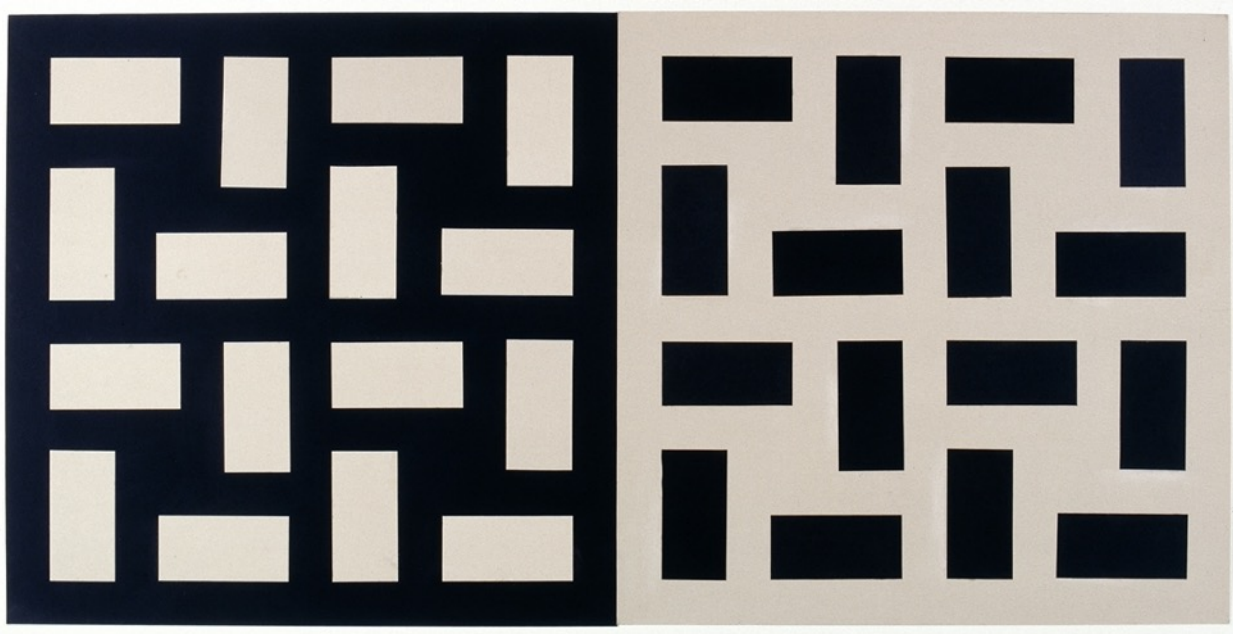


Figure 2.17 Vera and François Molnar, *Double mouvement giratoire*, 1955, Collage on cardboard, 75 x 150 cm (Musée de Grenoble, France © ADAGP, Paris)



Figure 2.18 Vera Molnar manipulating the accordion fold of *Love-Story* on the floor of her home/studio, from Hélène Faulat and Fabienne Wiazemski's *Vera Molnar sur le rôle de l'ordinateur dans la création artistique*, made for Télévision Française 1, October 30, 1981 (L'Institut national de l'audiovisuel, Bibliothèque nationale de France), <https://www.ina.fr/ina-eclairer-actu/video/i18089373/vera-molnar-sur-le-role-de-l-ordinateur-dans-la-creation-artistique>)

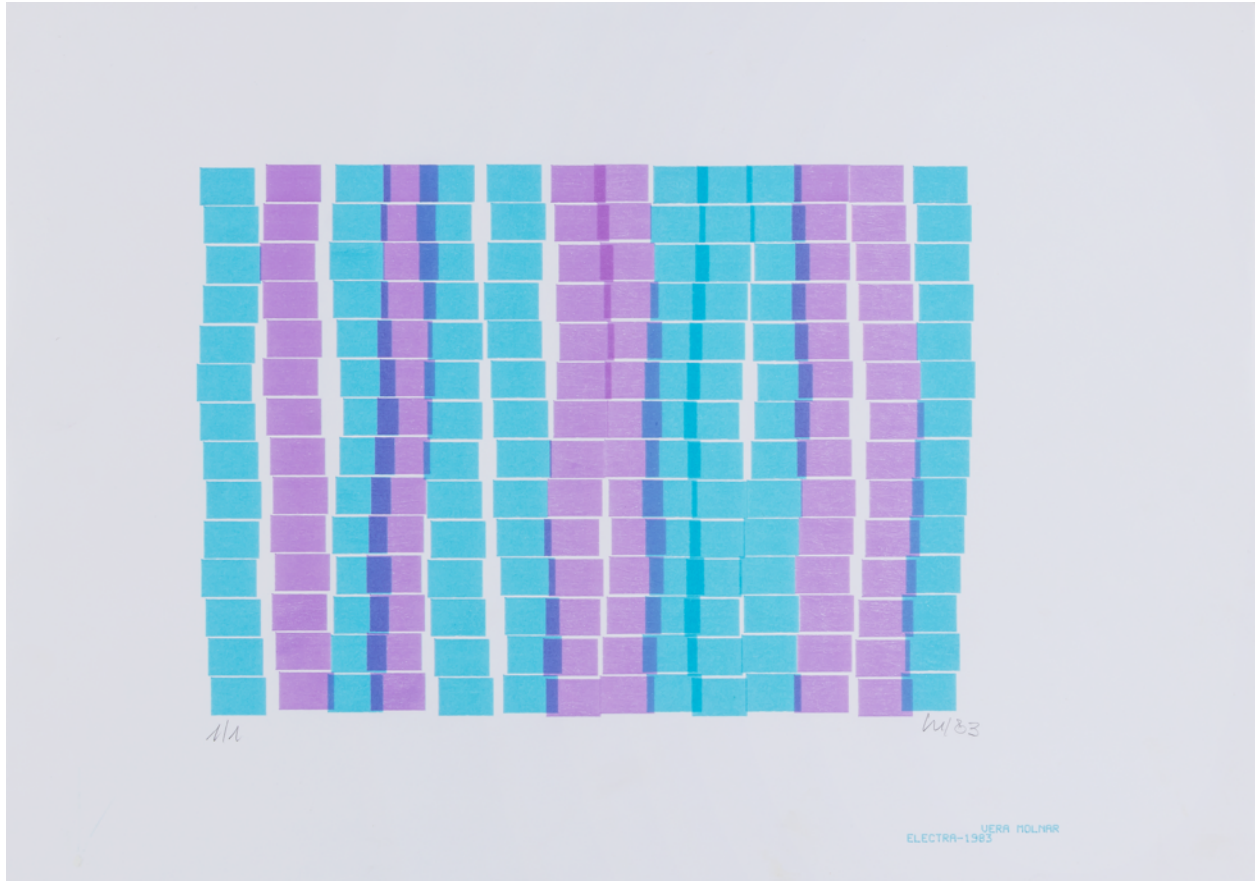


Figure 2.19 Vera Molnar, untitled plotter drawing made at *Electra*, Musée de l'art moderne de la ville de Paris, 1983 (Vintage Galéria, Budapest, Hungary)



Figure 2.20.01 Vera Molnar's live demo of her work at Le Grand Huit (1, rue Saint-Hélier, Rennes, France) at the *Festival des arts électroniques* (Festival of Electronic Arts), 1988, scanned 35mm negative (Photo by François Molnar, Archives Vera Molnar, Paris, France)

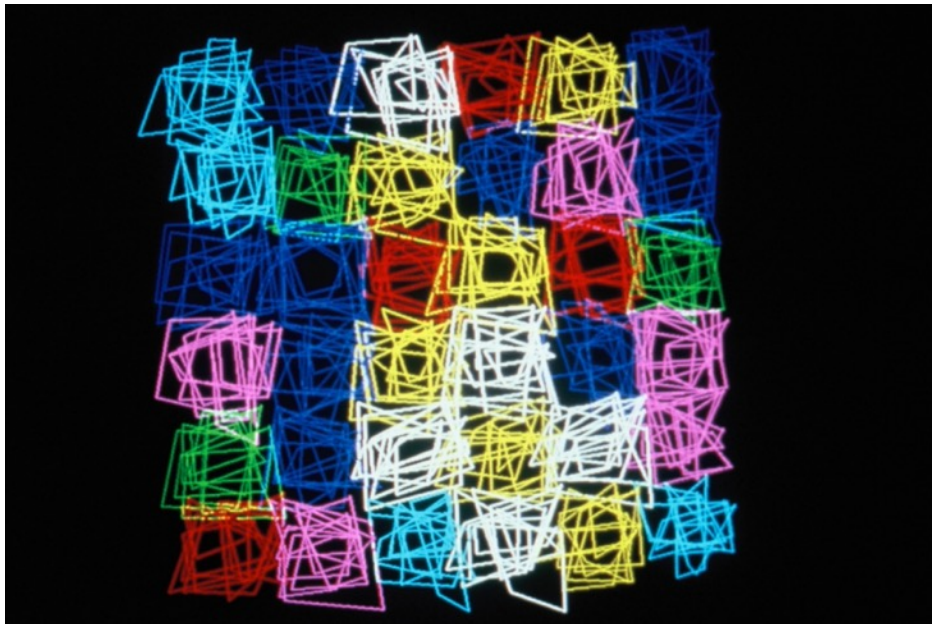


Figure 2.20.02 Vera Molnar, *Quadrilatères*, 1988 photograph of computer screen (scanned slide, Archives Vera Molnar); a similar image was printed in Vera Molnar, "Comment Faire Sortir Le Carré de Ses Gonds ?" *Festival des arts électroniques*, Rennes, 1988



Figure 2.21.01 Vera Molnar's station at the *Festival des arts électroniques* in Rennes, May 28-June 5, 1988, from Frank Popper's *Art of the Electronic Age* (1993)

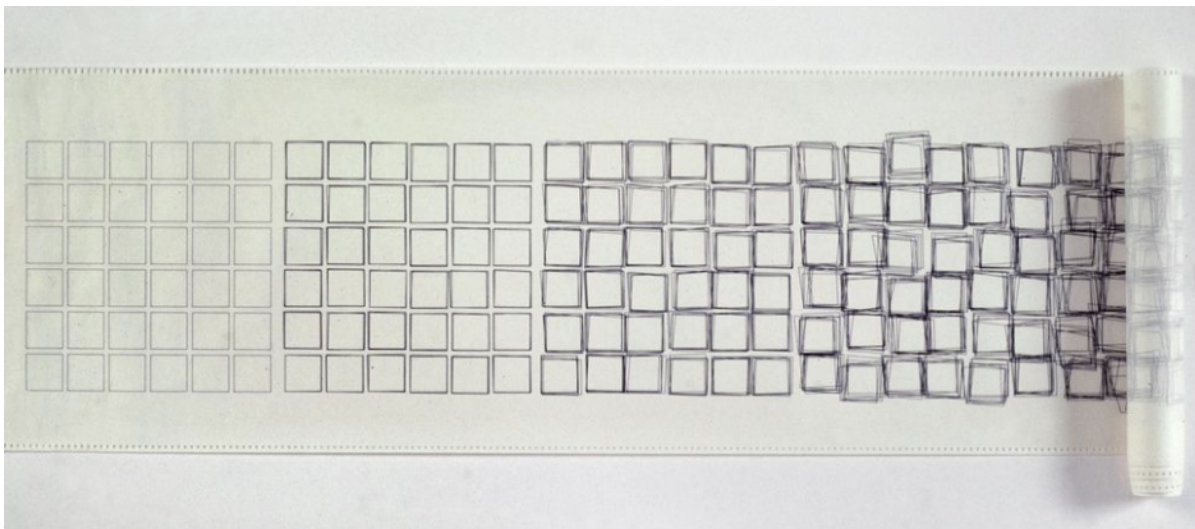


Figure 2.21.02 Vera Molnar, *Comment faire sortir le carré de ses gonds?*, 1988, Plotter drawing produced at the *Festival des arts électroniques* in Rennes at (FRAC Bretagne, photo by Hervé Beurel)



Figure 3.01.01 Vera Molnar, *Carrés concentriques*, 1977, Plotter and hand drawing in ink on A4-size paper (Collection of the artist, photos by the author)

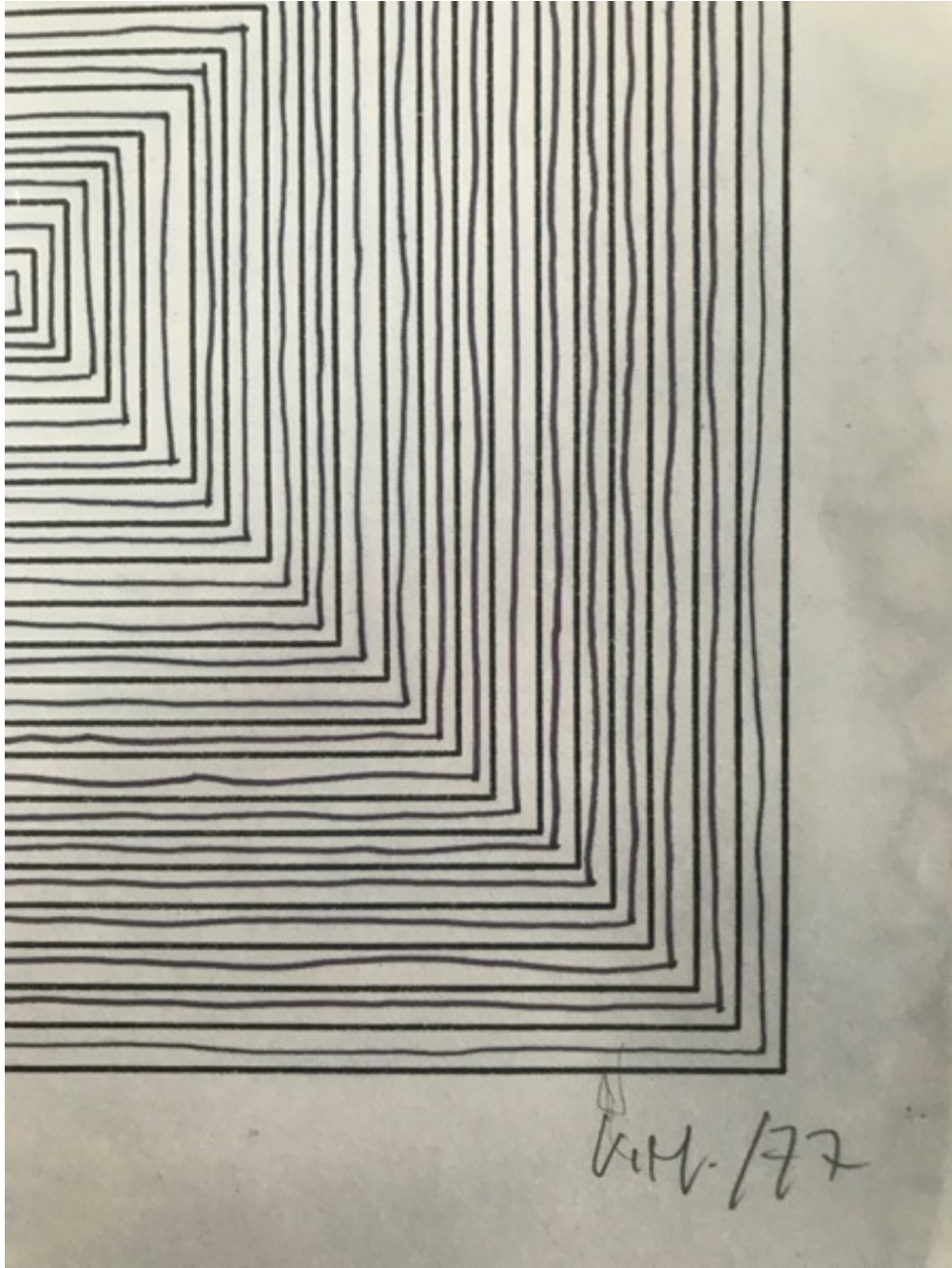


Figure 3.01.02 Detail,. Vera Molnar, *Carrés concentriques*, 1977, Plotter and hand drawing in ink on A4-size paper (Collection of the artist, photos by the author)



Figure 3.02 Vera Molnar, *A main levée et à la machine* (Freehand and by machine), 1977, ink on paper, 17 x 17 cm (Private collection)



Figure 03.03 “Leonardo da Vinci, if he had a computer” by Vera Molnar, with an image by Lillian Schwartz (1986), in *+0* n°52, 19, 1989 (Archives Vera Molnar)

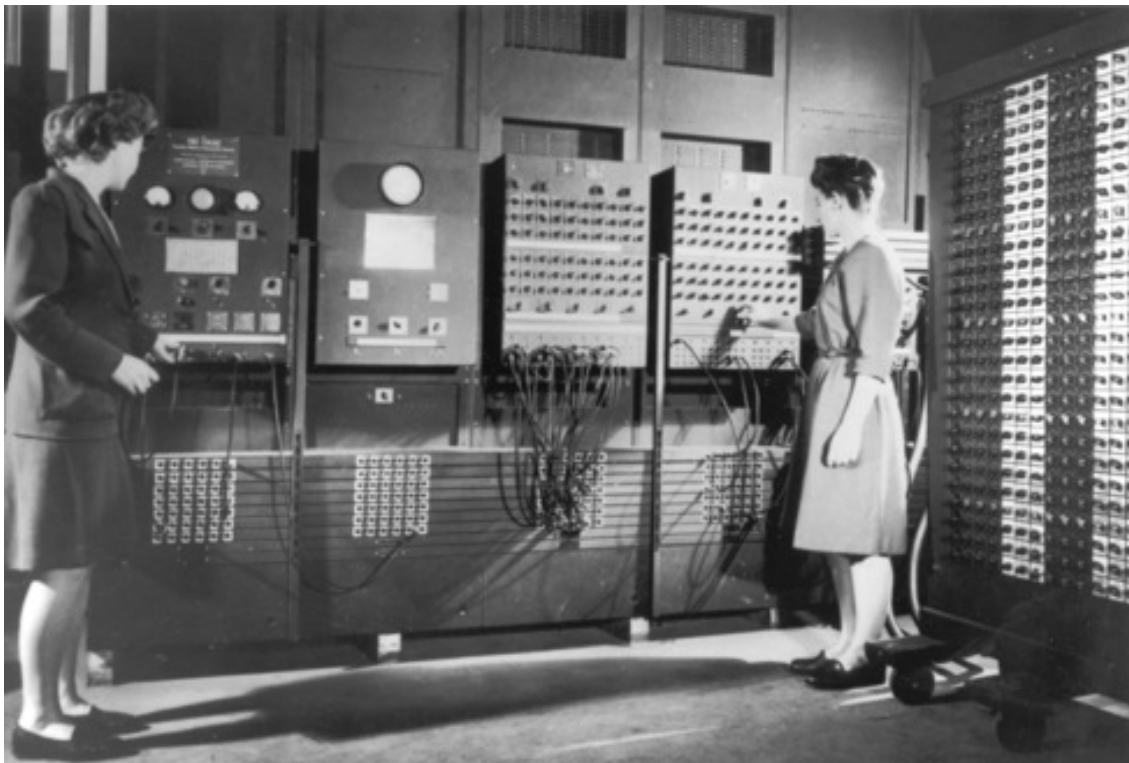


Figure 03.04 Women “computers” Frances Bilas and Elizabeth Jennings programming the ENIAC, 1946 (University of Pennsylvania archives)



Figure 03.05 Promotional image reproduced in the Polish journal *Informatyka*, 1972, advertising the IBM system/370, the same mainframe computer Molnar used (Public Domain)

Epilogue

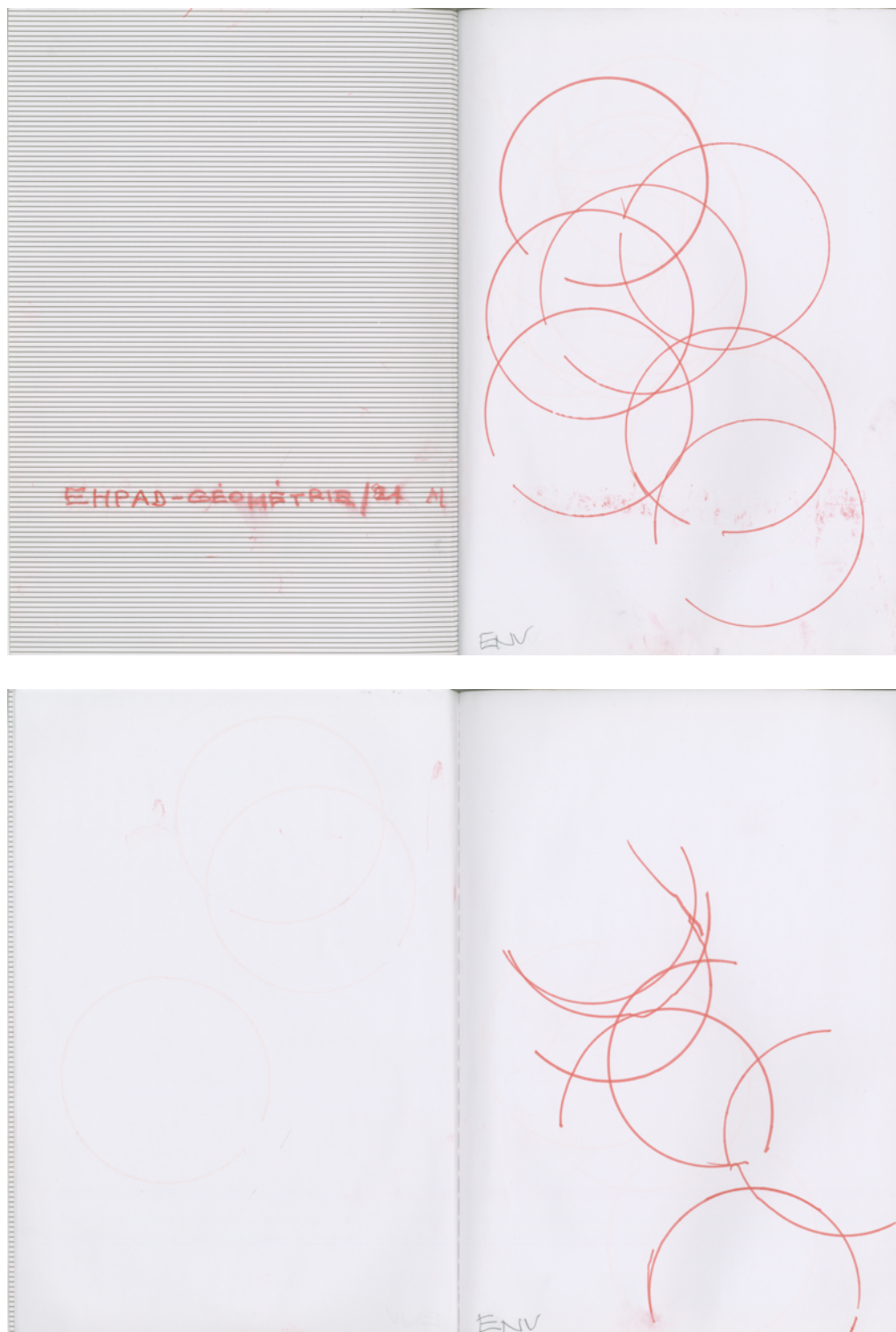


Figure 4.01 Vera Molnar, *EHPAD-Géométrie*, 2021, Drawings 1 and 5 of 25. Marker on notebook paper (18.14 x 25.9 cm) (Collection of the artist). The inscription *ENV*, short for *envoyé*, means she sent it to an assistant or gallerist.



Figure 4.02.01 Vera Molnar at l'Hôpital Saint-Paris, Paris, 2018. Photo by Laszlo Horvath.

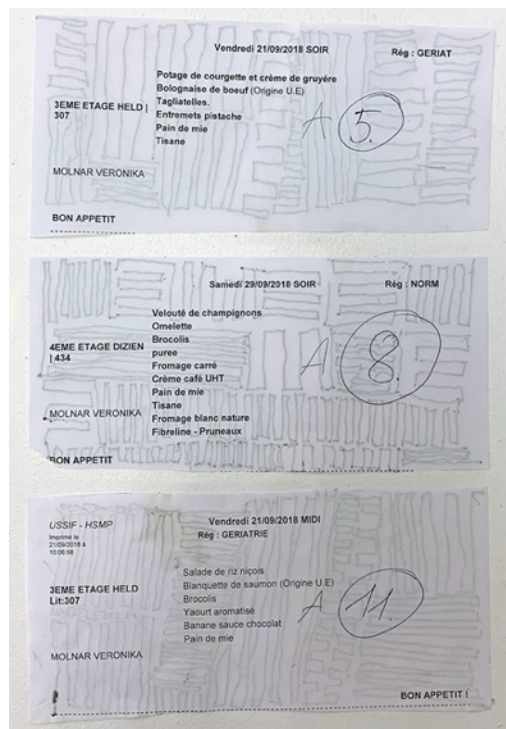


Figure 4.02.02 Detail, Vera Molnar, *Parcours Saint-Marie (Série A)*, 2018, Verso (hospital menus), (Bernard Chauveau Édition, Paris, France)



Figure 4.03 Vera Molnar, *Fragments de cercle P1*, 2021, Acrylic on canvas, 80 x 80 cm (Galerie Oniris, Rennes, France)

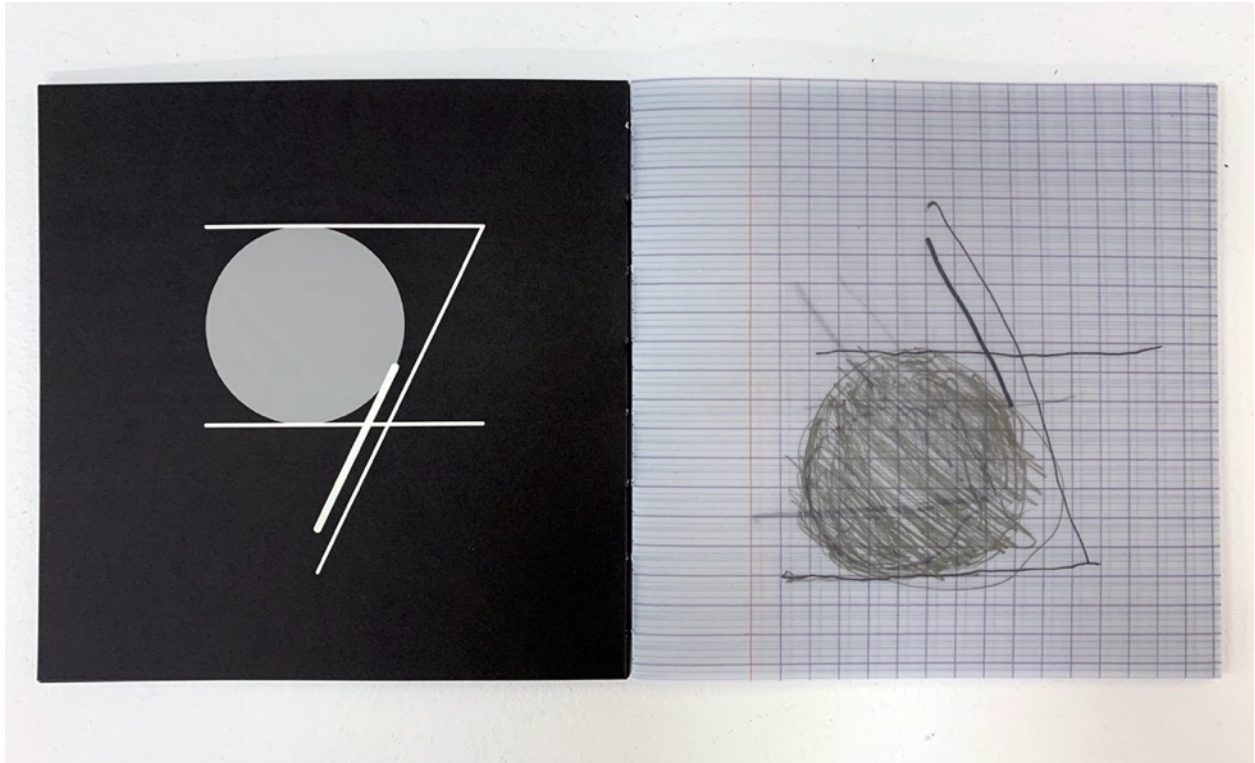


Figure 4.04 Detail, Vera Molnar, *Main/Machine (Hand/Machine)*, 2020. Hand-bound artist's book, 16,5 x 16,5 cm, printed on Sennelier, Awagami, and Cromático papers, 80 pages, edition of 45 (Bernard Chauveau Édition, | Galerie 8+4, Paris, France)

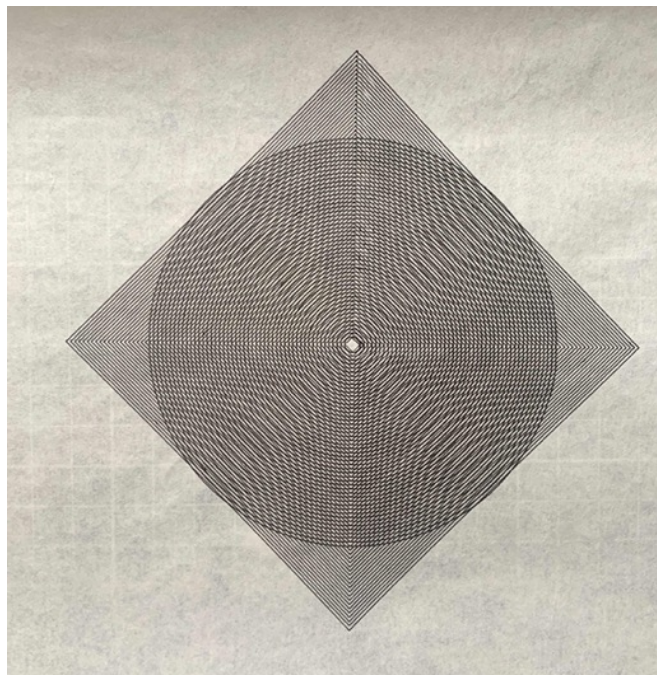
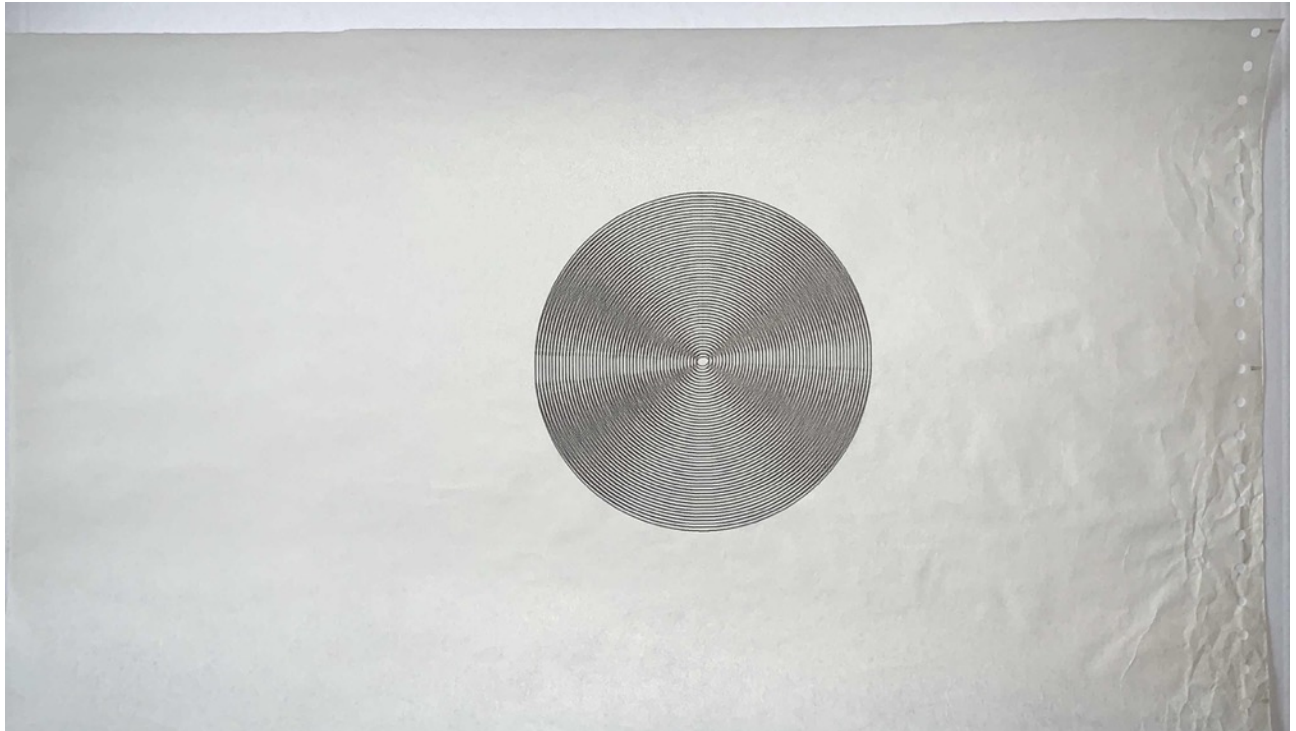


Figure 4.05 Vera and François Molnar, *Moirés or Cercles, carrés et un triangle gris*, ten plotter drawings in gray ink, approx. 36 x 21 cm each (Photos by the author, collection of the artist). Note: in the second image, the grid is not part of the paper, but the mat beneath it.