GHOSTS IN THE MACHINE

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OF GHOSTS AND MACHINES

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The more impalpable and invisible, user-friendly and communicative the machines around us become, the more pressing is the need to reinvestigate the prehistory of our digital era. Examining how the image of the machine evolved in the twentieth century—especially after the fifties, when the mechanical paradigm began to be replaced by a digital one—is ever more critical. Amid the clanking of rusty engines, the twists and turns of pumps and pipes, or the first fantasies of integrated circuits, computers, and post-human machinery, might we find a key to unlocking the myths behind our smartphones and our society of images?

According to Richard Hamilton—an artist and industrial archeologist, who, as an interpreter and rhapsodist of the technological world, has helped to inspire the entire concept of this exhibition—men and machines live together in a "dream-like life."[1] It is this oneiric state, this magical union, that we explore in this exhibition and in this book.

"Ghosts in the Machine," therefore, does not aspire to put together a systematic, comprehensive reconstruction of the ties between man, machine, and art; that would be a task too great to accomplish in a single exhibition. Rather than a classic historical survey, "Ghosts in the Machine" is conceived like a *Wunderkammer*, a cabinet of curiosities presenting a sequence of objects and artworks that are linked together by a web of references and associations, kinships and elective affinities, in the kind of surreal montage best suited to that "dream-like life." Or perhaps this exhibition could be described as a "minor history," in the same way that two other extraordinary analysts of our machine civilization, Gilles Deleuze and Félix Guattari, spoke of a "minor literature."[2] For this reason, the show pauses only briefly to examine the crucial juncture of Futurism, Surrealism, and Dada, and their mechanical obsessions at the dawn of the twentieth century, choosing to focus instead on less canonical works and figures. Its objective is to both reveal and luxuriate in the myths with which—as Hamilton teaches us—man tries to assimilate "the disruptive experience [of technology] to the balanced fabric of thought and feeling."[3]

Harald Szeemann's 1975 exhibition "The Bachelor Machines," the first incarnation of his museum of obsessions, explored the myth of the bachelor machine, which Szeemann saw as spreading across art and literature at the end of the nineteenth and beginning of the twentieth century. Based on the research of literary critic Michel Carrouges, Szeemann assembled what he called an "exhibition in a suitcase" that combined archival materials, artworks, architectural models, and advertisements, reconstructing the dangerous liaisons that the historical avant-garde movements had woven between sexuality and technology.[4] According to Carrouges, who was referring to the work of Marcel Duchamp, "a bachelor machine is a fantastic image that transforms love into a technique of death."[5] One of the most mysterious objects in the exhibition was a re-creation of the torture device described by Franz Kafka in his short story "In the Penal Colony." It also featured illustrations from Raymond Roussel's novels, Alfred Jarry's pataphysical visions, Francis Picabia's virgin machines, and Konrad Klapheck's gargantuan painted devices. Some of these same pieces are featured in "Ghosts in the Machine"[6] and are similarly combined with other artifacts in an attempt to move beyond the pure tautology of the masterpiece, trying instead to look at artworks and other manifestations of visual culture as documents describing a certain vision of the world.

"Ghosts in the Machine" incorporates and re-creates various fragments and even entire sections of past exhibitions that have explored the relationship between art, humanity, and technology. Among them, we should at least cite "The Machine as Seen at the End of the Mechanical Age" (1968), the first kinetic art shows held in America (especially "Kinetic and Programmed Art" at the Rhode Island School of Design in 1966, which we have tried to reconstruct in part), "Arte Programmata" (1962), "The Responsive Eye" (1965), "Art and Technology" (1970), "Cybernetic Serendipity" (1968), and the Pepsi-Cola Pavilion at the International Exposition of Osaka (1970).[7] Richard Hamilton's lost exhibition "Man, Machine and Motion" (1955)[8] has been almost entirely reconstructed in collaboration with the artist's studio and estate, just as Stan VanDerBeek's *Movie-Drome* (1963–66) has been re-built in collaboration with the artist's heirs, based on the plans he left behind.

This exercise in interpretative philology is inspired by Hamilton's work on Duchamp and his piece *The Large Glass* (1915–23). In the same way that Hamilton reconstructed *The Large Glass* by carefully following the notes in *The Green Box*—as if it were a machine that could be rebuilt with the aid of an instruction booklet—we have tried to unravel the logic behind Hamilton's work and reconstruct it by studying his notes and the archival materials preserved in his studio. In a similar manner, we have also devised a series of period rooms, combining works that were originally exhibited together in the early sixties to re-create a sort of archeology of vision.

TECHNOLOGY AS SYMPTOM / TECHNOLOGY AS DREAM

In the same period that the legend of bachelor machines began to emerge in art and literature, a new concept was gaining ground in the field of psychology that would significantly influence the study of the ties between man and machine. The year 1919 marked the suicide of Viktor Tausk, a disciple of Freud and author of an important essay on "influencing machines."[9] In it, Tausk describes the complex contraptions dreamed up by schizophrenic patients who believed they were being persecuted by mysterious, mechanical objects that combined telepathy and electricity, X-rays and batteries, gears and cables. These "machines of a mystical nature,"[10] as Tausk called them, systematically appeared in the artworks of the mentally ill, which Hans Prinzhorn had begun to collect at the University of Heidelberg's psychiatric hospital in around the same period. In one of the extremely rare drawings by Jakob Mohr, the patient shows himself being held hostage by rays emanating from a small machine. The pictures by Robert Gie—cited by Deleuze and Guattari in *Anti-Oedipus*—portray a society of mental patients connected by electrical cables. And in her embroideries, Johanna Wintsch proudly proclaims: *Je suis radio*, "I am radio." The idea that the schizophrenic experience presaged the Babel of modernity and the information pollution of hypermodernity is a recurring theme explored by philosophers, doctors, and the patients themselves, who in their ravings imagined consciousness itself "treated as programmable software and feelings… transformed into biomedical substances."[11]

The delusion that machines are controlling not only the behavior of individuals but also the entire universe lies at the heart of many works by "outsider" artists, and has also been taken up by professional artists, psychiatrists, and philosophers. The entire oeuvre of Jean Tinguely, for instance, is haunted by the memory of Heinrich Anton Müller, a farmer, self-taught artist, and inventor of useful and useless machines

who signed his drawings "God."[12] In his essays on Joey the Mechanical Boy, the psychiatrist Bruno Bettelheim described the behavior of a child whose existence is governed by the ritual use of imaginary machines.[13] American outsider artist Emery Blagdon spent three decades constructing his healing machines—precarious assemblages that he believed would help cure diseases.[14] And in Switzerland, Emma Kunz created drawings with the help of a divining pendulum—a process of depersonalization and automation made even more mysterious by the appearance of "bachelor"-like figures in some of her images.[15]

The notion that there is something mystical and supernatural in the relationship between men, machines, and art is one that even the most skeptical and clear-eyed observers are prone to embrace. Marshall McLuhan solemnly declared in the pages of *Playboy* that mysticism is just tomorrow's science dreamed today.[16] And in the early sixties, the Italian philosopher and semiologist Umberto Eco—then still at the beginning of a career that would become legendary—used the phrase "mystics of arrhythmia" to describe artists who blended cybernetics, information theory, technology, and industrial aesthetics.[17] Grouped together under the memorable label of "Arte Programmata," the artists presented by Eco showed their work in a series of exhibitions that traveled around Italy in 1962, sponsored by Olivetti—a typewriter manufacturer that was then at the cutting edge of IT research and trying to forge a new relationship between technological research and mass culture. Many of the Italian artists grouped together under the "programmed art" label—which include Marina Apollonio, Getulio Alviani, Alberto Biasi, Davide Boriani, and Grazia Varisco, among others—were in contact with a network of international artists who belonged to various movements, experiments, and groups revolving around the labels "kinetic art," "Concrete art," "Zero," and "GRAV." Beginning in 1961, these artists would be brought together for several years in a series of exhibitions titled "Nouvelle Tendance," held in Zagreb, in what was then Yugoslavia.[18]

This cluster of artists and practices is perhaps the final taboo of contemporary art: the last movement that still lies outside the margins of the official history. And yet it is in this very context—which Eco called the "bit generation"[19]—that an in-depth reflection began to emerge on the influence that technology could exercise on our perceptual abilities. The artists of Arte Programmata imagined art as a training ground of the senses, "a perceptual gymnastics":[20] a necessary preparation for survival in a world overstimulated by ever-more-invasive advertising and technology.

"The observer of Renaissance perspective was a good Cyclops who rested his only eye on the crack of a magical box in which he saw the world from the sole possible viewpoint," wrote Eco in "The Form of Disorder." Whereas the man—and the artist—of today "is forced to have a thousand eyes, on his nose, on his nape, on his shoulders, on his fingers, on his backside. And he is turned inside out. Uneasy in a world that batters him with stimuli that assails him from all sides. Through the programmatic wisdom of the precise sciences one discovers the uneasy inhabitant of an expanding universe."[21]

The half-prophetic, half-comic tone of this passage (in which one can hear more than an echo of Italo Calvino, another key Italian cultural figure of the era) masks both the enthusiasm and the embarrassment of a leftist intellectual who in postwar Italy—and Europe—found himself having to reconcile his Marxist background with a world in which technology and machines could no longer be described and

understood using the instruments of theory offered by *Das Kapital*. Eco's generation witnessed the epoch-making change in the European industrial and social landscape of the late fifties and early sixties, evolving as a result of the "economic miracle." Under the pressure of the new society of affluence, they were forced to completely rethink the relationship between highbrow and lowbrow culture, automation and alienation, art and machine. It is no coincidence that in the same period, Eco published another seminal text, *Apocalittici e integrati* (translated in part as *Apocalypse Postponed*),[22] that reconstructs the genealogy—so to speak—of two diametrically opposed attitudes toward mass culture and the machine civilization. On the one hand, it offers an apocalyptic stance that presents technology and the masses as the source of all evil. On the other hand, it reveals a new breed of thinkers at home in the present, who do not renounce their intellectual commitment, but rather put it to the test by honing their skills in all forms of culture: from experimental literature to advertising, from sophisticated electronic music to the sappiest brand of pop.

The question posed by Eco and many other artists and intellectuals of his time was how to remain revolutionary while still taking advantage of new technology. Within the fields of Arte Programmata and Nouvelle Tendance, artists were working to forge a new idea of commitment to a new kind of utopia and doing this with a radical courage that unfortunately—perhaps due to their very extremism—has long remained a dead letter. Indeed, while it is taken for granted that everyone knows the political views of the key figures in Arte Povera, or expounds on social criticism in relation to Pop Art, we are less inclined to think of kinetic art as being tied to a political and social vision. And yet it is in the various groups of Nouvelle Tendance that one finds a totally new concept of the figure of the artist and the status of art taking shape. In his texts, Eco calls artists "programmers" and "planners," and indeed, many of the artists in this contingent seem to increasingly identify with the figures of the engineer, the architect, and the sociologist. Their works are the direct emanation of a plan, and no longer bear the mark of a hand, the artist's touch: they are meant to be inexpressive and, as GRAV (Groupe de Recherche d'Art Visuel) explains, "The new tendency is above all a search for clarity."[23] In many cases, we also find an all-out rejection of art as an elitist practice in favor of a collective (many artists of Nouvelle Tendance worked in groups and signed their works collectively) and industrial vision (the works are often conceived as prototypes to be produced on a vast scale, more like design objects than individual expressions). Karl Gerstner outlines this when describing Nouvelle Tendance, writing, "Art does not interest us as such…. Our art is an everyday art, so much so that some of us would wish to qualify it as socialist. It is, at any rate, social."[24] The art market is rejected as a fetishization of the individual—a useless myth and commodity, according to Nouvelle Tendance artist Marko Meštrović. Art must be freed of every shred of egotism, romanticism, and subjectivity, in favor of a scientific, industrial, technological approach that is both collective and progressive. Or, to put it even more clearly and quoting Meštrović again: "the new tendencies nurture the seed of a general and encompassing revolutionary idea, which does not desire to express itself in a rebellious or destructive way."[25] A revolution, therefore, but a revolution that is cold, austere, electric, and silent. Even the information theorist Abraham Moles—whose work would have a fundamental influence on both the artists and intellectuals of the Nouvelle Tendance movement—said in 1965 that while

the Industrial Revolution had been noisy, the information revolution would be a quiet one, a secret one, but no less sweeping and pervasive.[26]

Information theory and early research into semiotics and language analysis played a fundamental role in the debates of Nouvelle Tendance artists. Not only did writers and thinkers like Eco and Moles attend the events and lectures in Zagreb, the artists themselves looked to information theory and informatics for metaphors through which to explain their work (and some went beyond mere metaphor, using computers to create poems, drawings, and videos, many of which are in this exhibition). Information theory, in particular, with its emphasis on the transmission of messages, placed a new focus on the listener, outlining a theory of reception that artists responded to by showing a new interest in the role of the audience, which was described and envisioned as an active participant, playing a fundamental part in the realization of the work. From the hard sciences, the Nouvelle Tendance artists also borrowed the idea of art as a measurable activity made up of discrete elements that could be discretely manipulated. Indeed, even the word "art" could be replaced by "visual information," and visual phenomena could be codified "just as music was codified into notes."[27]

The belief that the optical experience can be deconstructed and analyzed in its separate components also underlies the work of artists who have been linked to the label of "Op art" or "perceptual abstraction." In contrast to the Nouvelle Tendance artists, the "Op" label usually refers to painters and can be traced, in particular, to the pivotal exhibition "The Responsive Eye," held at the Museum of Modern Art in 1965. Although works of kinetic art were not included, it presented many figures who had been active in groups associated with Nouvelle Tendance. The painters of perceptual abstraction, such as Bridget Riley, Victor Vasarely, and Richard Anuszkiewicz, shared Nouvelle Tendance's fascination with smooth, anonymous, industrial surfaces, and its cult of "handlessness," as critic Dave Hickey has termed it;[28] while Riley describes her paintings as "Unchecked by any kind of touch" and "extremely naked thing[s]."[29]

"Much Op art is removed from the artist's subjective discovery," wrote Jon Borgzinner in the first article that launched the term and the Op art craze in America.[30] "It is the result of a mechanical muse," Borgzinner continues, "and the artist becomes a computer programmer churning out visual experiences," while the viewer serves as the engine that sets the painting in motion. "These works exist less as objects than as generators of perceptual responses," as William Seitz, curator of "The Responsive Eye," explained to Borgzinner.[31]

Some observers saw a connection between the frequent use of black and white in perceptual abstraction and the contrast of binary code, leading them to imagine that these paintings might have been created by a computer. Some were more skeptical. Riley was opposed to any overly scientific reading of her work, yet did not deny that "perception is the medium" and her pieces were, if not kinetic, at least akin to "happenings" in that they were stunning perceptual events (as Jonathan Crary describes them).[32] However, there were also those who liked to play on such misunderstandings. Vasarely, for instance, called his paintings "planar kinetic works" that in the future would be made by and for "cybernetic machines…more impartial than the best human beings could ever be."[33]

In the end, this yearning for the merging of artist and computer is not all that different from Andy Warhol's oft-quoted desire to be a machine. However, there was a more moralistic, apocalyptic edge to Warhol's technological vision, complete with car crashes, whereas the integrated stance of the Nouvelle Tendance artists was far more contemporary, albeit perhaps incredibly naïve.

If one wishes to explore the position of artists in relation to technology, it is essential to look at the work carried out by the Independent Group in London in the early fifties. As pioneers of a very different pop sensibility from the one that would catch on in America, the group of artists, writers, and critics that revolved around London's Institute of Contemporary Art (ICA)—which included, among others, Hamilton, Eduardo Paolozzi, Lawrence Alloway, and Reyner Banham—developed a very personal investigation of mass culture and technology. It could be directly linked to the first coeval experiments in cultural studies, with the anthropological analysis of mass culture by writers such as Roland Barthes (in *Mythologies*), the early McLuhan (in *The Mechanical Bride*) and, again, the early Eco.[34] Like these trailblazers, the artists and intellectuals of the Independent Group had a voracious curiosity about every visual expression of mass culture, from comics to advertisements, by way of fotonovelas, illustrated magazines, and the embryonic stages of television. In contrast to Barthes and McLuhan, they avoided moralistic, critical excesses and embraced highbrow and lowbrow culture with the same enthusiasm. In fact, they wanted to do away with all hierarchies and examine popular, vernacular expressions with the same serious attention usually dedicated to art and architecture. It is no coincidence that the presentation formats used by the Independent Group imitate the classic instruments of academia: lectures, slideshows, and debates, along with the hallmark tool of this group of artists, the exhibition. Within the group, an absolutely unique and original line of experimentation was emerging in which artists, critics, and architects collaborated to create exhibition settings, not necessarily to display their own works, but rather found images, artifacts, and pieces by other artists. These environments—the forerunners of contemporary installations—were inspired by the tradition of architecture and design, and more generally, by the culture of display that characterized the Concrete art of the first half of the century (from Lissitzky to Rietveld), but also seem to weave a dialogue into the tradition of museology. How can one not be reminded of Aby Warburg's *Mnemosyne Atlas* (1924–29), looking at the hundreds of images assembled by Hamilton for "Man, Machine and Motion"? The display has a forensic feeling, with the images arranged like evidence: cataloged fragments left over from the machine civilization. It is a Rosetta Stone through which Hamilton—artist, archeologist, and ethnographer of consumer society—tries to interpret the hieroglyphics of the contemporary world. But the combinatorial device created by Hamilton for this show envelops viewers in a sphere of images that seems to presage the experience of information overload characteristic of our image-society. In the end, "Man, Machine and Motion" is a sort of Google image search laid out in three-dimensional space, an encyclopedia of images in which the viewer loses his or her way. As in the new spatial experience typical of our technological times, described by Eco, here too the viewer "is turned inside out," immersed in "a world that batters him with stimuli, that assails him from all sides."[35] Though still enclosed in a system of perfect proportions, a modernist grid, Hamilton's installation and the spaces it describes are on the brink of dematerializing, dissolving into that "dream-like life" that is the very stuff of technological existence. It is not difficult to grasp how Hamilton's integrated prophecies would develop into the apocalyptic nightmares of

J.G. Ballard, the bard of the more insidious, invasive postmodern technology, who was familiar with many of the members of the Independent Group and frequented the ICA.

The idea that contemporary image-society is an external outgrowth of our nervous system, made possible by a kind of technology that slips under the skin, is a prophecy that Ballard would share with McLuhan. And it is a notion that gained ground among many American artists in the late sixties, particularly the filmmakers and videomakers who came out of the sphere of expanded cinema. VanDerBeek was one of the most active figures in underground and experimental film in the sixties. From 1963–66, he developed his *Movie-Drome*, a space where an international network of databases would share images and films—a cathodic church that today bears a close resemblance to the World Wide Web. VanDerBeek built a prototype of this "electric assemblage" in a dome made from the roof of a grain silo at Stony Point, New York. In this setting, the artist staged multimedia events that combined a flow of images, films, and projections to create an "overwhelming information experience."[36] Like Tausk's influencing machine, VanDerBeek's *Movie-Drome* plunges its viewer-patients into a river of images that seems to portend the extreme voyeurism of the internet. Might the global onanism of our social media be the latest incarnation—a transnational, corporate one, as befits this era—of the bachelor machine?

1. Richard Hamilton, "Man, Machine and Motion," in *Richard Hamilton: Collected Words* (London: Thames & Hudson, 1982), 19.
2. Gilles Deleuze and Félix Guattari, *Kafka: Towards a Minor Literature* (Paris: Les Editions de Minuit, 1975). The title for this exhibition is drawn from the book *The Ghost in the Machine* by Arthur Koestler, which itself took the phrase from British philosopher Gilbert Ryle. Both Ryle and Koestler are concerned with the Cartesian mind/body divide. The title is less inspired by (although not unaware of) the 1981 album by The Police.
3. Hamilton, 1982, 20.
4. Jean Clair and Harald Szeemann, eds., *The Bachelor Machines* (Venice: Alfieri, 1975). For Szeemann's commentary on the museum of obsessions see his *Museum der Obsessionen* (Berlin: Merve, 1981). For detailed information about "The Bachelor Machines," see *Harald Szeemann: with by through because towards despite*, eds. Tobia Bezzola and Roman Kurzmeyer (Zurich: Edition Voldemeer, 2007), 392–405.
5. Michel Carrouges, "Directions for Use," in *The Bachelor Machines*, 21.
6. I am especially grateful to Josy Kraft and Ingeborg Luscher for their help in bringing these remarkable works to the New Museum.
7. "Kinetic and Programmed Art": Rhode Island School of Design curated by Willoughby Sharp; "Arte Programmata": Olivetti at Galleria Vittorio Emanuele, Milan, curated by Bruno Munari and Umberto Eco; "The Responsive Eye": Museum of Modern Art, New York, curated by William Seitz; "Art and Technology": Los Angeles County Museum of Art curated by Maurice Tuchman; and "Cybernetic Serendipity": Institute of Contemporary Art, London, curated by Jasia Reichardt.
8. After being exhibited at the Hatton Gallery, Newcastle-upon-Tyne, in May 1955 and at the Institute of Contemporary Arts, London, in July 1955, the exhibition was dismantled but not preserved. Hamilton kept the photographs used to produce the exhibition as well as the floor plans and documentation of both installations. The exhibition was partially reimagined, in a much smaller form, for an exhibition about the Independent Group at IVAM, Center Julio Gonzalez, Valencia, in 1991. The presentation for "Ghosts in the Machine" attempts to fully reconstruct "Man, Machine and Motion" based on the original Hatton Gallery presentation and has been aided by the artist's wife, Rita Donagh, and long-time studio manager Nigel McKernaghan.
9. Viktor Tausk, "On the Origin of the 'Influencing Machine' in Schizophrenia," in *Internationale Zeitschrift für Psychoanalyse*, V, 1919.
10. Tausk, reprinted in *The Psycho-analytic Reader*, ed. Robert Fleiss (New York: International Universities Press, 1948), 33.
11. Thomas Fuchs, "Being a Psycho-Machine. On the Phenomenology of the Influencing-Machine," in *The Air Loom and Other Dangerous Influencing Machines*, ed. Thomas Röske and Bettina Brand-Claussen (Heidelberg: Verlag Das Wunderhorn, 2006), 41.
12. Szeemann, 1975, 136–139.
13. See Bruno Bettelheim, "Joey: A 'Mechanical Boy'," in *Scientific American*, March 1959, 116–127. Also, Bruno Bettelheim, *The Empty Fortress* (New York: The Free Press, 1967).
14. Leslie Umberger, ed., "Emery Blagdon, Properly Channeled," in *Sublime Spaces and Visionary Worlds* (New York: Princeton Architectural Press, 2007), 203–223.
15. Szeemann, 1975, 212–213. See also, *Emma Kunz: Artist Researcher Healer* (Würlenos: Emma Kunz Zentrum, 1998).
16. "Playboy Interview: Marshall McLuhan," in *Playboy*, March 1969, 26–27, 45, 55–56, 61, 63.
17. Umberto Eco, "The Form of Disorder," in *Gianni Colombo*, ed. Marcella Beccaria (Milano: Skira, 2009), 212. Originally published in *Almanacco Letterario Bompiani 1962. Le applicazioni dei calcolatori elettronici alle scienze morali e alla letteratura* (Milan: Bompiani, 1961), 175–188.
18. A number of exhibitions and publications survey the international movements making up Nouvelle Tendance. See Peter Selz, *Directions in Kinetic Sculpture* (Berkeley: University of California, 1996), Frank Popper, *Origins and Development of Kinetic Art* (Greenwich: New York Graphics Society, 1968), Lea Vergine, *Arte programmata e cinetica 1953/1963 – L'Ultima Avanguardia* (Milan: Gabriele Mazzotta, 1983), and *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: ZKM, 2011), among others.
19. Eco, 2009, 210.
20. Umberto Eco, "Arte Programmata," reprinted in *A Little-Known Story about a Movement, a Magazine, and the Computer's Arrival in Art: New Tendencies and Bit International, 1961–1973*, 100.
21. Eco, 2009, 213.
22. Umberto Eco, *Apocalittici e integrati* (Milan: Bompiani, 1964).
23. GRAV, *Groupe de Recherche d'Art Visuel. Paris 1962* (Paris: Galerie Denise René and GRAV, 1962), n.p.
24. Karl Gerstner, "Qu'est que la Nouvelle Tendance?" in *Propositions visuelles du movement international Nouvelle Tendance* (Paris: Mazarine, 1964), n.p.
25. Marko Meštrović, "Untitled," in *nove tendencije 2* (Zagreb: Galerija suvremene umjetnosti, 1963), n.p.
26. Abraham A. Moles, "Cybernetics and the Work of Art," reprinted 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: ZKM, 2011), 217.
27. Manfredo Massironi quoted in Jon Borgzinner, "Op Art: Pictures that Attack the Eye," *Time*, Oct. 23 1964.
28. Dave Hickey, "Trying to See What We Can Never Know," in *Optic Nerve: Perceptual Art of the 1960s*, ed. Joe Houston (New York: Merrell, 2007), 12.
29. Michael Craig-Martin, "Practising Abstraction: Bridget Riley Talking to Michael Craig-Martin," in *Bridget Riley, Selected Paintings, 1961–1999* (Düsseldorf: Kunstverein für die Rheinlande und Westfalen, 1999), 70.
30. Borgzinner, 1964.
31. Ibid.
32. Jonathan Crary, "Attention and Event in the Work of Bridget Riley," in *Bridget Riley – Rétrospective* (Paris: Paris Musées, 2008), 42.
33. Victor Vasarely quoted in Cf. Konrad P. Liessmann, "Die eigentlich physikalische Tätigkeit," in *Victor Vasarely*, ed. Klaus Albrecht Schröder (Munich: Prestel, 1992), 30.
34. Roland Barthes, *Mythologies* (Paris: Éditions du Seuil, 1957). Marshall McLuhan, *The Mechanical Bride: Folklore of Industrial Man* (New York: Vanguard Press, 1951). Umberto Eco, *Opera aperta* (Milan: Bompiani, 1962) and *Apocalittici e integrati*.
35. Eco, 2009, 213.
36. Stan VanDerBeek, "'Culture: Intercom' and Expanded Cinema: A Proposal and Manifesto," in *Film Culture* 40 (Spring 1966), 17.