

## *Repetition and the scientific model in art*

ELLEN K. LEVY

This essay explores repetition in the work of artists who use scientific models as a point of departure for their art. The biological and physical sciences provide these artists with examples of processes regularly occurring in nature, and the artists use science as a means of exploring relationships between art and the world. These artists use repetition to depict and evoke nature's processes, with such actions as duplication, folding, and mirroring. Through comparisons with genetics—a science particularly associated with repetitive phenomena—I offer fresh insights about the functions of repetition in the work of some contemporary artists. Just as repetition calls attention to variation within sameness, the artistic use of analytic systems can focus attention on personal vision. When artists specifically use genetics as *the* scientific model, their repetition suggests generative metaphors.

Repetition has several classic functions. It helps defer closure in a work of art by establishing expectations of recurrence while giving pleasure to the viewer. In his early paintings Frank Stella accomplished this effect by internalizing and reiterating the four edges of his paintings and implied that the internally depicted lines could continue out indefinitely past the framing border. Gilles Deleuze points out important distinctions between static and dynamic repetitions. Active repetition in art can evoke evolutionary processes, likening the dynamic repetition to genetic action.<sup>1</sup> Used dynamically in art, repetition can go beyond rote articulation to invoke experience and memory, in turn involving reproduction and reflection. When artists repeat visual phrases, they engage time, simultaneously setting up reverberations of prior use (memory) and suggesting the impossibility of their full retrieval (loss). This near-musical cadence is an aspect of work that has recurrent units, such as grids in Agnes Martin's paintings. Although not generally so regarded, appropriation might be considered a special instance of repetition. A contemporary artist, for example, might repeat a motif from Pablo Picasso, who in turn had borrowed it from a much-earlier and now-inaccessible African source. These applications in the suspension of closure and the marking of time establish a sense of organic continuity and outward growth. Repetition thus can generally suggest biological patterns, while replication, another kind of repetition, can share in this organic association or can imply the opposite, namely industrial standardization.

Repetition in art often gains power and fresh content by scientific contextualization. Such artists as Alfred Jensen and Robert Smithson capitalize on their ability to evoke nature's processes through repetitive patterns. Repetition reinforces the already existing scientific context in their work, permitting the surfacing of little-explored subject matter. I examine these new functions of repetition in selected artworks after first discussing pertinent aspects of repetition in genetics.

In science repetition is vital to the proof of a successful hypothesis. It also figures in each of three basic genetic processes: replication, transcription, and translation.<sup>2</sup> Replication enables the transfer of hereditary information from one DNA molecule to another, transcription copies the information to RNA, and translation yields the gene product, namely proteins.

Genetic *replication* involves the separation of two strands of the double helix and the subsequent synthesis of new strands that complement the originals. In replication the helix unwinds, and polymer-forming enzymes known as DNA polymerases subsequently copy the strands. Additional proteins unwind the helix, stabilize it, and permit the DNA polymerases to build new strands.

During *transcription* sequenced (ordered) bases of DNA are copied into RNA, which program the synthesis of a linear set of amino acids. An enzyme known as RNA polymerase copies one strand of the DNA into an RNA molecule and initiates the synthesis. Only one strand of the helix is copied: the coding strand, which contains the genetic information. The other strand is noncoding and acts as a template during replication.

The final process is *translation*. As there are only four bases each in DNA and RNA but twenty amino acids to be specified in living cells, three bases or triplets are needed to specify one amino acid. If a two-base system were used, for example, it would only yield sixteen (four-squared) coding possibilities. Three bases offer sixty-four (four-cubed) coding possibilities, more than enough to produce twenty amino acids. Subsequently, amino acids link together as a chain to form a protein molecule. The order of amino acids determines the function of a protein just as the order of words determines the meaning of a sentence. Repetitive protein folding subsequently generates structures with specific functional properties.

Genetics manifests repetition in other ways. Repetitive elements exist within the vast regions of the genome that do not participate in generating the body's supply of proteins. Called noncoding or "junk DNA," the long, repetitive sequences of letters differ from the triplet, coding sequences of nucleic acid pairs.<sup>3</sup> The so-called junk is widespread and constitutes all but roughly 3 percent of the more than three billion bases or building blocks that make up human DNA.

A small segment of the scientific community believes that the redundancy of the repetitive noncoding DNA may provide material for evolutionary change. According to this hypothesis new genetic ideas can be "tested" in the regions not engaged in protein production.<sup>4</sup> This cannot be accomplished without possible damage in coding regions that are vitally occupied in generating the body's supply of proteins. In this way the repetitiveness of the junk DNA might provide a source of evolutionary development that augments the separate genetic process of recombination, where chromosomes exchange segments resulting in a random assortment of recombined chromosomes. There is thus more than one way to provide for genetic change.

The structures of genetic processes have analogues in art. First, the two-stranded complementarity of DNA enables duplication of the genetic material and the inheritance of traits. This complementarity can suggest the mirroring that exists in some art. Second, each genetic process provides a linear order in which sequences determine function. This is true during transcription when DNA is copied into RNA and also during translation when the RNA molecule synthesizes strands of amino acids. Specific amino acid sequences are also responsible for folding, introducing another form of repetition. These linear sequences can be related to the sequences and patterns artists use. Finally, the repetitive, pieced-together, modular structure of genetic material allows flexibility. Different genetic products can be assembled into new configurations.<sup>5</sup> A corresponding feature in art is the flexibility provided by combinative units like grids and modules. As a model for art, genetics provides for system, variation, and organic metaphors.

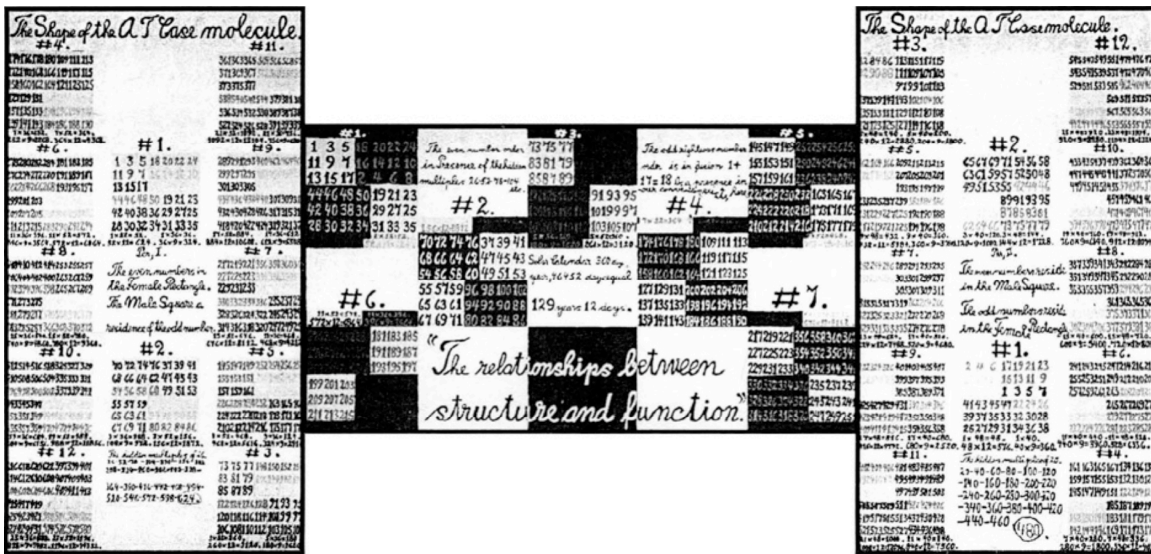


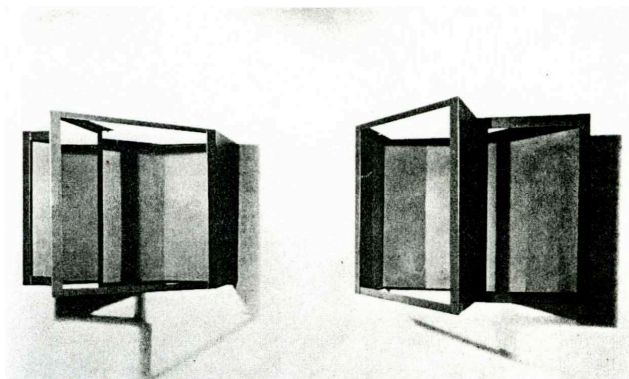
FIG. 1 Alfred Jensen, *Seeking to Unravel the Shape of an Enzyme*, 1977, oil on canvas, 3 panels, 86 x 182 inches. PaceWildenstein Gallery, New York.

In this essay I discuss functions of repetition in certain works, focusing upon one work by each of three artists who, notwithstanding common roots in Minimalism, come from different generations and aesthetic worlds: Jensen, Smithson, and Allan McCollum. I describe and compare their works and draw upon scientific conceptions that inform repetition in their art. I have selected art in which repetition (in the form of grids, recurring modules, and mirroring) functions in a manner that reflects scientific influence.

Because repetition can evoke biological processes, the scientific context of the artists I discuss is reinforced. In effect, the scientific model functions as a substitute for the model once provided by figurative representation. There is great advantage for artists to contextualize their work in this manner: the ability to couple abstract processes available in self-reflexive art with an external referent provided by the scientific model. This ability appears at a time when artists often seek to enlarge aesthetic concerns, avoiding strict formalism. Repetition in a scientific context can enhance the appearance of subject matter that is vital, universal, and visually accessible.

Each work discussed here embodies a different aspect of repetition. Jensen employs the grid as a source of repetitive units; Smithson, the duplication formed by mirrors; and McCollum, replication via templates and molds. Considered out of chronological order, the artists repeat elements in the two-dimensional space of painting (Jensen), in an object that mediates between two and three dimensions (Smithson), and in fully three-dimensional space (McCollum).

In 1977 Jensen painted a three-paneled work titled *Seeking to Unravel the Shape of an Enzyme* (fig. 1), incorporating signs, symbols, writing, and numbers into grids in combinations of color and black and white.<sup>6</sup> The paint is thick and juicy, forming a sensuous contrast to his analytic subject. The painted phrase “The Shape of the ATCase molecule” appears twice in this painting, as a heading on each of the two side panels. One source for Jensen’s painting is the action of the enzyme ATCase (aspartate transcarbamoylase) in the biosynthesis of pyrimidine, one of the bases along with purine essential to the complementarity



**FIG. 2** Robert Smithson, *Enantiomorphic Chamber*, 1964, painted steel and mirror. John Weber Gallery, New York.

of DNA. The ATCase enzyme might have provided Jensen with a point of departure in this particular work.<sup>7</sup> In preparing the painting Jensen had preserved newsclips of the research of Nobel Prize laureate William Lipscomb, who investigated properties of ATCase in pyrimidine metabolism. Jensen's exploration of ATCase is consistent with his readings<sup>8</sup> about physical systems as presented in J. Needham's *Science and Civilization in China* as well as in theories

of Michael Faraday, the nineteenth-century physicist and chemist.

In *Seeking to Unravel the Shape of an Enzyme*, grids help Jensen to establish mirrored relationships, most noticeably, a symmetrical relationship within the three panels echoed by a fragment of text. The phrase "the relationships between structure and function" is positioned on the bottom center panel like a pivot. Because Jensen has given his painting a scientific context, his depicted mirroring could be viewed as suggesting notions of complementarity.

In addition to the conceptual framework of enzymatic configurations, Jensen incorporates within his grids other systems, signified by references to male and female dualities and painted phrases and sentences, one of which reads "solar calender 360 day year, 46452 days equal 129 years 12 days." This phrase provides a taking-off point for inscribed numerical sequences. By merging ancient epistemologies with references to Western science, Jensen gains a sense of play and a rich layering of associations.

Through repetition Jensen achieves the appearance of near-mystical ineffability. At first view he employs many nearly indistinguishable elements that present an excessive array of numbers and words. The apparent interchangeability of numbers leaves the viewer with the impression of repetition itself. The viewer looks at painted words, blurring the distinction between image and text. Jensen appears ultimately inscrutable.



**FIG. 3** Robert Smithson. *Gyrostasis*, 1968, flat white paint on folded steel. 73 x 57 x 40 inches, John Weber Gallery, New York.



**FIG. 4** Allan McCollum, *Drawings*. 1989/91, over 2,000 framed drawings of pencil on museum board, installation: Centre d' Art Contemporain, Geneva, Switzerland, 1993.

Smithson's *Enantiomorphic Chamber* (fig. 2) employs repetition in a way both similar to and different from Jensen's *Seeking to Unravel the Shape of an Enzyme*. During the 1960s Smithson often used repetitive modules.<sup>9</sup> An example is his spiraling work *Gyrostasis* (fig. 3), which is based on numerical progressions that diminish away from the base of the sculpture. *Enantiomorphic Chamber* points to Smithson's growing involvement with scientific systems of transformation.

In *Enantiomorphic Chamber* Smithson's specific scientific reference is crystallography, the structural arrangement of atoms or molecules within crystals.<sup>10</sup> An enantiomorphic system is a system in which the introduction of heat reverses the normal direction of physical changes.<sup>11</sup> The resulting molecules (enantiomers) are identical to each other except for rotation about a key atom. A similar situation is the presence in nature of right- and left-handedness.

Smithson's sculpture features two identical but reversed chambers, whose internal mirrors duplicate the symmetry of their side-by-side positioning. Each of Smithson's mirrors reflects the other half of the sculpture. As a result the mirrors reflect each other in a manner suggestive of complementarity in DNA strands. Using mirrors, Smithson recalls enantiomers (isomers) that are identical except that they are positioned in reverse of each other. The function of such isomers is dependent on their orientation because the mirror-image state can exhibit different properties in nature. Smithson's mirrors create an illusion of the altered physical form and metaphorically link function with structure.

Creative play emerges within Smithson's system. In *Enantiomorphic Chamber* mirrors are framed obliquely by painted steel that gives rise to varied spatial illusions, appearing like frames seen simultaneously from different vantage points. In this way Smithson uses

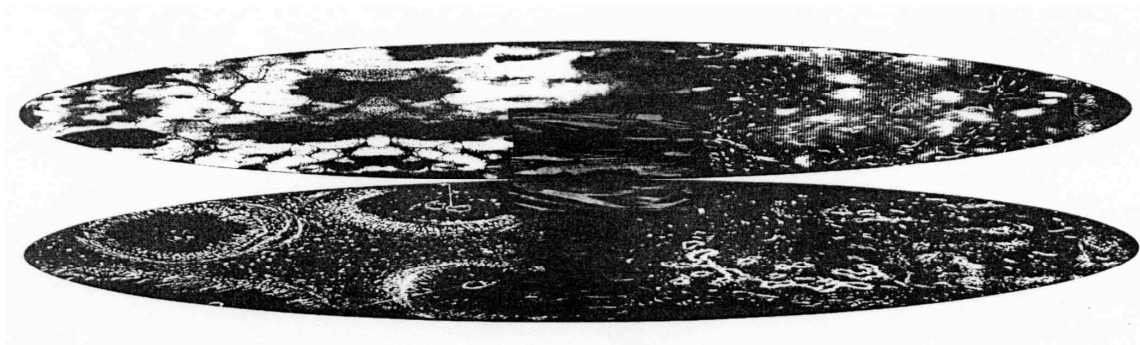


**FIG. 5** Allan McCollum. *Natural Copies from the Coal Mines of Central Utah*. 1994-95, enamel on polymer-reinforced gypsum, installation at John Weber Gallery. John Weber Gallery, New York.

geometry to question its own premises of rationality. The numerous reflections in Smithsonian's piece help to offset an otherwise symmetrical arrangement and add a sense of unpredictability.

McCollum, best known for his endless repeats of minimal paintings, has also created *Drawings* (fig. 4), where each work is a replica in that it is a variant of a template. His system allows for an enormous expansion with approximate repetition. Repetition is associated here with capitalist production, rather than notions of evolutionary process. Critical of consumerism and interested in the collusion between mass culture and high art, McCollum, like Andy Warhol, exposed in his early work the assumptions built into advertising.<sup>12</sup> In recent work he has extended these concerns to conditions of museum display, particularly paleontological exhibitions. By replicating fossils, McCollum shifts his works' associations from industrial standardization to evolutionary themes.

McCollum's exhibition *Natural Copies from the Coal Mines of Central Utah* (fig. 5) consists of multiple recasts of "natural casts" of dinosaur tracks. McCollum first came upon the natural casts in a museum of prehistory in Utah. He made rubber molds from the fossils, "manufactured" impressions, and displayed them.<sup>13</sup> The slight difference in each casting is caused by variable conditions at the time of casting. Photocopies of literature about the techniques of casting are available on stands near the sculpture and contribute to the sense of proliferation.

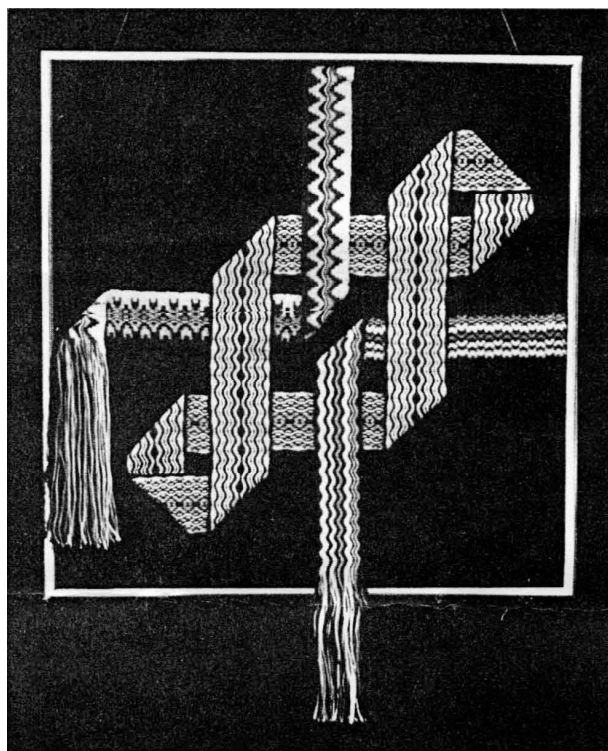


**FIG. 6** Beverly Fishman, *Untitled*, 1993, photo-based collage and painting, 24 x 96 inches. Private collection.

Other contemporary artists have drawn more consciously on genetic paradigms. In her diptych *Untitled* (fig. 6), which is a painted and photo-based collage made with a four-color laser copier, Beverly Fishman refers explicitly to genetic replication in her own artistic process. Fishman manipulates imagery appropriated from scientific texts by inverting, coloring, distorting, and reproducing cellular forms. The duplications in Fishman's piece mimic generative mechanisms. The sleek, elliptical shapes suggest analogies to cellular structures, which prompt the viewer to recognize that forms that might initially be categorized as non-objective are, in fact, representations of biological subjects and processes. These cells, one imagines, are intended as representations of primal and vital forces.

*Kinetic Trap* (fig. 7), by chemist Marilyn Emerson Holtzer, conflates the ancient ritual of weaving with the genetic process of protein production (translation) in DNA. This coupling of women's crafts with generativity can suggest a feminist viewpoint. Holtzer's works are inspired by protein folding, and her motifs are loosely based on the sequence of amino acids in a particular protein chain. According to Holtzer, "just as the sequence of amino acids in a protein chain determines its native structure, the specific sequences and interlacements of warp and weft fibers determine the intricate patterning of the narrow woven bands."<sup>14</sup> The repetitive elements that define her weavings also, therefore, imply a genetic process.

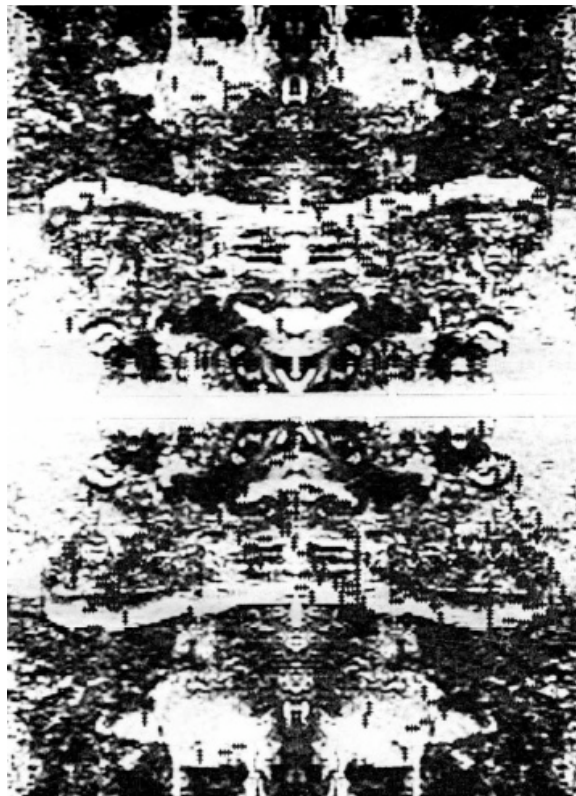
In his work Joseph Nechvatal replaces cybernetics for Warhol's factory model of the social order. He refers explicitly to computer



**FIG. 7** Marilyn Emerson Holtzer, *Kinetic Trap*, 1993, tablet woven in silk, 14 x 14 inches. Courtesy the artist.

viruses and their proliferation in *viral attaque: amoR foRti* (fig. 8). This painting represents one of many possible configurations. Nechvatal introduces a computer virus into his computer, generating and recording images that infect and multiply, transforming his initial production. His intention is to create excess through technological means. He associates the “viral” invasion with biological invasion, suggesting that the resultant overloaded art be viewed as a “bodily” defense.<sup>15</sup>

We have seen repetition in the gridded systems of Jensen, the mirrorings of Smithson, and the context-sensitive duplications of McCollum, as well as in the techniques of other artists. Repetition enables the exploration of scientific subjects previously untreated in art while emphasizing an abstract, process-oriented method. The repetition artists use generally draws attention not to standardization (Warhol-related work is the exception), but to differences grounded in experience and specificity. Science provides the artists discussed here with a model of a process by which art can be made. At its best, when artists unite scientific analysis with self-expression, they encompass creative metaphor and play, avoiding doctrinaire applications of scientific principles. The rigor of science can also provide a striking counterpoint to artistic freedom. In addition, when artists place repetitive elements of their work within the specific context of genetics rather than in that of science in general, repetition reinforces generative associations.



**FIG. 8** Joseph Nechvatal. *viral attaque: amoR foRti*, 1994, computer-robotic assisted acrylic on canvas, 39 x 58 1/2 inches. Courtesy the artist.

ELLEN K. LEVY is guest editor of this issue of Art Journal.

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## Notes

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<sup>1</sup> Gilles Deleuze, *Difference and Repetition* (New York: Columbia University Press, 1968), 70.

<sup>2</sup> Dr. Robert Shapiro has provided a careful reading of this information.

<sup>3</sup> Natalie Angier, "Keys Emerge to Mystery of So-called Junk DNA," *New York Times*, June 28, 1994, C1, C3.

<sup>4</sup> Susumu Ohno, *Evolution by Gene Duplication* (New York: Springer, 1970); Stephen Jay Gould, *Eight Little Piggies* (New York: W. W. Norton 1993), 318-20.

<sup>5</sup> Roland Saldanha et al., "Group I and Group II Introns," *FASEB* 7 (January 1, 1993): 15-24.

<sup>6</sup> Maria Reidelbach, *Alfred Jensen: Paintings and Works on Paper*, exh. cat. (New York: Solomon R. Guggenheim Museum, 1985), 8-20.

<sup>7</sup> Regina Bogat (artist's widow), telephone conversation with author, July 6, 1995; Lupert Stryer, *Biochemistry*, 4th ed. (New York: W. H. Freeman, 1995), 237-44.

<sup>8</sup> See Linda Cathcart and Marcia Tucker, *Alfred Jensen: Paintings and Diagrams from the Years 1957-1977*, exh. cat. (Buffalo: Albright-Knox Art Gallery), 3-24; and *Alfred Jensen, The Late Works*, exh. cat. (New York: Pace Gallery, 1984).

<sup>9</sup> Toby Muszman, "Literalness and the Infinite," in Gregory Battcock, ed., *Minimal Art* (New York: E. P. Dutton, 1968), 237-50.

<sup>10</sup> Lawrence Alloway, *Topics in American Art* (New York: W. W. Norton, 1975), 221-36.

<sup>11</sup> *Ibid.*, 223.

<sup>12</sup> Craig Owens, *Beyond Recognition* (Berkeley: University of California Press, 1992), 117-21.

<sup>13</sup> This was on view at John Weber Gallery, New York, March 25-April 22, 1995.

<sup>14</sup> Marilyn Emerson Holtzer, artist's statement, April 1995; and *idem*, *Weavings*, exh. card (Washington: American Association for the Advancement of Science, 1993).

<sup>15</sup> Joseph Nechvatal, "The Art of Excess in the Techno-mediocratic Society," in *New Observations* 94 (March-April 1993): 19.