Design and the Elastic Mind, Museum of Modern Art (Spring 2008)

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The exhibition *Design and the Elastic Mind* (February 12 through May 12, 2008) at the Museum of Modern Art (MoMA) received consistently positive critical acclaim for its inspirational message of progress through design allied with science.[1] Focusing primarily on works involving nano, genetic, and robotic technologies created by and implemented through computational tools, the exhibition offered its viewers a glimpse into "the future" currently being realized by eminent scientists and designers. Antonelli's selection of works succeeded in bringing to public attention many of the most recent trends in digital design conception and production. These include not only the seemingly magical powers of instant realization of complex virtual designs through 3D printing technologies, but also the very significant sharing of theories, tools, and methods across academic disciplines that is permeating research and product development based upon the design principles of complex adaptive systems, both natural and cultural. Despite continual references to avant-garde technologies and contemporary scientific theories, however, Antonelli's overarching narrative cast the works in a resoundingly familiar, problematic, machine-age modernist mold, one built upon strong faith in technological determinism and the "technofix" as keys to social and evolutionary "progress." This curious enfolding of twenty-first-century design and science within early-to-mid-twentieth-century ideology raises a number of issues that merit further exploration, particularly because her chosen narrative is itself the subject of questioning by a number of works that she included in the show.

Unraveling this heady multidisciplinary terrain is no small feat, as the more than two hundred works on display revealed. Doing so with clarity, precision, and depth, however, proved an even more elusive goal. In part, this resulted from Antonelli's choice to rely upon the usual short format for wall text and plaques, which did not offer enough room for in-depth explanations of the technologies and the scientific theories used or referenced by the works. This shortcoming unfortunately was not rectified by the accompanying Website, which overloads viewers with a dizzying abundance of tiny, faint, white-on-black text periodically obscured by floating graphic images. The Website does provide a link that lists the participants

at a number of salons co-sponsored by MoMA and *SEED* magazine throughout 2007 leading up to the show. These brought together significant architects, designers, scientists, mathematicians, programmers, and venture capitalists to discuss the cross-fertilization of design across the disciplines.[2] Undoubtedly, these salons sparked interesting conversations among experts which could have been, but were not, uploaded as videos to the Website for the benefit of all who could not attend in person.

The best explanations available to a broader public—although only to those individuals willing to pay double the twenty-dollar entry fee in order to procure the exhibition catalogue—were offered by outside specialists who contributed essays. These include Hugh Aldersey-Williams's partial history of crossovers between design and science in the twentieth century, Ted Sargent's descriptions of the goals and processes of nanotechnology, and Peter Hall's discussion of some of the critical problems surrounding visualizations of complex data.[3] However, the content of these essays did not appear on the walls of the exhibition or the Website. Rather, much of what viewers saw came almost directly from the text and themes of Antonelli's promotional marketing transcripts and the leading essay for the catalogue. Her words, therefore, shaped the show's predominant narrative of "progress"—so pervasive that it infuses design and life at every scale, a theme reiterated spatially through the layout of the exhibition.[4]

Upon entry, viewers moved from the micro-scale, through the human-scale, to the macro-scale in a procession that symbolized the infinite and universal reach of design and science, both within the natural world as well as in our daily lives. This figurative zooming out/zooming in, connecting the global to the local, is made possible through new technologies and routinized through the media of film and Internet tools such as Google Maps. It also is the chief characteristic of elastic: hence the exhibition's title, *Design and the Elastic Mind*. However, this seemingly neutral, out-and-back linearity took on a troubling symbolic significance when considered in relation to other discursive themes from Antonelli's texts in the show. It began to resemble the pattern of colonial ventures, Spencerian notions of evolutionary hierarchies, and ongoing mythic narratives of technological progress conquering new frontiers.[5] This teleological linearity was literally mapped down the walls of the hallway running east to west that formed the central axis for the public's procession through the show. Almost-parallel black partitions, inscribed with what appeared to be a computationally-generated algorithmic linear pattern, slightly converged at eye level on each side at the end of the central aisle.[6] This reference to the Western gaze and mastery over nature—epitomized by the Renaissance artistic technique of linear perspective, and metaphorically extended even further here through computational tools—is drawn toward an infinitely receding horizon, one that literally echoed the westward direction of manifest destiny.

In keeping with this theme of control of nature through science and design at all scales, the first rooms presented viewers with images made by atomic force microscopy of nanoscale happy faces made from strands of DNA; wedding rings grown from the human bone cells of each partner; a living, miniature "leather" jacket tissue-engineered from mouse cells; and an aluminum "bone chair" designed with optimization software that mimics biological growth processes under stress forces.[7] Further in, past the end of the central hallway, the "human scale" section displayed bejeweled nose plugs for sniffing the genetic codes of others (in order to "sniff out perfect mates"); toys for acculturating children to genetic and reproductive technologies (such as cows producing pharmaceuticals and spider silk, and human reproductive outsourcing through surrogacy); and robotic mechanical forms for various uses in the home (including a deployable, wall-like structure that folded and unfolded in response to external stimuli).[8] The "macro-scale" area at the very back featured video installations and complex data visualizations in the form of posters and screens, many of which demonstrated our reliance upon and ordering of information at a global scale, accessed through computer and satellite technologies, and subject to surveillance.[9]

The layout and the wall text repeatedly emphasized that scientists and designers are gaining control of information-based evolutionary processes of self-organizing complex systems at every scale, be it the molecular structure of DNA, the growth potentials of the cell, computational algorithms that mimic natural processes and come "to life" in three-dimensionally printed models or robots, or the fast exchange of all of this information and more via the Internet. Yet this idea of designer control is explicitly at odds with scientific understandings of self-organization, which by definition excludes all external influences, direction, or leadership imposed upon self-organizing systems.[10] Some of the most common examples of these systems in popular and academic texts are termite mounds, ant colonies, and beehives.[11] Hence the poignancy that arises from Antonelli's featuring of artist Tomás Libertíny's *Honeycomb Vase "Made By Bees,"* one of the first pieces viewers encountered which was, in fact, made by bees doing their usual work albeit within the constraints of a vase-shaped scaffold the artist created. Libertíny brilliantly harnesses the bees' creative power and natural beeswax to his own stunning artistic ends, fusing form with material with process. Yet like other sculptors throughout history who have worked with casts, he relies upon a very traditional method and is not fundamentally reprogramming nature from scratch to create his art.

His work is thus similar to that of Oron Catts and Ionat Zurr, who also use scaffolds to impart particular forms to their chosen natural artistic material, living cells. Their tissue-engineered *Victimless Leather* jacket was shown in the same room as Libertíny's piece. These artists therefore address contemporary scientific theories and processes, while intentionally questioning the depth to which

human control is rewriting the script of life. In their publications describing their work, Catts and Zurr specifically hone in on the problematic history and Western ideology of colonization inherent in the theory and practice of genetic technologies. However, the plaque next to their piece contained little mention of this. Rather, Antonelli's text uncritically positioned the adoption of living products as a sustainable "organic design" solution that would "curb our destructive consumerism" and prevent the slaughter of cattle for leather, thereby lessening the environmentally-damaging cattle industry. To the contrary, Catts and Zurr have pointed out in their various publications that the nutrient fluid that is a major requirement for keeping tissue-engineered entities "alive"—the red fluid that was in the beaker feeding the jacket at MoMA—is made in part from the serum of a calf fetus, whose mother and it are killed just for its procurement. Hence the irony of the piece's title, and the serious misrepresentation to viewers that occurred through Antonelli's brief, face-value description of it.[12]

As the inclusion of Libertíny's vase and Catts's and Zurr's jacket reveals, at numerous points throughout the exhibition a slippage occurred between *art*, which more often has a critical edge than design, and *design*, which is usually tied to production and less often openly ironic. Interestingly, this blurring sometimes occurred within individual pieces, such as when the artist's chosen form of vase or jacket was a utilitarian design that categorically could be mass-produced. A number of works made by faculty and students from the Design Interactions Department at the Royal College of Art that were included in the "Design for Debate" category fully pushed the boundaries dividing these artistic disciplines.[13] Their work drives home the idea that the distinctions between art and design are trivial given the recent collapse of culture into nature (Or is it the other way around?), living cells into products, the virtual into the material, and the imagined into the actual. Perhaps the blurring stems in part from ever-increasing academic interdisciplinarity, or arises because designers working with these new technologies and their potential outcomes have to cultivate a sense of irony to adeptly handle their subject and material.

At other times, however, the slippage was due to curatorial sleight of hand, as with the inclusion of works by artists in a design exhibition without making the effort to specifically call attention to the creator's self-identification as "artist" or to mention the ironic criticality of their work. Antonelli also decided not to differentiate, through either the accompanying text or display format, between *imagined visions*—virtual pieces, if you will, materialized for the exhibition through digitally manipulated photographs or videos—*one-off prototypes* seemingly ready for production, and *post-production designs*.[14] This display strategy obfuscates the real-world processes through which imagined designs become manifest broad-scale in the world beyond academia and the museum, where issues of their

materiality, production, market audience, profitability, and sustainability come into play. At the same time, it lent more credence to Antonelli's textual assertions of her technologically determinist faith: that design of the sort on display, achieved through combining design with scientific theory and avant-garde technologies, will become our inevitable blessed "future." Together, these display strategies effectively ignored or rewrote in the language of the faithful, the irony, and critique inherent within many works themselves.[15] They therefore appeared more strongly to support her belief that design as technofix can always solve the problems created by older technologies (as suggested by Mikael Metthey's piece *The Minutine Space*, but critiqued by Michael Burton's *The Race*), and that new "degrees of freedom" and the "evolution of society" do in fact result from technological design evolution (questioned by Burton's *Nanotopia*).

The latter two beliefs pervade American history and constructions of the history of technology, having informed conquest narratives and their accompanying myth of the "second creation": that superior technologies turn nature's raw materials and "wilderness" to productive use (in the process, decimating indigenous populations and their land-use patterns, both of which are cast as "first creation").[16] Recent cultural critics have characterized this zealous, almost religious, version of technological determinism as "technofundamentalism."[17] Antonelli's reliance upon a "progressive" westward-leading teleology, which she combines with modernist evolutionary language to frame her presentation of cutting-edge technological designs, therefore is highly problematic. For example, she positions contemporary science, technology, and design on the forward cusp of a continually "progressive" evolutionary process, one that is rapidly evolving from "simplicity" toward "complexity" (to use both Spencerian and emergent complex systems rhetoric). "Progress," she asserts, is driven by the ever-increasing intelligence and technological inventiveness of a "few exceptional individuals," those at the helm who first master the ability to grasp complexity. Designers, who "stand between revolutions and everyday life," then mediate between this elite and "the masses." They span the divide through good design, which translates complex theories and novel technological capacities into accessible, useful, and efficient visualizations and material forms.[18] MoMA Director Glenn Lowry concurs with her positioning of today's designers. "In this era of fast-paced innovation," he writes in his Foreword to the exhibition catalogue, "designers are becoming more and more integral to the *evolution of society*."[19]

This evolutionary rhetoric pervaded most aspects of the show, including allusions within its title. In her definitions of elasticity, Antonelli repeats early-twentieth-century modernist arguments about the need for evolving increased intelligence to keep pace with the evolution of machines.[20] She writes in her introductory essay,

"Adaptability is an ancestral distinction of human intelligence, but today's instant variations in rhythm call for something stronger: elasticity. The byproduct of adaptability and acceleration, elasticity means being able to negotiate change and innovation without letting them interfere excessively with one's own rhythms and goals." The introductory wall text described "elasticity" as "the ability to grasp progress and make it one's own."[21] But how, she asks in her essay, can "the masses" grasp "fundamental concepts—such as the scope of the human genome or its comparison with that of other primates" that "remain ungraspable by most"?[22] Note her use of the word "grasp": "the masses" should "grasp progress" but "most" cannot grasp "fundamental concepts." Antonelli's answer is that "the masses" learn through the "visual design translations" graciously offered by their priest-mediators: designers … and curators. Recall Raymond Williams's famous mid-century statement: "There are in fact no masses; there are only ways of seeing people as masses." This points to the importance of considering the vantage points of discourse, particularly "progressive" discourses about the elevation and evolution of society through exposure to "Culture."[23]

Prior to the opening of the show, the MoMA Website explicitly stated that a major goal of the exhibition was to "catalyze these technologies." Furthermore, the wall text and catalogue essays repeatedly stress the "urgency," "fast-pace," "acceleration," and "speed" of "progress," along with the belief that greater "degrees of freedom" and the "evolution of society" are "opened by the progress of technology."[24] In her reliance on an evolutionary narrative; in her unwavering faith in the inevitability of technological and social "progress" through her frequent use of the passive voice (a hallmark of manifest destiny and second-creation narratives); and through her elitist positioning of avant-garde scientists, designers, and curators in relation to "the masses" as the grateful recipients of good design; Antonelli restates the major creeds of modernism without even a hint of recognition of the *failures* of this dogma. It is as if World War II did not end with the catastrophes of the atomic bomb and the Holocaust; as if the postwar rhetoric of "social evolution" sailed right over the painfully turbulent 1960s and 1970s; and as if postmodernism and deconstruction never happened, or as if they were a sham that covered over a largely untouched modernist nugget inside—except for the facts that we find ourselves in a much more interconnected global economy, with greater disparity of wealth, with an abundance of new technological inventions, and new versions of unifying scientific theories.[25]

Antonelli's discursive frame ignores the numerous resounding postwar critiques of the underlying assumptions that fuel this rhetorical discourse of Western-dominated evolutionary and technological "progress." These critiques arose from diverse academic disciplines, including historians of science and culture, gender studies scholars, anthropologists, disability theorists, and art historians

among others. These have effectively deconstructed the hubristic Western ethnocentrism, sexism and heterosexism, class-ism, and able-ism of dominant evolutionary and eugenic paradigms, the myth of the scientific idea of "race," and the myth of technological determinism as inevitably resulting in "social progress."[26] Yet this postcolonial, deconstructionist, anti-"modernist" history hardly informed the exhibition's themes, spatial organization, or primary narrative. Rather, the latter acted as if solely because of new technologies, rather than through serious social and political activist struggle, the end goal of global social harmony is nigh.

Antonelli concludes the show with this specious supposition by entitling her final essay in the catalogue "All Together Now!" Its hyperbolic assertions of global harmony accomplished through nearly universal access to cell-phone technology (the Japanese mobile communications company NTT DoCoMo sponsored the exhibition) deconstructs her own persistent technological determinist discourse.[27] She writes, among other things, that cell phones have liberated women "in more conservative societies" by allowing them "more freedom to work by enabling a 'remote control' connection with their children, the elderly, and other household responsibilities."[28] The "degrees of freedom opened by the progress of technology" that foster the "evolution of society" are thus slight indeed (an assumption queried in different ways by Laura Kurgan and Eric Cadora's *Architecture and Justice Project*).[29] Similarly, after praising open-source software for its "harmonious, self-organizing structure," which implies democratic access and promotes "The Common Good," Antonelli then contradicts her assertions by stating: "We have known since Plato that democracy is not always the best governing model for humankind."[30] Through internal contradictions such as these—be it from her own words, or through the messages of some of the works in the show—and because of her use of an ideologically narrow, dated, and discredited discursive frame, the threads of her narrative of a technologically determined "progress" unravel and force us to turn to the works themselves to consciously consider, discuss, and decide the potential directions and applications of contemporary design allied to science and technology.

1 Thanks to Joel Dinerstein, Jeffrey Meikle, Dennis Doordan, Carolyn de le Peña, and Irene Cheng for comments on an earlier and much longer draft of this review. *Design and the Elastic Mind* was created by Paola Antonelli, Senior Curator, Department of Architecture and Design, and Patricia Juncosa Vecchierini, Curatorial Assistant. Previews and reviews of *Design and the Elastic Mind* include Paola Antonelli, "Design and the Elastic Mind: An Exclusive Preview to the MoMA Exhibition," *Abitare* 478 (December 2007-January 2008): 101; Nicolai Ouroussoff, "The Soul in the New Machines," *New York Times* (February 22, 2008): E1; Hadyn Shaughnessy, "Creative Impulse Key to Success in Fast Changing World," *The Irish Times* (May 19, 2008): 19; Tim McKeough, "Intelligent Design (By Humans)," *The Globe and Mail* (Canada) (March 8, 2008): L10; Todd Bracher, "Exhibition Design and the Elastic Mind Review," *Blueprint* (May 2008): 115; John Hockenberry, "Eternal Sunshine of the Elastic Mind," *Metropolis* 27:10 (May 2008): 194, 196, 198; Julian Bittiner, "You Say You Want a Revolution? Exhibition Review: *Design and the Elastic Mind*," *Visual Communication* 7:4 (2008): 503–08; John Schwartz, "Museum Kills Live Exhibit," *New York Times* (May 13, 2008): F3; Eyal Lavi, "MoMA Exhibit Dies Five Weeks into Show," *The Art Newspaper* Issue 191 (May 10, 2008), online at: www.theartnewspaper.com/article.asp?id=8413. Thanks to Peggy Chung for bringing the latter article to my attention.

2 The list of participants at the MoMA/*SEED* Salons is available at: www.moma.org/interactives/exhibitions/2008/elasticmind/assets/pdf/DEM-SEEDMoMASalons2007.pdf.

3 Hugh Aldersey-Williams, "Applied Curiosity," 46–57; Ted Sargent, "Nanotechnology: Design in the Quantum Vernacular," 80–86; and Peter Hall, "Critical Visualization," 120–31; all in Antonelli, *Design and the Elastic Mind* (New York: Museum of Modern Art, 2008).

4 Paola Antonelli's introductory essay to the catalogue is available as a pdf on the exhibition Website at: www.moma.org/interactives/exhibitions/2008/elasticmind/assets/pdf/Design_and_the_Elastic_Mind.pdf.

5 Antonelli, "Design and the Elastic Mind: An Exclusive Preview to the MoMA Exhibition," *Abitare* 478 (December 2007-January 2008): 101; and Antonelli, "Design and the Elastic Mind" in *Design and the Elastic Mind,* 14, as well as the primary introductory wall text at the entrance to the exhibition.

6 Ouroussoff, "The Soul in the New Machines," noted that the trick of slightly converging the walls of a hallway began with Palladio in the sixteenth century.

7 For more information about any of the themes or objects discussed in this review, please see the MoMA Website: www.moma.org/exhibitions/2008/elasticmind/, which has links to the checklist, *SEED* Salons and other accompanying events and lectures, descriptions of the major themes and works, and much more information than was included in the exhibition itself. The works mentioned here, in order, are Paul Rothemund's *DNA Origami* (2004–5); Tobie Kerridge, Nikki Stott, and Ian Thompson's *Biojewellery* (2003–7); Oron Catts's and Ionat Zurr's *Victimless Leather* (2004, 2008); and Joris Laarman's *Bone Chair* (2006). For more information on these works, see also the exhibition catalogue by Antonelli, *Design and the Elastic Mind*, 82–3, 111, 115, and 71. Many of the artists, designers, and scientists have Websites of their own that provide much more information. These are easily found through online searches, but they are too numerous to include in this review.

8 Antonelli, wall text for section "Design for the Senses," in the exhibition described genetic technologies that would "revive our long-lost ability to sniff out perfect mates." Works here in order are Susanna Soares, *Genetic Trace, Part Two: Sniffing Others* (2007); Elio Caccavale, *MyBio* toy series (2005) and *Fertilitoys* from the *Future Families Project* (2007); Anthony Dunne and Fiona Raby, *Technological Dreams Series: No. 1 Robots* (2007); and Chuck Hoberman, *Emergent Surface* (2007). See Antonelli, *Design and the Elastic Mind,* 110, 31–32, 28, and 37.

9 Important works in the complex data visualization section at the rear included: Laura Kurgan, Eric Cadora, et al, *Architecture and Justice Project* (pdf available for viewing or downloading in the "Publications" section at: www.spatialinformationdesignlab.org/projects.php?id=40); MIT's SENSEableCity's *New York Talk Exchange* (2008) (available at http://senseable.mit.edu/nyte/) and *Real Time Rome* (2006) (available at http://senseable.mit.edu/realtimerome/); Ben Fry's *isometricblocks* (2002/2004–05); and Demetrie Tyler's *Hypothetical Drawings about the End of the World* (2006). See also Peter Hall, "Critical Visualization," 129–31, and Antonelli, *Design and the Elastic Mind*, 139, 142, 149.

10 Scott Camazine, Jean-Louis Deneubourg, Nigel Franks, James Sneyd, Guy Theraulaz, and Eric Bonabeau, *Self-Organization in Biological Systems* (Princeton, NJ: Princeton University Press, 2001), 7–8, defines self-organization very clearly and repeatedly emphasizes the necessity of no external intervention or direction.

11 For examples of self-organizing termite mounds, ant colonies, and beehives, see Camazine et al, 59–60, 285–93; J. Scott Turner, *The Tinkerer's Accomplice: How Design Emerges from Life Itself* (Cambridge, MA: Harvard University Press, 2007); and Steven Johnson, *Emergence: The Connected Lives of Ants, Brains, Cities, and Software* (New York: Scribner, 2001).

12 The ironic words "curb our destructive consumerism" are Catts's and Zurr's and, as their publications show, they were meant to be provocative. And yet this irony, which is clear from their publications, was erased in the plaque accompanying their piece. Also, their work was displayed in the "Organic Design" room near the entry to the show. See Antonelli, *Design and the Elastic Mind*, 115; Oron Catts and Ionat Zurr, "The Ethics of Experiential Engagement with the Manipulation of Life" in *Tactical Biopolitics: Art, Activism, and Technoscience*, Beatriz da Costa and Kavita Phillip, eds. (Cambridge, MA: MIT Press, 2008), 125–42; Catts and Zurr, "Are the Semi-Living Semi-Good or Semi-Evil?" *Technoetic Arts: A Journal of Speculative Research* 1:1 (2003): 47–60; Catts and Zurr, "Growing Semi-Living Sculptures: The Tissue Culture & Art Project," *Leonardo* 35:4 (2002): 365–70. On sustainability, the cattle industry, and tissue nutrient fluid, see, "The Ethics of Experiential Engagement with the Manipulation of Life,"132–33, 141 n.19. The latter footnote cites a statement from the chief executive officer of the Australian Association for Humane Research, Inc., from June 30, 2006: "It has been estimated that around half a million liters of raw FCS (fetal calf serum) is produced each year worldwide, which equates to the harvesting of more than one million bovine fetuses annually. Some sources have suggested that the actual figure may be closer to two million fetuses per year."

13 Key examples of this boundary-blurring work, coming out of the Royal College of Art, include Susanna Soares's *New Organs of Perception* series, Mikael Metthey's *The Minutine Space*, and Michael Burton's *The Race* and *Nanotopia*. Antonelli included the work of many more members of this group in the show. See *Design and the Elastic Mind*, 43, 105, 197–08, and 110.

14 This continual intermixture reminded me of designer Norman Bel Geddes's mantra, "the imagination creates the actual," an idea he most famously embodied in his *Futurama* exhibit for General Motors at the 1939 New York World's Fair. See Christina Cogdell, "The Futurama Recontextualized: Norman Bel Geddes's Eugenic 'World of Tomorrow,'" *American Quarterly* 52:2 (June 2000): 235, 245 n.125, citing Geddes. See also the first few chapters of Colin Milburn's *Nanovision: Engineering the Future* (Durham: Duke University Press, 2008) for further elaborations on the "back to the future" motif, whereby projections by scientists writing nanotech science fiction contribute direction to actual research and development. On religious motifs in nanotech that resemble some of Antonelli's descriptions of designers as priests/mediators, see Milburn, 14–15.

15 A few of the artists and designers who brought a critical edge to the ways in which technologies function, or might function, within culture and society, in addition to Libertíny and Catts and Zurr, are Michael Burton, Demetrie Tyler, SENSEable City Laboratory of MIT, Michiko Nitta, and Jon Ardern. In a few instances, Antonelli notes the criticality of the works, and her inclusion of the section "Design for Debate" also indicates her acknowledgement of this tension. The "Debate," however, does not happen within the exhibition's texts. However, perhaps realizing this oversight, her recent column in *SEED* magazine entitled "Of Design and Being Just: In Science Designers Find New Ways to Probe Questions of Ethics," *SEED* (April 2009): 21–22 addresses in much greater detail the works of Catts and Zurr, their critical message, and the ethical debates instigated by their work and its "death" during the show. She also mentions that the "Design for Debate" (aka "Critical Design") section was inspired by Anthony Dunne and Fiona Raby, who head up the Royal College of Art's Design Interactions Department. She quotes Dunne: "Design in that way can facilitate a debate about whether we want these futures or not."

16 See Michael Adas, *Dominance by Design: Technological Imperatives and America's Civilizing Mission* (Cambridge: Belknap/Harvard University Press, 2006); Adas, *Machines as the Measure of Men: Science, Technology, and Ideologies of Western Dominance* (Ithaca: Cornell University Press, 1989); David Nye, *American Technological Sublime* (Cambridge: MIT Press, 1994); and Nye, *America as Second Creation: Technology and Narratives of New Beginnings* (Cambridge: MIT Press, 2003).

17 Siva Vaidhyanathan, *The Anarchist in the Library* (New York: Basic, 2004), xii, coined the term "techno-fundamentalism," which Joel Dinersterien fully elaborates in "Technology and Its Discontents: On the Verge of the Posthuman," *American Quarterly* 58:3 (September 2006): 569–595.

18 Antonelli, "Design and the Elastic Mind," 14–15. She writes: "A few exceptional individuals are already wired for change, and the masses have a tendency to either admire them as visionaries or burn them at the stake as witches and heretics. However, these individuals do not represent the majority.In order to step boldly into the future, the majority needs design. …Designers stand between revolutions and everyday life. …Without a visual design translation, many fundamental concepts …would remain ungraspable by most."

19 Glenn Lowry, "Foreword," *Design and the Elastic Mind*, 4–5. Antonelli uses the same phrase, "evolution of society," on page 24. Italics added.

20 Step back to the mid-1930s, when designer Egmont Arens argued that the fast pace of technology demanded a higher level of national intelligence, a goal eugenicists promised to produce. He said: "This age needs streamlined thinking to keep pace with its streamlined machines." See Christina Cogdell, *Eugenic Design: Streamlining America in the 1930s* (Philadelphia: University of Pennsylvania Press, 2004), 144–47. Compare his statements with Antonelli's, "Design and the Elastic Mind," 14. On intellectual evolution, see Antonelli, "All Together Now!" in *Design and the Elastic Mind* (New York: Museum of Modern Art, 2008), 154.

21 Antonelli, "Design and the Elastic Mind: An exclusive preview to the MoMA exhibition," 101; and "Design and the Elastic Mind,"14; as well as the primary introductory wall text at the entrance to the exhibition.

22 Antonelli, "Design and the Elastic Mind," 15. On 21, she writes: "If design is to help enable us to live to the fullest while taking advantage of all the possibilities provided by contemporary technology, designers need to make both people and objects perfectly elastic."

23 Raymond Williams, *In Culture and Society 1780–1950* , (New York: Columbia University Press, 1958), 300. He discusses "Mass and Masses" in detail in relation to the idea of democracy on pages 297–300.

24 On pace and acceleration in nanotechnology discourse, see Milburn, 10–11; Antonelli, "Design and the Elastic Mind," 22. For example, in the wall text for the 3-D Printing section, she describes how rapid manufacturing will become ever more rapid, cutting the time it takes to print a chair (now seven days) over the next few years down to seven hours, and then a few years later, seven minutes. Her emphasis on accelerating pace is repeated in her recent article "Core Principles: How Science Can Help Form a Theory of Design," *SEED* 20 (February 2009): 29. David Nye, in "Technology and the Production of Difference," *American Quarterly* 58:3 (September 2006): 598, elaborates the traits of technological determinism: belief that technology can "break down cultural barriers and bring world peace"; and when rooted in the free market, it is "as if a beneficent determinism were the inevitable outcome of 'the invisible hand' in laissez-faire economics." Historians of technology and culture have worked hard to take apart the myth of technological determinism, which posits that successful inventions and technological systems are the primary agents of social "progress." They have done so through close-up examinations of the particular contexts within which inventors and designers, out of their own agency and intention, create technologies that then, in combination with other socioeconomic forces, become revolutionary within society. See also Susan Douglas, "The Turn Within: The Irony of Technology in a Globalized World," *American Quarterly* 58:3 (September 2006): 623.

25 See Cynthia Henthorn, *From Submarines to Suburbs: Selling a Better America 1939–1959*, (Athens: Ohio University Press, 2006), on the continuity of the rhetoric of social evolution from before to after World War II. In her new column in *SEED* magazine, Antonelli recently stated: "Design is looking for a unified theory." See "Core Principles: How Science Can Help Form a Theory of Design," 29.

26 On the dissolution of the idea of "race" as a scientifically useful construct, see *The History and Geography of Human Genes* by population geneticists Luca Cavalli-Sforza, Paolo Menozzi, and Alberto Piazza (Princeton: Princeton University Press, 1996); and Jefferson Fish, *Race and Intelligence: Separating Science from Myth* (Mahwah: L. Erlbaum, 2002), 1–28, 113–41.

27 Antonelli's final sentence of this final essay states: "For the first time in history, a crowd of billions of individuals will be able to unite the power of common sense and the imaginative vision of personal initiative with the most advanced principles of design wisdom." Antonelli, "All Together Now!" 159. For more on recent interpretations of the "global village" in communication studies, see Douglas, "The Turn Within," 619–38.

28 Antonelli, "All Together Now!" 156. For a critical history of the idea that new technologies liberate women from work, opening the door to a life of leisure, see Ruth Schwarz Cowan, *More Work for Mother: The Ironies of Household Technologies from the Open Hearth to the Microwave* (New York: Basic Books, 1983).

29 Antonelli, "Design and the Elastic Mind," 22; and Laura Kurgan, Eric Cadora, *et al*, Architecture and Justice Project (pdf), 3.

30 Antonelli, "All Together Now!" 157.