

NOTES

PREFACE

1. See, for example, Ian Berry, ed., *Paradise Now: Picturing the Genetic Revolution* (2001), Lucy R. Lippard, Stephanie Smith, and Andrew Revkin, *Weather Report: Art and Climate Change* (2007), Guy Abrahams, Bronwyn Johnson, and Kelly Gellatly, *Art + Climate=Change* (2016), and Hannah Star Rogers, ed., *Art's Work in the Age of Biotechnology: Shaping Our Genetic Futures* (2019).
2. For a compilation of organizations working in this area and their leadership, see Clay, Rut, and Senior (2015).
3. In *Making Art Work* (McCray 2020), W. Patrick McCray articulated the Cold War context of Frank Malina, the pioneering U.S. engineer-artist who founded the journal *Leonardo* in Paris in 1968. Malina co-founded what would become the Jet Propulsion Laboratory in Pasadena in 1936 and Aerojet Engineering, America's first rocket engine manufacturer, in 1942, before he grew disillusioned with McCarthyism and the militarization of rocketry in the 1950s and moved to France.
4. The final report, *The Integration of the Humanities and Arts with Sciences, Engineering, and Medicine in Higher Education: Branches from the Same Tree*, was issued in 2018 and is accessible from the National Academy of Sciences website: <https://www.nationalacademies.org/our-work/the-integration-of-the-humanities-and-arts-with-sciences-engineering-and-medicine-in-higher-education#sectionPublications>.
5. This indeterminacy complicates potential alliances with funding bodies. Even as efforts to understand the effects of art-science are ongoing, its meaning remains contested.

CHAPTER 1

1. Chris Salter (2010) argued that the co-development of technology and art, especially in the space of innovation in the performing and visual arts, should be understood as having many historical links and a more interrelated process of development than is generally understood.
2. Stirling's claims about the problems of oversimplification were pointed out to me by communications and composition scholar Elizabeth Pitts.
3. The construction and use of the term technology is particularly central in projects of Critical Art Ensemble, subRosa, and Mark Shepard. The Ars Electronica community has laid the foundation for how many artists and others define what art and technology might look like. The changing definitions of technology remain important in how practitioners in that community define their artwork, which is often clustered as the use of a specific piece of hard or software as opposed to an aesthetic drive. Similarly, the idea of art and engineering has been central to academic programs, such as Arizona State University's Arts, Media, and Engineering program and the short-lived but important Arts, Computation, and Engineering (ACE) graduate program (2003–2011) at the University of California at Irvine, as well as being an important touchstone in the careers of Natalie Jeremijenko, Beatriz da Costa, and Brooke Singer.
4. As Barry Barnes has pointed out to me, reification like deconstruction is as complex as it is unavoidable and this situation is not entirely regrettable as it leads to community. The literature of finitism is a good source of further justifications for constructivism. Constructivists should not regret having to reify 'science' and 'art' as our aims are to identify them as social constructions. Reification cannot be avoided as it is crucial to language and communication, as not even those most adroit at deconstruction manage to avoid it. In a world of diverse things and processes, every one of which is both similar to and different from every other, communication needs constructed classifications, which are continually selected, supported, and deconstructed. Reification is at least as important as deconstruction as these constructs build collective understanding. This means that possessors of language must be seen as at once constructors, modifiers, and destroyers of the orders they inhabit. This is, in fact, an ordinary condition. Anyone may act: to reify or deconstruct and to wrap ideas in layer after layer of rationalisations which authorise, diminish, and complicate constructs.

CHAPTER 2

1. A helpful interactive map indicating where the Blaschka models were sold and where they are currently housed worldwide was created by the Corning Museum of Glass in Corning, New York (<https://dm.cmog.org/blaschka/>).
2. Since the time of this writing, the Blaschka glass models at Cornell University were significantly restored under the direction of curator Drew Harvell. The models were relocated for a major exhibition at the Corning Museum of Glass and at the Albert R. Mann Library and are now back on display following their conservation and a redesign of the displays in Corson Mudd Hall.

3. Drew Harvell, personal communication, 2010.
4. Reviewers praised the color lithographs made from Gosse's watercolors. The *Literary Gazette* of April 7, 1860, noted Gosse's artistic and scientific acumen as "alone and unrivalled in the extremely difficult art of drawing objects of zoology so as to satisfy the requirements of science" while providing "vivid aesthetic impressions" (Thwaite 2002).
5. For more on Haeckel's visual arguments for Darwinian theories, see Halpern and Rogers (2013).
6. During the major model restoration at Cornell led by Drew Harvell, the black background was used as a standard in photographing the objects for digitization, so that most images of the Cornell models can be compared with the same background conditions.

CHAPTER 3

1. I regret that I have been unable to reproduce Abbott's photographs for the reader owing to the costs of securing the right to reproduce them. I believe that artwork is realized through experience and engagement. It is a special irony that these images are unavailable given the stated wish of the photographer to make science accessible. Artists should always be the beneficiaries of their labor, and our current situation often gives them or their heirs few benefits while further consolidating art, like capitol, in the hands of a few.
2. It is this form of inquiry, the attempt to analyze the possible interpretation of the object, that is one clear form of the way in which curator's practices are forms of knowledge making. In the same way that STS scholars primary interviews and archival reconstructions of how others' have made sense, curators create new knowledge around objects by analyzing the layers of meaning added to them in different context. This process is not dissimilar from the STS analyst approaching a technical artifact with the Bijker and Pinch's SCOT method.
3. It is interesting that Abbott credits both men, because their aims were rather different. Man Ray invented the Rayogram as part of his investigation of surrealism and the human mind, whereas Moholy-Nagy was experimenting with the physics of art.
4. For an overview of Berenice Abbott's photographic and textual collaboration with Muriel Rukeyser's "So Easy to See," see Kennedy-Epstein (2019).
5. Bubbles are more readily formed in soft than hard water because hard water contains calcium, which creates a polarity that interferes with bubble formation, interrupting the action of soap. Soaps contain polar and nonpolar molecules, which act as a bridge to bound water to lipids, such as fat or grease.
6. Elsewhere I have written with Megan Halpern about the way in which different artworks can offer affordances for different types of science communication efforts that stretch beyond communicating information to engagement efforts around context and contested science. See Halpern and Rogers (2022).

CHAPTER 4

1. The BLO documented its press coverage in a short film entitled Operation New-Speak, which included footage and participants as well as newsclips presented to the resulting press. In addition to media outlets, the intervention was referenced in an episode of *The Simpsons* and in a Jay Leno monologue on *The Tonight Show*; see <http://sniggle.net/barbie.php>.
2. These include *The Electronic Disturbance* (1994), *Electronic Civil Disobedience & Other Unpopular Ideas* (1996), *Flesh Machine: Cyborgs, Designer Babies, Eugenic Consciousness* (1998), *Digital Resistance: Explorations in Tactical Media* (2001), *Molecular Invasion* (2006), and *Marching Plague* (2012).
3. The story of Kurtz's work and arrest inspired the film *Strange Culture* (2007) by documentarian Lynn Hershman Leeson. Major features of the story inspired Richard Power's novel *Orfeo* (2014).
4. Manjari Mahajan observed that she encountered a similar phenomenon with a nongovernmental "organization" in India that opposed GMOs, which turned out to be a single resourceful activist.
5. Mark Shepard, interview with the author, September 8, 2007.
6. Natalie Jeremijenko, interview with the author, September 25, 2007.
7. Paul Vanouse, interview with the author, July 28, 2007.
8. Igor Vamos, interview with the author, August 10, 2007.

CHAPTER 5

1. It is worthwhile to note here the distinction between SymbioticA and the Tissue Culture and Art Project (TC&A). SymbioticA is a Centre of Excellence in Biological Arts within the School of Human Sciences at University of Western Australia and hosts a very wide range of artists and researchers, among whom were founders Oron Catts and Ionat Zurr. These two artists practice their own art as The Tissue Culture and Art Project (TC&A). TC&A is "hosted" within SymbioticA, but SymbioticA refers to the broader institution and activities of many visitors, residents, and other ongoing art-science ventures.
2. Note how this statement resonates with the thesis of Evelyn Fox Keller's "Feeling for the Organism" (1983).
3. This follows well from the distinction made by Born and Barry (2010) that many practitioners in the field of what they term current art-science are making a radical departure from the idea that they are communicating a complete science and are working instead to form a "public experiment," which by its nature insists on an incompleteness and allows artistic researchers to enter into the same questions as scientists from new perspectives, a platform from which they are potentially contributing to knowledge making.

CHAPTER 6

1. For more on how art-science curators make arguments, see the author's exhibition-related publications: "Curating art and science: Art's work in the age of biotechnology" (Rogers 2019); "Curating art, science, and technology" (Rogers 2018a); "Shadows and ashes: The peril of nuclear weapons" (Rogers 2018b); "Intersecting art and science: Curation, curriculum, and collaboration" (Rogers 2017b); and "Art's work in the age of biotechnology: Shaping our genetic futures" (Rogers 2017b).

2. Zurr gave this explanation which connects tissue culture to Evelyn Fox Keller's book on cytogeneticist and Nobel Prize winner Barbara McClintok, *A Feeling for the Organism* (1984) in her undergraduate course on bioart at the University of Western Australia in 2007. Zurr demonstrates once again the degree of crossover between educators, facilitators, theorists, and practitioners in the area of art and science. The history of the field of ASTS has been occluded to a degree by disciplining and categorization around STS and art-science, which leads many STS scholars working in this area to formally divide their roles as analysts from their roles as curators and facilitators. There are a number of STS-trained practitioners with a professional interest in the arts who have worked as art-science facilitators or curators including Bruno Latour, Peter Weibel, Christopher Salter, Ruth Benschop, and Regula Valerie Burri. My own work in this field developed in relation to an emerging community of ASTS practitioners including Bilge Hasdemir, Dehlia Hannah, Silvia Casini, Nora S. Vaage, Megan K. Halpern, Jane Calvert, Lea Schick, and Kathryn Vignone-de Ridder. Another notable feature of these interactions is the frequency with which they also resulted in publications authored by STS scholars in combination with artists. For a recent example, see Szymanski et al. 2020.

3. The exhibition continued in 2021 at the University of Pittsburgh in collaboration with Elizabeth Pitts under the title *Art's Work in the Age of Biotechnology: Critical Methods for Collective Experiments*. This new assemblage of works and responses placed further emphasis on creating layers of content around a fresh set of artworks connected with issues of race, gender, and non-humans.

4. Panels included *Biotechnology as Culture* (moderated by Priscilla Wald; panelists: Joe Davis, Jennifer Willet, Ciara Redmond, Kirsten Stolle, Maria McKinney, and Rich Pell); *Genetic Arts Intervening in the Anthropocene: Climate, Geoeengineering, and Ecosystems* (moderated by Jason Delborne; panelists: Aaron Ellison, David Buckley Borden, Jon Davis, Joel Ong, Erin Kirchner, and Rachel Rusk) and *Art and Identities: From Surveillance and Privacy to Collective Identities and Personal Choices* (moderator: Patsy Sibley; panelists: Charlotte Jarvis, Paul Vanouse, Adam Zaretsky, and Emeka Ikebude).

5. Field Trial repurposed the pop-up exhibit as a knowledge-making event supporting the construction of the main exhibition. Pop-up exhibits have largely emerged as a way to deal with the expense of a long-term exhibition, particularly in places where rental costs exceed the means of most artists. Pop-up exhibitions tend to combine the feeling of an installation visit with an arts event. One of the effects

of a pop-up exhibit is a further emphasis on documentation, such that most viewers experience the artwork through images and video rather than at the short-term exhibition. The situation of wanting to encourage social media users to widely broadcast documentation of the artwork encourages art world professionals to locate pop-up exhibits in places with a high volume of foot traffic and in locations that contextualize the art in a way that is “selfie ready.” These experts often select physical contexts for the artworks that contrast with or heighten the works, rendering them easy to photograph in aesthetic, attractive, or fun ways. Our goals in creating the Field Trial pop-up exhibit were different in that our intention was to test potential artworks and offer a draft experience to the public and symposium contributors to which they might respond to shape the final exhibition.

6. I am indebted to artists and operatic scholars Michael Klein and Roman Lemberg for conversations on this point.

7. For more on critical approaches to improving Ethical, Legal, and Social Implications Research Program frameworks, see Balmer et al. (2016). For more on best practices in Rights and Resources Initiative contexts, see The ERA CoBioTech strategic agenda, which is published as a joint effort between the partners of the European Research Area Network Cofund for Biotechnologies (ERA CoBioTech). This framework was developed by Robert Smith, Deborah Scott, Thoko Kamwendo and Jane Calvert (Science, Technology & Innovation Studies, School of Social & Political Science, University of Edinburgh) in March 2019.

8. This work was a precursor to Agapakis’s well-received collaboration with Sisel Tolas and Alexandra Daisy Ginsberg *Resurrecting the Sublime* (2019).

9. Like many works in the life sciences and art that use live animals, McKinney directly addresses ethics and the use of animals in art as part of her work.

10. In a 2015 article on bioart in *Trends in Biotechnology*, Yetisen et al. note that though Steichen would go on to work with colochine and delphiniums—creating Carl Sandberg in 1938 and the well-known Connecticut Yankee in 1960—those shown in the Museum of Modern Art in 1936 were not achieved using colchine because the first publication about using colchine on plant materials did not appear until 1937 (Blakeslee and Avery). This point was helpfully suggested to me by Joe Davis, who coauthored the article and whose work appeared in the *Art’s Work in the Age of Biotechnology* exhibition. Indeed, the press release for the exhibition describes the delphiniums as “a new American strain which after twenty-six years of cross-breeding and selection by Mr. Steichen” are being exhibited to the public for the first time. Materials from Steichen’s delphinium project are catalogued at the Museum of Modern Art archive. I found no evidence to contradict Yetisen’s claim that colchicine was used by Steichen until after the 1936 exhibition.

11. The artist’s own work seems to have sought to undermine the suggestion of this one-to-one correspondence with further works on probability in pieces like *Probably Chelsea* (2017).

CONCLUSION

1. Crossing Kingdoms was included in Art's Work in the Age of Biotechnology: Critical Methods for Collective Experiments at the University of Pittsburgh in 2021.
2. Artist Tarsh Bates is a noted expert on working with yeasts. For more on Bates's interspecies work, see T. Bates, "Performance, bioscience, care: Exploring interspecies alterity," *International Journal of Performance and Digital Media* 10 (2) (2014): 216–231.
3. The experiment attempted to fuse yeast cells with human embryonic kidney cells using a protein derived from a snake virus.
4. *Tissue Culture & Art* critiqued Alexis Carrel's eugenicist positions and suggested the way in which such positions remain entangled in current biotechnologies.
5. This item was helpfully pointed out to me by an anonymous peer reviewer.

